TECHNICAL SPECIFICATION - INSTRUMENTATION AND CONTROL

GENERAL

Prepared by:

Instrumentation, Automation & Control Services
Operational Technology

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Approved for release by:

Dennis Fruci - Instrumentation, Automation and Control Services Manager

Foreword

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Note: This Technical Specification was previously titled Instrumentation and Control Standards (General) TOG_TS01. External references may refer to this title until they are updated. In either case this specification applies. The document number, HSS0009, has not changed.

Technical Specification

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Part 1 – General Information

1. General Information

1.1 Purpose and scope

The purpose of this manual is to provide instrumentation and control design standards for Sydney Water Corporation's assets. This document is prepared as a central design reference and to be used by designers, consultants, and contractors in order that SWC assets can be built and refurbished to the standard required.

Whenever a new site is incorporated into SWC assets, or an existing site control system is replaced, the control system must be designed in accordance with the standards set out in this document. The cost benefits obtainable through the use of standardised procedures for design, equipment procurement and maintenance are obvious. In addition to use of proven techniques, approved equipment, and a functional commonality of hardware and software will result in overall benefits from uniformity of control strategies, calculation and optimisation, and improvement in business efficiency.

1.2 Change history

Revision	Revision Details	Author	Endorsed By	Issue Date
4.0	Issue 4.0	Simon Ross	Dennis Fruci	June 2023
3.0	Issue 3.0	Simon Ross	Dennis Fruci	April 2021
2.3	Issue 2.3	ED/AB	MJ	December 2016
2.21	Issue 2.21	E.D/A.B	E.D/G.B/R.B/D.F	April 2012
2.2	Issue 2.2	E.D/A.B	E.D/G.B/D.F	25th August 2011
2.1	Issue 2.1	E.D.	M.W.	August 10
2.0	ISSUE 2	E.D.	M.W.	October 07
1.0	ISSUE 1	E.D.	M.W.	September 03
A	DRAFT	E.D.	M.W.	June 03

1.2.1 Revision details

Rev. No/Date	Revision Details
4.0 – 2023	Document renamed from Instrumentation and Control Standards TOG_TS01 General to Technical Specification – Instrumentation and Control (General). Part 3. Clarified IP2X requirements, updated requirements for tool operated handles and latches, clarified spare capacity requirement, added cable section requirements for IICATS sites, updated control panel colour requirements and modified labelling requirements. Part 4. Clarified IP2X requirements and added additional criteria for AC UPS, added requirements for 24VDC SMPS and UPS for IICATS sites, added power supply unit asset naming requirements. Part 5. Clarified IP2X requirements for terminals. Part 6. Clarified use of 230VAC transmitters, updated to BSP fittings requirement in alignment with other SWC standards, updated AS4020 requirement, updated hydrostatic level transmitter double seal requirement, updated radar level transmitter frequency and performance requirements, updated electromagnetic flowmeter requirements. Part 7. Clarified RTU loom wiring requirements, removed battery RTU pit details and added turret requirements. Part 8. Updated ethernet LAN requirement to shielded cable, updated fibre optic LAN cabling requirements, updated antenna requirements for 4G. Part 9. Update and clarify cable segregation requirements, updated depth of burial, bedding sand and cable marker requirements, updated cable labelling requirements and updated cable identification code requirements to include the asset code. Part 11. Updated SPD specification requirements to align with latest AS1768 and IEC61643 standards.

	Part 12. Added lagging requirement for process piping, clarified pressure gauge requirements for booster stations. Part 16. Modbus RS485 cable specification updated. Appendix 7. Monitoring and control requirements for starters at IICATS sites updated. Appendix 8. IICATS preassigned loop numbers added. Appendix 9. Typical IICATS cable numbers added.
3.0 - 2020	Document reformatted to comply with quality management system standards. Part 6 section 1. Expired instrument contract references removed. Flowmeter verification and installation requirements updated. Part 16 Modbus added. Appendix 1. Multiple outdated drawings withdrawn. Refer to Appendix 1 index. Appendix 4. Control and monitoring policy under review and excluded. Appendix 5. E-stop policy date and WHS references updated. Appendix 7. Reference to Sydney Water Technical specification – Electrical updated.
2.3- 2015	GEN-160: Update Telecommunications section to include wireless communications details
	GEN-161: Update analytical instrument section 6.2 to include comments from treatment technical services group
	GEN-162 :Electrical cubicle colour/painting issues to comply with electrical technical specification
	GEN-163: Safety issues relevant to voltages higher than 50V AC
	GEN-164: Update RTU section 7 to cover battery powered RTUs
	GEN-165 : references to 240V/415V AC should be changed as 230V/400V AC as per AS 3000 changes
	GEN-166: New requirements for RCD/Earth leakage protected circuit breakers
	GEN-167: Review and update Australian Standards referenced in the manual to reflect the new changes
	GEN-168: Add notes for the requirements relevant to 'Emergency Stop Policy'
	GEN-169: Replace IICATS strategy doc with the new doc 'Control and Monitoring Strategy'
	GEN-170: Review reference docs, contents, naming etc.
	GEN-171: General English grammar review to comply with SWC Style guidelines
	GEN-172: Include a clause to prevent toxic material usage such as mercury
	Gen-173: Review drawings and remove superseded drawings
	Revision Details
2.21- 2012	GEN-150: Telecommunications (section 8 & comms drawings updated)
	GEN-151: 24V DC cable segregation for treatment plants (section 9 updated)
	GEN-152: RTU, PSU and battery size related issues (section 4 & 7 updated)
	GEN-153: New O&HS Regulations (section 2 & 3 updated)
	GEN-154:Misc. minor updates (section 5 & appendix 7 updated)
	GEN-155: Radar level transmitter tech. spec. (section 6.1 updated)
	GEN-156: Misc. surge protection related issues (section 11 updated)
	GEN-157: IICATS fire and security alarms (section 6.1 updated)
	GEN-158: Prequalified suppliers for pressure & flow inst. (section 6.1 updated)
	GEN-159: Misc. update for section 11 (lightning and surge protection)

1.3 Referenced documents

Attention is drawn to the following related documents:

- Sydney Water Standards and specifications

  - Controls and Monitoring Systems Policy
  - Emergency Stop Policy
  - Technical Specification - Electrical
  - Treatment Plant SCADA Standards
  - Site Specific IICATS Standards (SPS, WPS, PMS etc.)
  - Maintenance related Clauses for Capital and Operational Projects
  - Commissioning – transitioning assets in operation
  - Technical Specification – Mechanical
  - High Voltage Technical Specifications
- Australian and International Standards listed below:

AS 1768	Lightning protection
AS 60529	Degrees of protection provided by enclosures for electrical equipment (IP code)
AS 2053	Conduits and fittings for electrical installations
AS 2129	Flanges for pipes, valves and fittings
AS 2380	Electrical equipment for explosive atmospheres-Explosion protection techniques
AS 2648	Underground marking tape
AS 2676	Guide to installation, maintenance, testing and replacement of secondary batteries in buildings
AS/NZS 3000	Electrical installations (Australian/New Zealand wiring rules)
AS 3008	Electrical installations-Selection of cables
AS 3011	Electrical installations- Secondary batteries installed in buildings
AS 3111	Approval and test specification- Miniature overcurrent circuit breakers
AS/NZS 4020	Testing of products for use in drinking water
AS 61439	Low-voltage switchgear and controlgear assemblies
AS 60947	Low-voltage switchgear and controlgear
AS 5000	Electrical cables- Polymeric insulated- Working voltages up to and including 0.6/1 kV
AS/NZS 60079.0 to 60079.35 AS 1826 AS 2380.4 AS/NZS 4761	A set for electrical equipment for explosive atmospheres including classification of hazardous areas Note: Refer to section 13 of this manual for details
AS/CA S001	Safety requirements for customer equipment (telecommunications)
AS/CA S003	Customer switching systems connected to the public switched telephone network (telecommunications)

AS/CA S006	General requirements for customer equipment connected to the non-switched telephone network (telecommunications)
AS/CA S008	Requirements for authorised cabling products (telecommunications)
AS/CA S009	Installation requirements for customer cabling wiring rules) (telecommunications)
ISO 6817	Measurement of conductive liquid flow in closed conduits; method using electromagnetic flowmeters
IEC 60073	Coding principles for Indicating devices and actuators

1.4 Definitions

Acronym/Term	Definition
AC	Alternating current
ACMA	Australian Communications and Media Authority
AS/ NZS	Australian Standard/ New Zealand Standard
CPE	Customer premises equipment
DC	Direct current
DO	Dissolved oxygen
ELV	Extra low voltage
EMC	Electromagnetic compatibility
EPR	Earth potential rise
FAT	Factory acceptance test
FOBOT	Fibre optic breakout tray
FSD	Full scale deflection
FTP	Field terminal panel
GPO	General power outlet
HART	Highway addressable remote transducer
HV	High voltage (3.3 kV, 11 kV, 22 kV)
I&C	Instrumentation and control
IEC	International Electrotechnical Commission (Standard)
IICATS	Integrated instrumentation, control, automation and telemetry system
ISE	Ion selective electrode
LAN	Local area network
LCD	Liquid crystal display
LEL	Lower explosive limit
LPU	Lightning protection unit or surge protection unit (SPU)
LV	Low voltage (230 V, 415 V, 690 V)
NATA	National Association of Test Authorities
N/O, N/C	Normally open, normally closed (contacts)
MEN	Multiple earthed neutral
OTS	Operational Technology Services
PLC	Programmable Logic Controller
PPM	Parts per million
RTD	Resistance temperature detector
RTU	Remote terminal unit
SAA	Standards Association of Australia

SAT	Site acceptance test
SCADA	Supervisory control and data acquisition
SBL	Sludge blanket level
SPS	Sewage pumping station
STP	Sewage treatment plant
SWC	Sydney Water Corporation
Sydney Water	In the context of an approval or submission this is the nominated relevant SWC technical authority or for contractors your nominated point of contact.
TFEE	Telecommunications functional earth electrode
THD	Total harmonic distortion
TOG	Telemetry Operations Group
TRC	Telecommunications reference conductor
TRT	Telstra Remote Telemetry
UPS	Uninterruptible power supply
WFP	Water filtration plant
WPS	Water pumping station
WTP	Water treatment plant

1.5 Ownership

Role	Title
Group	Operational Technology (OT)
Owner	Instrumentation, Automation and Control Services (IACS) Manager
Author	OT Standards Engineer

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Part 2 – Overview

2. Overview

2.1 About this manual

This Standard sets out the minimum requirements for the design, construction, testing and commissioning of instrumentation and control equipment for all Sydney Water projects and sites. This includes NEC type contracts where the SWC IICATS and SCADA standards form part of the Technical Specification set described in the NEC contractual framework model.

This manual **does not** include requirements for drives, actuators, power distribution board and starter cubicle equipment, which are covered in "Technical Specification - Electrical", nor does it cover the requirements for automation and SCADA hardware and software items, which are covered in the "Treatment Plant SCADA Standards".

The Instrumentation and Control Standards Manual and the "Technical Specification - Electrical" are Level 2 documents in the SWC IICATS and SCADA documentation hierarchy and together they form a generic set of standards for use at all SWC sites.

This generic standard set must be used in conjunction with one or more Level 3 documents to define the minimum required control and automation standards for a site to comply with the SWC Controls and Monitoring Systems Policy.

At all SWC treatment plants they must be used in conjunction with **SWC's Treatment Plant SCADA Standards** to define the minimum required level of control and automation standards for SWC treatment plants.

At all other SWC sites they must be used in conjunction with the site specific IICATS Standard to define the minimum required level of control and automation standards for that particular asset type. For example the following set of standards would form the minimum control and automation standards for a sewage pumping station;

- Technical Specification – Instrumentation and Control (General) – Level 2 document
- Technical Specification - Electrical – Level 2 document
- Sewage Pumping Station Related Instrumentation and Control Standards – Level 3 document

Should there be a contradiction between the various standards then this must be notified to the Sydney Water, Operational Technology (OT) group whose decision on which standard must take precedence will be final.

Safety requirements included in any Instrumentation and Control Specification or Standard must not take any precedence over:

- any legal requirements such as Work Health and Safety Regulations
- compliance with Australian Wiring Regulations
- Australian Standards
- manufacturers' requirements as they apply from time to time.

However, where the Instrumentation and control specifications specify a higher safety or functional requirement than these other documents, the instrumentation and control specification requirements have precedence.

Should there be a contradiction between the Instrumentation and control specifications and these other documents then consult with the author of this specification for clarification.

An overview of the SWC IICATS and SCADA documentation hierarchy has been included as figure 2.1 at the end of this section.

2.2 Summary of the other documentation

Other documents in this series are 'Technical Specification - Electrical ' and 'Treatment Plant SCADA Standards' and IICATS site specific I&C Standards. Their contents are summarised below.

2.2.1 Technical Specification – Electrical

Technical Specification - Electrical sets out the minimum requirements for the design, construction, testing and commissioning of electrical equipment and installations for all Sydney Water treatment plant projects and sites. It does not include equipment that, are varied in design depending on specific applications, such as high voltage variable speed drives and high voltage motors. Refer to Sydney Water High Voltage Specifications.

2.2.2 Treatment Plant SCADA Standards

The purpose of the 'Treatment Plant SCADA Standards' is to provide supervisory control and data acquisition control system design standards for SWC, designers, consultants, and contractors to use in order to ensure the uniformity and consistency of control system projects in SWC facilities.

'Treatment Plant SCADA Standards' manual consists of the following sections:

	Foreword and Introduction
Part I	Design Philosophy
Part II	Document Control
Part III	Plant Process Control Hardware and Software
Part IV	Plant Communication Hardware and Software
Part V	Person Machine Interface (PMI) Hardware
Part VI	PMI Software
Part VII	Documentation
Part VIII	SCADA Test and Commissioning
Appendix A	Tag Naming
Appendix B	Typical Graphics Display
Appendix C	Drawings and Figures
Appendix D	Related SCADA Standards and Recommended Practice
Appendix E	Glossary of Terms
Appendix F	Workstation Descriptions
Appendix G	Not Used
Appendix H	Document Revision
Appendix I	IICATS Interface
Appendix J	PLC Hardware
Appendix K	Cluster Needs Specification
Appendix L	Units of Measurement
Appendix M	IICATS & SCADA Policy
Appendix N	Emergency Stops Policy

Appendix O SCADA Security Policy

Appendix P Risk Assessment Procedure

2.2.3 Site Specific IICATS Standards

The purpose of the site specific IICATS Standards is to set out the minimum requirements for the design, construction, IICATS interface, test and commissioning of SWC's wastewater collection (sewerage system) assets and water distribution system assets to ensure the uniformity and consistency of control system projects. Site Specific IICATS Standards consists of the following documents:

- HSS0007 Sewage Pumping Station Related Instrumentation and Control Standards;
- HSS0008 Water Distribution System Instrumentation and Control Standards TOG_TS02 (Water Pumping Stations, Reservoirs, Valves etc.);
- IICATS Standalone Stations Instrumentation and Control Standards;
  - HSS0005 Flow Monitoring Station Standards TOG_TS05
  - HSS0006 Potable Water Pressure Monitoring Station Standards TOG_TS04
  - HSS0004 Sewer Odour and Corrosion Control Standards TOG_TS08

Note: If a standard site consists of more than one asset type, for example a reservoir, pressure and flowmeter assets on the same site, the SWC IACS group must be consulted to find out which documents are the most suitable ones and which standards are applicable to those particular asset types.

2.2.4 Documentation standards

Shell documents

The purpose of the shell documents is to provide guidelines to assist the Contractor who is responsible to develop and submit comprehensive manuals. The following level 4 shell documents must be used in conjunction with the other standards by the Contractor to develop the manuals listed in the Scope of Work.

Plain English Functional Descriptions;

Unit Process Guidelines;

Standard Operating Procedures;

Trouble Shooting Procedures;

SCADA System Operation Manual;

SCADA Maintenance Manual;

Test and Commissioning Specification.

Procedures

The procedures required for a specific project must be defined within the relevant scope document for the contract [Engineering and Construction Contract (ECC), Engineering and Construction Short Contract (ECSC), Professional Services Contract (PSC) or Term Service Contract (TSC)].

Refer to SWCs OT, IACS group for approval on which Instrumentation, Automation and Control procedures are to be complied with at all SWC Networks assets.

Refer to SWCs OT, SCADA Solutions group for approval on which Instrumentation, Automation and Control procedures are to be complied with at all SWC Treatment Plant assets.

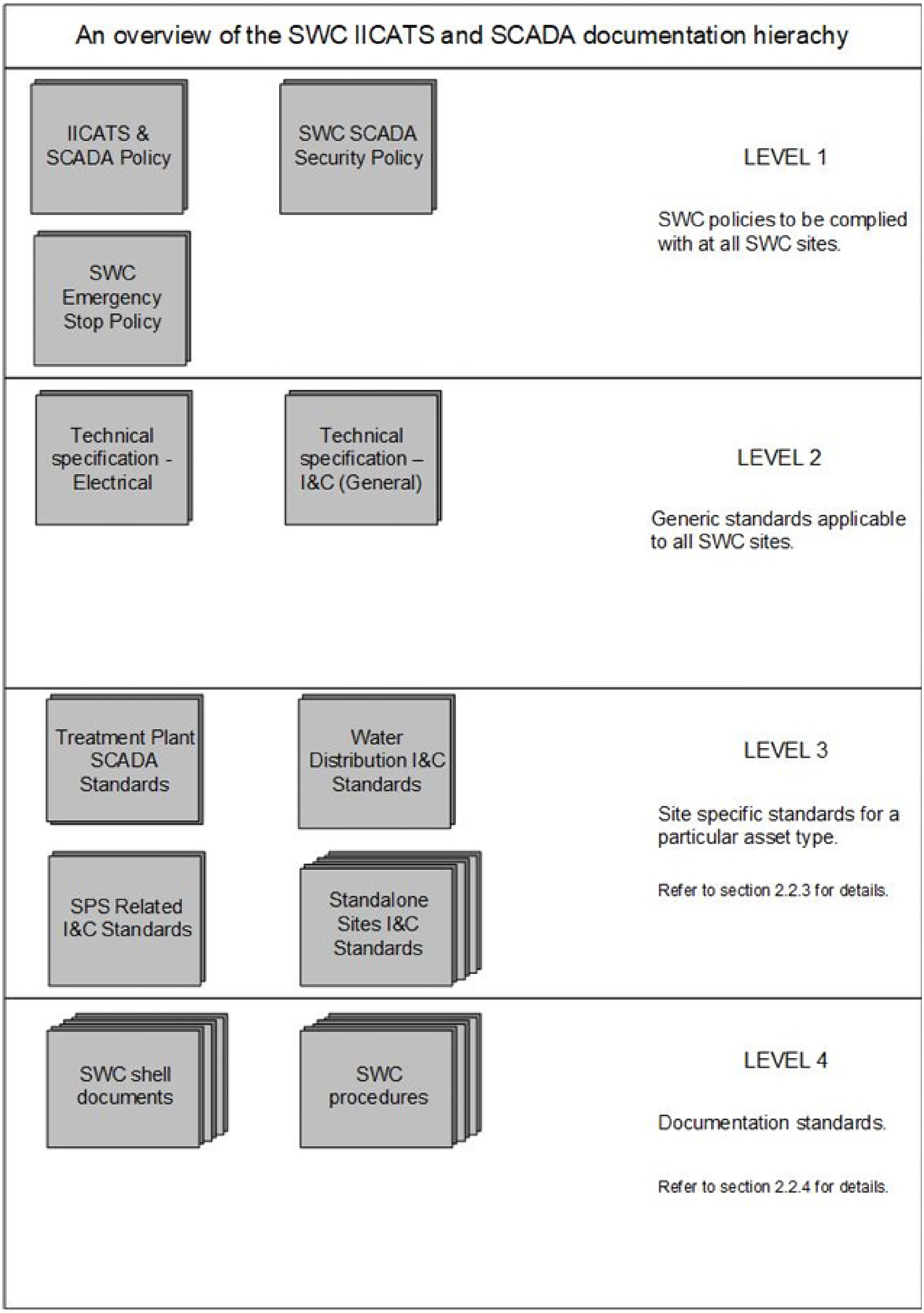

Figure 2.1 SWC IICATS and SCADA documentation hierarchy.

Technical Specification

Part 3 – Control Cubicles and Enclosures (PLC, RTU panels etc.)

3. Control Cubicles and Enclosures (PLC, RTU cubicle etc)

3.1 Design and construction of the control panel/cubicle

Control panels must be manufactured, wired and identified similar to low voltage switchgear and controlgear assemblies as appropriate. Where panels form part of the SCA/MCC line-up, they must be of the same height and similar appearance to maintain a harmonious appearance.

Control panels must be manufactured with ample room to accommodate all the required control equipment, 24VDC power supply, circuit breakers, fuses, relays, terminals and all required instrumentation and communication equipment. Control panels must be constructed and verified to comply with AS3000 , or AS61439 where required due to rating, and must be of the either indoor or outdoor, floor mounting, enclosed (metal clad), multi cubicle type.

Indoor control panels must have a degree of protection of IP52 and outdoor control panels of IP56 to AS 60529 with Form 1 segregation and must be dust and vermin proof, including the top and bottom of the cubicles and cable entries.

'Live' metal must not be exposed, shrouds must be provided on all exposed 'live' equipment including terminals to a minimum level of IP2X.

Safety to the operator and personnel must be an inherent feature of the cubicles. Dangerous situations must be highlighted by a warning label and where necessary, warning indication lamp.

Under no circumstances must any equipment be subject to a second source of mains supply.

Each cubicle must be fitted with an earth bar.

All electrical work must comply with AS/NZS 3000 and Work Health and Safety Regulations.

Indoor panels must be constructed from 2 mm (minimum) CRCQ mild steel. Outdoor panels must be constructed from 2mm (minimum) 316 stainless steel. Panels must have adequate supports to withstand mechanical stresses during transport and installation and at times of electrical faults.

All welds must be continuous. Tack welding will not be accepted.

Where removable covers are provided they must be fitted with tool operated captive thumb screws, wing handles or latches and lift off handles. Steps must be taken to ensure that lift-off covers cannot be wrongly positioned should this action cause incorrect identification to items or a danger through incorrect operation of any switching device.

If a panel front opening exceeds 0.4 square metres in area, it must be fitted with a hinged door or doors. Doors must be fitted with concealed hinges with removable pins and chrome plated handles complete with closing mechanism to ensure that all edges of the door seal with sufficient pressure against the sealing medium when the door closed.

All indoor cubicles must be fitted with tool operated quarter turn latches (type Selectrix TL118 series or equivalent) with a standard cam with stopper (Selectrix MCAM or equivalent) on up to or equal to 900 mm high cubicles only. A three point cam locking system must be used on all cubicles over 900 mm high. The handle assembly, housing and insert must be zinc die cast/chrome plated and the cam must be zinc plated.

All outdoor cubicles must be fitted with padlockable stainless steel swing type handles (type Selectrix 1107series or equivalent) with a standard 1107 tongue (or equivalent) on up to or equal to 900 mm high cubicles only. The handle assembly, lock, tongues, cams, rods and mechanism must be 316 stainless steel. A three point stainless steel, or zinc plated, cam system must be used on all cubicles over 900 mm high.

The internal doors of outdoor cubicles, or kiosks, must be fitted with two (2) tool operated quarter turn latches as described for indoor cubicles. A three (3) point cam locking system is not required.

Outdooor cubicles should be located in a sheltered area and appropriately positioned to avoid direct sunlight Outdoor cubicles must be positioned so that the sides with the smallest surface area are orientated in an East/West direction.

Doors up to and equal to 900 mm high must be fitted with two (2) stainless steel hinges.

Doors from 900 mm high and up to 1.2 m height must be fitted with three (3) stainless steel hinges.

Doors equal to or exceeding 1.2 mm high must be fitted with four (4) stainless steel hinges and must be fitted with three (3) point locking mechanism.

Doors must seal against a 15 mm wide neoprene seal, which must be held in place by continuous metal retainer in addition to adhesive. The seal must be continuous to allow all edges of the door to be completely sealed when closed, and in particular, must be continuous over hinges.

All doors exceeding 500 mm in width and/or 750 mm in height, must be provided with internal channel stiffeners, which must be located clear of any components mounted on the doors.

The doors must be capable of being mechanically latched open at 120° (i.e. the fully open position).

Terminals must not be mounted lower than 250 mm from the base of the cubicle. Terminals, sockets or operable equipment must not be greater than 1800mm above the base of the cubicle, or 2000mm above the finished ground, floor or permanent work platform level.

Each transport unit must be adequately rigid to enable lifting from above and handling during storage, transport and installation, and to permit the use of rollers for final location. Lifting eyes must be provided.

A drawing pocket must be provided on the inside surface of the control panel outer door and must be large enough to hold the drawings.

The cubicle must have front access only, must have bottom cable entry and must be wall mounted or sit on a 75mm high metal plinth. Outdoor cubicles must then be installed on a 100mm high concrete plinth mounted on a hardstand, with the hardstand 300mm above the 1% AEP level. Refer to relevant Sydney Water template drawings.

The Contactor must ensure that all cable entries to the cubicle be sealed.

Each cubicle must be provided with at least 20% spare space for future use. This spare capacity must include space for all equipment including cable glands, cable bending radius, surge protection, communications equipment and associated terminals. Spare gland plate space should be accessible, from the front of the panel, to allow for future installation work.

All cubicles must be fitted with ventilation units and must be designed to ensure that internal temperature must not rise above the maximum operating temperature of any component within the cubicle.

A space of at least 100mm for the cubicle must be provided between the cubicle ventilation outlets and any obstruction to allow to sufficient ventilation airflow.

In IICATS applications, where three (3) or more RTUs are installed, an additional cable section is required to allow adequate space in the control panel for field cable entry and termination. At sites with two RTUs a cable section is required at pumping stations where additional valves or penstock monitoring is required and the cables run directly to the RTU control panel. The cable section must be a minimum 400mm wide and sized to accommodate the additional incoming cables and associated equipment. This includes, but is not limited to, terminals, surge protection and earthing requirements.

The height of RTU and PLC control panels must be consistent with other SCA and MCC panels.

Clearance around panels must comply with the requirements of AS3000.

RTU control panels must be fitted with LV internal lights as per part 5.7 of this document. Treatment plant PLC control panels must be fitted with ELV internal lights as per the Treatment Plant SCADA Standards and part 5.7 of this document.

3.2 Equipment mounting, supporting and positioning

Treatment plant applications:

All electrical equipment must be mounted and positioned in accordance with the requirements in the relevant clause of 'Technical Specification - Electrical'.

IICATS applications:

All electrical equipment must be mounted and positioned in accordance with the requirements in the relevant clause of appendix 6 of this manual (Instrumentation and Control Standards TOG_TS01).

3.3 Mechanical protection

Treatment plant applications:

All electrical equipment must be protected in accordance with the requirements in the relevant clause of 'Technical Specification - Electrical'.

IICATS applications:

All electrical equipment must be mounted and positioned in accordance with the requirements in the relevant clause of appendix 6 of this manual (Instrumentation and Control Standards TOG_TS01).

3.4 Surface treatment and painting instruction

The interior and exterior surfaces of the cubicles (including framework) of the SCA and the control panel must be treated and painted in accordance with WSA 201- 'Selection and application of protective coating' and SWC supplement. Colours must be as follows:

- Indoor:
  - Interior components: White.
  - Exterior: Aqua (B25/AS2700), or
    For Treatment plant applications RAL7035 Light Grey only where there is a requirement to match the electrical panels and MCC, so that all cubicles are a consistent colour.
- Outdoor:
  - Interior components: White.
  - Exterior: Ocean Mist Satin (Oxytech Oxyplast PR12/61077/CS9 or approved equivalent), or RAL9018 Papyrus White.

Colours must be confirmed with Sydney Water during the design stage before switchboard manufacture.

3.5 Cubicle and equipment identification

The Contractor must supply and install labels to identify all electrical and instrumentation equipment in accordance with the equipment identification, name and number as specified and as subsequently detailed on the approved Contractor's Drawings. Where no such identification is specified the Contractor must seek direction from SWCs nominated representative as to the identification to be used.

All labels must be fixed to permanent structures adjacent to the particular item of equipment they identify with the wording horizontal. Labels must not be fixed directly on the item of equipment. Bolt-on or clamp-on label brackets must be supplied and installed as necessary.

All labels of length 80 mm or more must be self adhesive and fixed with at least two stainless steel screws, and an extra screw per additional 80 mm or less of label length. Labels of length less than 80mm must be self adhesive. Labels for indicating lamps and push buttons must also be secured in place by the lens cap or fixing nut.

Screws used for fixing labels in position must be stainless steel M3. Screws must be tapped, or fitted with nuts and washers where appropriate. Self tapping screws will not be acceptable without prior agreement of Sydney Water.

Self adhesive labels must use double sided, high strength, long life acrylic adhesive tape (Husky 190 double sided tape, or equivalent). The acrylic must be UV resistant and have a stainless steel adhesion of greater than 5.2N/cm (peel).Power supply isolation identification at items of equipment, such as cubicles, light switches, power outlets and the like, must include the distribution board (DB) number together with the respective circuit breaker (CB) number at which the circuit can be isolated, e.g. DB3/CB6.

Labels installed in trafficable areas must be made of stainless steel and fixed with a minimum of two stainless steel screws. Labels identifying physical assets must be visible without the removal of a cover or access lid.

The manufacturer's name plate, attached to electrical and instrumentation equipment, must be in addition to the Contractor's label described above and must be visible from the access position.

All equipment mounted on or within the cubicles, enclosures and the like must be clearly identified by means of suitably engraved "Traffolyte", or similar labels (e.g. Gravoply2 or equivalent), preferably fixed immediately above the items for panel mounted equipment. Labels must be white with black lettering, unless specifically nominated otherwise. Edges of labels must be bevelled on all sides. Shutdown system labels and warning labels will be white lettering engraved on a red background except emergency stop label that must comprise black engraved letter on a red background.

“Traffolyte” labels must be minimum 1.5mm thick. For very small labels, less than 10mm x 20mm, labels may be 0.8mm thick where the manufacturer advises it is not possible to construct using 1.5mm material.

Stainless steel labels (e.g. installed on outdoor enclosures such as kiosks, cubicles, buildings etc., or high wear locations) - are to be 1.2 mm thick, 316 Stainless Steel, engraved and in-filled with black paint. Labels in chemical contact process areas must be treated similarly. Edges of labels must be bevelled on all sides and corners rounded to prevent injury. Etched labels will not be accepted.

In cases where a label is fixed to a removable door or cover an identical label must be fitted to the stationary part.

The manufacturer's data plate of any piece of equipment mounted within the cubicle must be clearly visible from the access position, or an engraved “Traffolyte” label containing the name of manufacturer and data must be installed where it may be readily seen.

Letter font and height must be as specified in D0001440 Commissioning – transitioning assets to operation.

Requirements for labels in other areas, and for other equipment, is specified in D0001440 Commissioning – transitioning assets to operation. Typical labels for standard IICATS sites are detailed in the Sydney Water sample electrical drawing sets.

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Part 4 – Power Supplies

4. Power Supplies

General Requirements

All power supply cable terminals must be touch free, covered and insulated, such that personnel cannot inadvertently touch live parts (minimum IP2x). The cover for equipment and terminals must be removable for maintenance purposes and must not prevent air circulation for effective removal of heat generated by equipment.

All electrical equipment including RTU/PLC DC power supply units must be powered through discrete RCBO circuit breakers where the supply of the electrical equipment exceeds 50V AC or ELV as defined by AS3000.

4.1 230V AC 50 Hz power supply

4.1.1 General

The Contractor must design, supply and install all equipment necessary to provide and reticulate 230V 50 Hz single phase power to all equipment, requiring this supply, installed or interfaced by the Contractor and as indicated in the Scopes of Work and as specified in the following sections.

4.1.2 Distribution and cabling

On sites where the existing distribution board has the rated capacity and sufficient spare ways to supply each item of equipment, then the Contractor must supply and install the required rated equipment (e.g. additional main switches, circuit breakers) to the distribution board and supply, install and terminate the required rated cabling from the distribution board to each item of equipment.

On sites where the existing distribution board has insufficient rated capacity, insufficient or no spare ways, then the Contractor must do one of the following:

- replace the existing distribution board with a new circuit breaker distribution board with sufficient ways to supply existing and new equipment plus 3 spare ways
- supply and install a new circuit breaker distribution board adjacent to and fed from the existing distribution board or an upstream switch board and having sufficient ways to supply any existing equipment removed from the existing distribution board and new equipment plus 3 spare ways.
- the Contractor must reconnect existing equipment cabling to the new distribution board and supply, install and terminate the required rated cabling between the distribution boards and from the new distribution board to each new item of equipment.

On sites requiring an Electricity Authority power supply, the Contractor must design, supply and install the equipment necessary to provide the power supply in accordance with the requirements of the Electricity Supply Authority.

In addition to the above the Contractor must supply and install the required rated equipment (e.g. additional main switches, circuit breakers) on the distribution board for use by other Contractors where listed in the Scopes of Works.

The Contractor must supply and install suitably rated lightning/surge protection units on the 230 V AC, 50 Hz power supply to each equipment item listed in the Scopes of Work, requiring this supply, installed or interfaced to by the Contractor.

Power supplies to equipment items include, but are not limited to the following:

a) instruments (e.g. 4 wire transmitters),

b) 24V DC power supply unit,

c) cubicle (RTU, water quality monitoring, etc),

d) PLCs, and

e) other relevant items as listed in the Scopes of Work.

The protection unit must have a speed of response sufficient to ensure that a surge of 40kA pulse, 8/20 microseconds waveform, line to line or line to earth measure is accommodated and in consequence protection is maintained in all situations other than overload resulting from a direct strike. The units must be auto reset type.

The protection units must have a total series resistance of less than 50 ohms. The clamping voltage must be 275V. The specification of SPDs must comply with section 11 of this manual, and the earthing of the SPDs must comply with the requirements of the manufacturer and section 10 of this manual.

4.2 24V DC power supply (no battery backup)

The 24V DC power supply units must comply with the following:

i.	rating:	as per design requirements
ii.	overload rating:	115% of continuous full load for 10 min.
iii.	ambient temperature:	-10^{O}C to +60^{O}C
iv.	input voltage:	230V AC ±10%
v.	input frequency:	50 ±1 Hz
vi.	output voltage:	24V DC
vii.	regulation:	5% from no load to full load
viii.	ripple voltage:	less than 50mV peak to peak
ix.	noise:	less than 500 mV rms under all operating conditions
x.	protection:	protection against short circuit, overload, over-voltage and voltage surges.
xi.	alarms:	alarm contacts for unit failed.

4.3 230V/400V AC uninterruptable power supply

The UPS must be permanently on-line and not rely on switching from mains to inverter supply.

The UPS must comply with the following specifications:

i. voltage regulation must be +/- 1% maximum between no load and 100% load with the input voltage at 230VAC +/- 10%

ii. the output must be sinusoidal and Total Harmonic Distortion (THD) into the Mains Supply must be limited to a maximum of 5%. The Contractor must nominate the expected harmonic distortion, especially 3rd and 5th harmonic distortion, with the offer. The THD of the output voltage must be < 5%

iii. voltage transients must be limited to +/- 5% when 100% load is applied or removed instantaneously. Under these conditions, the output voltage must return to normal within 20 milliseconds

iv. rated for a crest factor of 3:1

v. the frequency of the generated supply must be within 0.05% and under transient conditions must not deviate by more than 1%

vi. the output must be capable of sustaining a 110% load for 10 minutes at an ambient temperature of 40^{O}C

vii. the output frequency and phase relationship must be synchronised with the input frequency and the switching break time must be a maximum of 1 millisecond

viii. fitted with a make-before-break automatic bypass switch for when the UPS fails and a manual make-before-break bypass switch for maintenance purposes. The manual bypass switch must be separate from the UPS and be suitable for wall mounting adjacent to the UPS. When the manual switch is in the 'Bypass' position, there must be no hazardous voltages present anywhere inside the UPS cabinet

ix. an input power factor of >0.98 and able to support a load power factor minimum range of 0.9 lagging to 0.9 leading, or as required for the application

x. fitted with feedback protection on the UPS system input for both rectifier and bypass lines

xi. the UPS must be appropriately rated to support the required load, with an additional 20% capacity, for the environment in which it will be installed

xii. the UPS, and battery enclosure if separate, must provide a minimum IP2x degree of protection.

The UPS must provide alarms as required by AS 3011.2 "Electrical installations - Secondary batteries installed in buildings. Part 2: Sealed cells".

The following are the minimum number of alarms to be sent to the PLC/RTU: Mains failure, UPS failure, battery low voltage and bypass switch set alarm. All hardwired alarms should be volt free alarm contacts and connections must be made so that the non-alarm state of the input must be the closed condition, thus providing a loss of power or broken wire indication since the PLC/RTU will declare an alarm when input goes open. Mains failure, UPS failure and battery low voltage alarms must also be available via a data link. For IICATS sites refer to Part 16 of this document. For Treatment Plant applications refer to the Treatment Plant SCADA Standards for full details.

The batteries must comprise 10 year rated sealed lead acid cells and must be sized to allow the UPS to provide 100% output at its specified voltage and frequency limits for four (4) hours or the nominated time. The UPS must be able to fully recharge the backup batteries from flat within 24 hours.

The battery cubicle must be a separate enclosure to the UPS and must be ventilated in compliance with the requirements of AS 2676.2 "Guide to the installation of secondary cells in buildings. Part 2: Sealed cells". Outdoor cubicle must be manufactured from 2mm grade 316 stainless steel while indoor cubicle must be manufactured from 2mm CRCQ mild steel.

GPOs supplied by a UPS must be coloured red.

4.4 24V DC RTU and site power supply

This section applies to RTU and site power supply for IICATS sites only. This includes the 24V DC power supply to the RTU and the 24VDC supply to the site instrumentation. This also applies to a 24V DC power supply located outside the RTU panel that supplies the RTU 24V DC power or 24V DC instrumentation.

The 24V DC power supply must provide a battery backed supply. This may be provided in a single unit or combination of devices that meet the same functional capability.

Where two battery backed 24V DC power supply units are located in the same cubicle one 230V AC power supply distribution board and surge protection unit must be used to supply both the power supply units. Separate circuit breakers on the output of the surge protection unit must be provided to protect and isolate the 230V AC supply to the each 24V DC supply unit individually.

4.4.1 24V DC linear power supply and battery charger

a) **rating:** Minimum of 5A rated at an operating temperature of $60^{O}C$ or as per design requirements with a minimum of 25% spare capacity at an operating temperature of $60^{O}C$.

b) **supply voltage:** the unit must be suitable for connection to a 230V AC $\pm$ 10%, 50Hz $\pm$ 2% single phase power supply via a 230V AC, 50Hz surge protection unit and suitably rated circuit breaker. Conditioning must be inherent in the unit's design to protect against voltage transients and mains borne radio frequency interference typically found in an industrial environment

c) **output voltage:** the unit must provide a 24V DC ± 2% regulated output, and must be fully protected against short circuit, overload and over-voltage with auto resetting protection circuits. The unit may provide both battery backed and non-battery backed outputs as required for the particular application.

d) **ripple voltage:** the maximum ripple voltage at the output must not exceed 20mV peak to peak

e) **battery charger:** The charger must be capable of carrying the connected load, in addition to charging the battery, and must be matched to the recommended charging rate of the battery. The charger must automatically regulate the charge rate depending on the charged state of the batteries. The charger must be capable of restoring the full charge to a discharged battery or batteries within 24 hours after restoration of supply after power supply failure. The power supply will not connect to the charger and the load if the batteries are:

- incorrectly installed
- reverse polarity connected
- short circuit or flat (below the deep discharge voltage).

f) **temperature compensation:** the power supply must contain circuitry to alter the cell float voltage from an external temperature sensor installed adjacent to the batteries

g) **batteries:** the batteries must be of the sealed lead acid type and must be of adequate capacity. The batteries must be securely mounted and be able to be isolated via a suitably rated fuses or circuit breaker for replacement or maintenance without interruption to the normal operation of the circuit.

The battery capacity is to be sized to provide a minimum of 8 hours battery backup of the maximum designed load while not being charged.

h) **alarm contacts:** The following two volt-free contacts, rated at 50V DC, 2A (open to alarm- failsafe) must be provided and must be self resetting:

Mains power / power supply failed relay must operate for the following:

- when the batteries are supplying the power
- the power supply fails or the voltage is outside acceptable limits.

Battery volts low/battery condition relay must operate for the following:

- battery voltage falls below 21 Volts (resets above 22 Volts)
- difference in voltage between batteries by more than 1 volt
- batteries are disconnected from power supply.

i) **visual indications:** The unit must provide a visual indication of:

i. power supply ok, supply low, supply high,
ii. battery ok, battery low, battery warning,

for the unit or each component, as appropriate, if the unit is made up of multiple parts.

j) **enclosure and mounting:** The unit and associated components must, preferably, be mounted on the cubicle back-plate or must be enclosed in a ventilated, vermin proof, sheet metal enclosure with hinged battery door and suitable for wall or floor mounting depending on size. The installation of batteries must comply with AS 2676 requirements. The unit must provide an IP2x degree of protection or greater.

k) **distribution and cabling:** Where two battery backed 24V DC power supply units are located in the same cubicle, 230V AC power supply distribution board and surge protection unit must be used to supply both the power supply units. Separate circuit breakers on the output of the surge protection unit must be provided to protect and isolate the 230V AC supply to the each 24V DC supply unit respectively.

Each instrument loop must be provided with a separate fuse to prevent faults from one loop influencing others supplied from the same circuit breaker or source of supply.

Note: Refer to Part 7 of this manual for additional requirements for IICATS PSUs.

l) **terminals:** The unit must provide separate terminals for connection of the batteries, load and relay contacts including an extra negative output terminal for earthing such that only one wire need to be place in each terminal.

Removable block**,** screw connection or push in terminals will be accepted. All terminals must accept a wire with diameter of up to 2.5mm^2.

Where push in terminal are provided, they must require a pull-out force of 150N using a standard conductor pull-out test.

m) **dead start operation:** The power supply must have provision to connect the batteries to the load when the AC mains are “not” present via a momentary push button. This feature allows for the replacement of discharged batteries with fully charged batteries for controlling critical loads during extended AC power failure scenarios. All protection features must still be available.

n) **Configuration software:** if configuration software is available to configure the unit it must be free issue. If any configuration cables, modems or converters are available for configuration from a PC then one (1) must be supplied for every ten (10) power supplies provided. Cables must be supplied progressively at the time of delivery.

o) **Protective coating:** Installation conditions include the presence of high humidity and hydrogen sulphide gas. Electronic components and internal circuit boards must be conformally coated to protect against premature failures.

4.4.2 24V DC switch mode power supply and uninterruptable power supply

Sydney Water has a shared services contract, awarded through a competitive tender sourcing activity, in place for this item. Equipment can be ordered through the Sydney Water procurement platform (iBuy).

a) **Rating:** Minimum of 5A rated. Units rated for 10A and 20A applications should also form part of the manufacturers standard range. The nominal rating must be at an operating temperature of 60^{O}C or as per design requirements with a minimum of 25% spare capacity at an operating temperature of 60^{O}C.

b) **Distribution input voltage connection:** the unit must be suitable for connection to a nominal 230V AC $\pm$ 10%, 50Hz $\pm$ 3Hz single phase power supply via a 230V AC, 50Hz surge protection unit and suitably rated residual current circuit breaker with overcurrent protection (RCBO).

Conditioning must be inherent in the unit’s design to protect against voltage transients and mains borne radio frequency interference typically found in an industrial environment.

There must be no derating in output power across the nominal input voltage range.

The unit must be capable of operating across an AC input frequency range of 47Hz to 63Hz.

c) **Input protection:** the unit must be suitably insulated to provide a withstand voltage of at least 3kV between the input and output and 2kV between the input and protective earth (PE).

The leakage or discharge current to PE under normal operating conditions must be less than 3.5mA tested when the input voltage is at 264V AC.

The unit must provide internal transient surge protection.

d) **Output voltage:** the unit must provide a nominal 24V DC $\pm$ 1% regulated output and must be fully protected against continuous short circuit, overload and over-voltage with auto resetting protection circuits. The unit may provide both battery backed, and non-battery backed, outputs as required for a specific application. Where both battery backed, and non-battery backed, options are provided the output rating compliance will be taken to be the battery backed output capacity.

   The output voltage must be manually adjustable from 22V DC to 27.6V DC.

   On mains power the DC output voltage must be maintained independent of the backup battery supply state. This includes battery failure or removal. The unit should be auto resetting following a prolonged AC power outage where the batteries discharge to the cut-off voltage or following battery replacement.

   The unit should be permanently on-line and provide seamless transfer on loss of mains power with no change in output voltage.

   The set-up time, or response time, must be 1000ms or less. This is defined as the time from switch on to 90% of the nominal output voltage.

   The rise time must be 50ms or less. This is defined as the time for the output to rise from 10% to 90% of the nominal output voltage.

e) **Output protection:** in the event of a short circuit the unit must have an active current limitation of 105% - 150% of the maximum output power.

   The unit output overvoltage must be limited to a maximum of 125% of rated voltage.

   The unit must be suitably insulated to provide a withstand voltage of at least 0.5kV DC between the output and PE.

f) **Output current:** the nominal 24V DC output must be capable of providing the rated full load current continuously across the temperature range of -10^{O}C to 60^{O}C. The unit must be capable of providing a peak current of 150% of rated full load current for 5 seconds.

   The nominal 12V DC output must be capable of providing a minimum output current of 2A continuously across the temperature range of -10^{O}C to 60^{O}C.

g) **Ripple voltage:** the maximum ripple voltage at the output must be less than 50mV peak to peak across the specified operating temperature. Output interference with HART communication devices will deem the power supply non-compliant. The manufacturer must warrant compatibility with HART communication.

h) **Operating conditions:** the unit must have a working temperature range of -10^{O}C to 55^{O}C. There must be no derating below 55^{O}C.

   The unit must be able to operate in up to 95% relative humidity at 25^{O}C non-condensing.

i) **Efficiency and power factor:** the unit must have an efficiency of 90% at nominal voltage. The power factor must be greater than 0.9.

j) **Reliability:** The MTBF must be >650 000 hours of operation.

k) **Enclosure and mounting:** the unit must provide an IP2x degree of protection or greater.

Units, or each module for a modular system, must be fully enclosed in a ventilated, vermin proof, sheet metal enclosure.

All power supply models throughout the manufacturers range must contain a battery mounting enclosure.

The standard unit for 5A applications, associated batteries and battery enclosure, must be suitable for mounting on a back-plate with dimensions described in this specification (part l) Dimensions).

The manufacturers power supply range must include larger power supply and battery combinations. They must have the ability to separate the power supply and batteries suitable for wall or floor mounting. All the power supply modules for the rated 10A and 20A units, excluding the batteries, must be suitable for mounting on a back-plate with dimensions described in this specification (part l) Dimensions).

The installation of batteries must comply with AS 2676 requirements.

l) **Dimensions:** The unit back plate must fit within the dimensions 310mm x 290mm (height x width). The depth, with equipment and battery enclosure, must be less than 210mm. Four mounting points must be provided for securing to the panel back plate. They should be located in each corner. The unit back plate design must ensure it can be installed without removing components.

m) **Terminals:** removable block**,** screw connection or push in terminals will be accepted. All terminals must accept a wire with diameter of up to 2.5mm^2.

Where push in terminal are provided, they must require a pull-out force of 150N using a standard conductor pull-out test.

Terminals must be labelled, and all cables must have appropriate wire numbers. Cable colours must be red for positive DC, black for negative DC or blue for signal or control voltages.

n) **Battery charging:** The unit must be capable of carrying the connected load, in addition to charging the battery, and must be matched to the recommended charging rate of the battery. The charger must automatically regulate the individual charge rate of each battery depending on the charged state of the batteries and battery type.

The unit must automatically regulate the absorption end of charge voltage level to suit the installed battery type. The unit should be capable of charging up to a maximum end of charge voltage of 29V DC.

The unit must be capable of restoring the full charge, of the designed battery capacity after power failure, to a discharged battery or batteries within 24 hours after restoration of mains power. The power supply will not connect to the charger and the load if the batteries are:

i. incorrectly installed,
ii. reverse polarity connected,
iii. short circuit or flat (below the deep discharge voltage).

o) **Temperature compensation:** the battery charger must contain circuitry to automatically regulate the cell float voltage from an external temperature sensor installed adjacent to the batteries.

p) **Batteries:** the batteries must be of the sealed lead acid type. Alternative battery types may be considered in consultation and with approval from the principal. The battery capacity is to be sized to provide a minimum of 8 hours battery backup of the designed load while not being charged. The minimum battery size is to be 20Ah. The batteries must be securely mounted and be able to be individually isolated via an integral suitably rated circuit breaker for replacement or maintenance (hot swapping) without interruption to the normal operation of the circuit.

q) **Dead Start Operation:** The power supply must have provision to connect the batteries to the load when the AC mains are "not" present via a momentary push button. This feature allows for the replacement of discharged batteries with fully charged batteries for controlling critical loads during extended AC power failure scenarios. All protection features must still be available.

r) **Alarm contacts:** Two volt-free contacts, rated at 50V DC, 2A (open to alarm- failsafe) should be provided. The contact rating must be tested at a temperature of 40^{O}C for at least 6000 operations. They must be self-resetting with the following functions:

   Mains power / power supply failed relay must operate for the following:

   i. when the batteries are supplying the power.
   ii. the power supply fails, or the input or output voltage is outside acceptable limits.

   Battery volts low/battery condition relay must operate for the following:

   i. battery voltage falls below a nominal 21 Volts (resets above 22 Volts), user selectable.
   ii. individual battery monitoring circuit detects a failed or faulty battery.
   iii. batteries are disconnected from power supply.

s) **Online monitoring:** the unit must provide real time monitoring of battery state of charge, battery charging status, battery discharge current, battery life, battery remaining, battery temperature, battery voltage and supply source (mains or battery). This must be available via a Modbus RTU connection consistent with the Modbus Organisation Modbus Application Protocol Specification V1.1b3 and Modbus over Serial Line Specification and Implementation Guide V1.02. A serial cable must be supplied with each power supply unit for interfacing to the RTU. An option for ethernet monitoring via Modbus TCP should also be available.

t) **Visual indications:** The unit must provide a visual indication of:

   iii. AC mains power available/failed
   iv. PSU unit available/failed
   v. battery condition, state of charge and battery failed for the unit or each component if the unit is made up of multiple parts.

u) **Labels:** All functional units must be labelled to indicate their function.

   A stainless-steel rating plate must be provided that indicates the manufacturer, model and serial number, input rating, output rating for both the 12V and 24V outputs, and battery capacity.

v) **Drawings:** AutoCAD and PDF versions of the general layout, including terminals, must be provided. This includes a parts list, or bill of materials. The drawings must be reviewed and approved by the principal as part of finalising the design.

w) **Configuration software:** if configuration software is available to configure the unit it must be free issue. If any configuration cables, modems or converters are available for configuration from a PC they must be supplied with the unit.

x) **Protective coating:** Installation conditions include the presence of high humidity and hydrogen sulphide gas. Electronic components and internal circuit boards must be conformally coated to protect against premature failures.

4.4.3 Power supply unit asset ID at IICATS sites

The following naming convention for power supply units (PSU) must be used at IICATS sites. These asset IDs and descriptions must be used when entering asset data into the Sydney Water asset management system, currently Maximo.

Standard sites

Sites with 1 PSU as standard

For standard sites with 1 PSU the description should be:

- PSU01 Power Supply Unit – RTU & Field
  - This usually applies to standard Water and small sewer sites such as sewer flowmeters and gauging sites.
  - E.g. WP0012PSU01 Power Supply Unit - RTU & Field

Sites with 2 PSUs as standard

For standard sites with 2 PSUs the description should be:

- PSU01 Power Supply Unit – RTU
- PSU02 Power Supply Unit - Field
  - This usually applies to SPS and similar sites built to the same template e.g. DP and SU pump stations.
  - E.g. SP0066PSU01 Power Supply Unit – RTU
  - E.g. SP0066PSU02 Power Supply Unit - Field

Non-standard sites/exceptions:

The following naming convention should be used at non-standard IICATS sites.

Sites with multiple RTU sets at one (1) facility:

Some sites have multiple RTU sets at one (1) facility. They need PSU/s for each RTU.

- For sites with multiple RTU sets the description should include a reference to the RTU set that the PSU supplies.
- The asset ID will be non-standard.
  - e.g. Ryde. Ryde was considered as it is a known exception due to the number of RTUs.
  - WP0005PSU01 Power Supply Unit - RTU & Field for RTU-A
  - WP0005PSU02 Power Supply Unit - RTU & Field for RTU-B
  - WP0005PSU03 Power Supply Unit - RTU & Field for RTU-C
  - WP0005PSU04 Power Supply Unit - RTU & Field for RTU-D
  - WP0005PSU05 Power Supply Unit - RTU & Field for RTU-E
  - WP0005PSU06 Power Supply Unit - RTU & Field for RTU-F
  - WP0005PSU07 Power Supply Unit - RTU & Field for RTU-G

Sites with an additional RTU controlled facility:

There are some sites that have an additional RTU controlled facility, as well as the primary facility (site). This usually applies to a facility that requires independent control and may be designed to be relocated. E.g. CDUs and OCUs. This scenario is not considered in ACP0055 and is therefore non-standard.

- For sites with an additional RTU controlled facility:
  - E.g. SP0733 & SX0055
- The primary facility should follow the standard asset ID and description defined for standard sites
  - E.g. SP0733 is the standard SPS site, or primary facility, with two (2) PSUs,
    - SP0733PSU01 Power Supply Unit – RTU
    - SP0733PSU02 Power Supply Unit – Field

- For the additional RTU controlled facility the asset ID will use the additional RTU controlled facility number. It should otherwise follow the asset ID and description defined for standard sites.
  - E.g. SX0055 is an additional RTU controlled facility with one (1) PSU.
  - SX0055PSU01 Power Supply Unit – RTU & Field

Sites with power supplies for other functions:

Some sites have power supplies for other dedicated functions.

- For sites with power supplies with other dedicated functions the description should include a reference to the equipment supplied.
- They should not use the RTU and/or Field label.
- The asset ID will be non-standard.
  - e.g. PSUs dedicated for a LAN switch
    - WC0PB1PSU01 Power Supply Unit - LAN Switch 19
    - WC0PB1PSU02 Power Supply Unit - LAN Switch 20

4.5 Batteries

Batteries must be valve regulated stationary lead-acid cells or monobloc batteries as defined by AS4029.

These types of batteries are more generally known as Valve Regulated Lead Acid (VRLA) or may also be referred to by the generic term Sealed Lead Acid (SLA) battery. Absorbent glass mat (AGM) or Gel cell (Gel) VRLA batteries will also be accepted.

Alternative battery types may be considered in consultation, and with approval, from the principal.

Batteries must be fully compliant and tested as required by AS4029. The battery construction must offer an IP20 degree of protection. They must not vent corrosive gas. Individual batteries must be nominally rated at 12V.

Batteries must have a minimum operating temperature range of 0 to 40 degrees. Batteries should have a designed operational life of 10 years under standard temperature and conditions.

A manufacturers datasheet must be provided for review and approval by the principal.

Technical Specification

Sydney WATER

Part 5 – Miscellaneous Electrical Equipment in Control Cubicles (PLC, RTU panels etc)

5. Miscellaneous Electrical Equipment in Control Cubicles (PLC, RTU panels etc.)

5.1 Terminals

a) General

All terminals must be selected from manufacturers' standard range suitable for DIN rail mounting. The connection components must contain not less than 85% copper. The insulator must be of a polyamide type material.

b) Cable cores and terminals

All cable cores and wiring must be terminated in rail mounted, clip on, feed through terminals (Phoenix Contact UT series, Weidmuller W series or equivalent). Where the terminal is part of the distribution rail from the 24V DC power supply unit, the positive terminal must provide a screw in fuse holder incorporating a 5x20mm fuse suitably rated for the particular circuit. In addition, RTU/PLC input/output terminals must be knife disconnect terminals with socket screw to accept test plugs (e.g. Phoenix Contact UTT 2.5 2MT P/P series, Weidmuller WDTR 2.5 series or equivalent).

Instrument cable cores and internal connection cores must be terminated in a rail mounted, clip on terminal with an internal 250 ohm precision resistors, as applicable, which must be capable of dissipating 0.5W and be of a tolerance of +0.1% of value (e.g. Phoenix Contact UTT with metal film resistor, Weidmuller WDTR 4R or equivalent).

c) Spare termination

All spare cable cores entering an enclosure must be terminated. A minimum of 25% spare terminals above the requirements for fitting equipment must be included in all instances.

d) Terminal layouts

Terminals must be segregated according to the type of signal.

Terminals must have 150mm (minimum) spacing from glanding plates.

Terminals must have insulated barriers between different types or groups. The terminals must be grouped and labelled according to their duty, with identification labels securely attached to each terminal group.

e) Terminal connections

All internal wiring must be to one side of the blocks, the same orientation to be used for all blocks.

No more than two wires must be terminated on any terminal. Where two connections are made, one crimped end connector must be of the cranked type.

f) Terminal shrouding

Insulated covers, with a minimum IP2x rating, must be provided for terminals with voltages above 50V AC.

Terminals, which may be live when the equipment is isolated from the mains supply must be clearly identified with a warning label.

g) Terminal strip identification

Each terminal strip must be identified with the full cable number of the cable it is provided for. The label must be white black white Traffolyte and must be affixed into the terminals with nylon screws or adjacent to the strip with M3 metal screws, nuts and washers.

In addition each separate terminal provided for each core of a cable must be labelled with its respective core number or colour.

All terminal strips and their respective identification must be shown on the Contractor's drawings.

h) Earth terminals must be rail mounted, clip on type and affixed to panel main earth bar.

5.2 Fuse terminals

All fuse terminals with fuses sized to suit circuit protected must be rail mounted, clip on type (Weidmuller WS1 6 series or equivalent).

5.3 Miniature circuit breakers

Miniature circuit breakers (MCB) must be of the RCBO type to provide overcurrent and earth leakage detection.

MCBs must fully comply with AS3111. Current ratings must suit the application. DC devices must be rated for DC or DC/AC applications by the manufacturer. Devices rated for AC only will not be accepted for DC applications.

5.4 Timers-DC voltage applications

All timers must be of the electronic multi function plug-in type, which permits removal of the timer body without disturbing the connecting wiring.

Timer coil voltage must suit the application.

Timer coils must be fitted with over voltage suppression diodes.

Timers must have the time range to suit the application.

Contacts must be chatter free and have a rated switching capacity of at least 2A at 230V AC or 50V DC (utilisation category DC13) as applicable.

5.5 Relays-DC voltage applications

All relays must be of the plug-in flat pin type which will permit removal of the relay body without disturbing the connecting wiring.

The relay coil voltage must suit the application. Relay coils forming part of a 24V DC control circuit must be fitted with overvoltage suppression diodes and LED status indication. Relays must also have test facility to force the armature into the energised position.

Contacts must be chatter free and have a rated switching capacity of at least 2A at 230V AC or 50V DC (utilisation category DC13) as applicable.

Relays must be rated for at least 1 million operations.

5.6 Control cubicle anti-condensation heaters

Anti-condensation heaters must be rated at not greater than 120 watts and suitable for operation on a voltage of 230V AC, 50 Hz. Power supply for the anti-condensation heater must be taken from an appropriate RCBO that is dedicated and labelled for the heater.

The equipment and cable terminals must be touch free (covered and insulated) such that personnel cannot inadvertently touch live parts. The cover for equipment and terminals must be removable for maintenance purposes and must not prevent air circulation for effective removal of heat generated by equipment.

5.7 Control cubicle enclosure internal lights

Where LV enclosure internal lights are specified, they must be a 10-14 watt LED lamp fitting suitable for operation on a voltage of 230V AC, 50 Hz. Supply for the light must be taken from a separate RCBO on the power distribution board. LED lights must be of rigid construction, flexible lighting strips will not be accepted.

Where ELV enclosure internal lights are specified, they must be a 10-14 watt lamp fitting suitable for operation in ELV range. They must feature no electromagnetic or radio interference which may affect telecommunication or electronic equipment in the control cubicle.

The enclosure internal light must be controlled by a door switch located on the inside of the enclosure.

5.8 Selector Switches

All selector switches must be of the flush mounting rotary type with wiping action contacts rated at 50V DC 2A or 230V AC 2A.

Switches must be supplied complete with escutcheon plate engraved by the manufacturer to suit the application.

5.9 Indicator lights

Indicator lights must be LED cluster type with integral lamp test and must be installed to indicate the operation shown on the approved Contractor's drawings.

Colour coding and positioning of the indicating lights must be in accordance with AS60947.5.1-Low-voltage Switchgear and Controlgear, Electromechanical Control Circuit Devices.

5.10 Pushbuttons

Pushbuttons must be complete with colour cap head, minimum IP65 rated and with screw clamp terminal connections provided with double contacts. The full assembly must have mechanical durability of 10million cycles and be shock and vibration resistant. Front of panel components, such as bezels and mounting rings, must be non-conductive engineering grade thermoplastics, such as PBT/polyamide, polyamide or polycarbonate. Each pushbutton must be provided with a legend plate or label indicating its function.

Colour coding and positioning must be in accordance with AS60947.5.1.

Contacts must be rated at 230V AC 2A or 50V DC 2A as applicable.

5.11 Annunciator Panels

Annunciator indicating light panels must contain the required number of lamp modules to suit the application, plus a minimum of two (2) spare modules. The window height and width must suit the required signal engraving but must not be less than 25 mm x 25 mm. Each window must be illuminated by two (2) lamps of voltage rating 28V DC for operation from a 24V DC supply.

5.12 Colours of indicating lights and pushbuttons

5.12.1 General

This subclause is to be read in conjunction with AS60947.5.1 and IEC60073. It is not intended for this subclause to supersede or override any of the provisions of AS60947.5.1 but rather to interpret requirements of this standard as they apply to SWC's installations.

Furthermore, it is not possible to cover in this subclause all, which may arise in SWC's installations due to the large number and diverse nature of such installations. However, this subclause does cover the majority of applications, which occur frequently in SWC's installations.

Where modifications are being made to existing installations the existing light and pushbutton colour philosophy in use in the plant must be followed for consistency within that installation.

The colour to be displayed by indicating devices must be chosen with regard to the information to be imparted. Meanings must be assigned to the colours according to which of the following monitoring criteria is given priority:

- Safety of persons or the environment (IEC60073 - Coding Principles for Indication Devices and Actuators- definition of 'persons' is "persons who are in the vicinity of the plant or process, but who are not themselves operators);
- Condition of the process;
- State of the equipment.

The preferred indicating light colours for new installation are listed below:

5.12.2 Preferred indicating light colours with respect to the safety of persons, property and/or environment

Function	Colour	Steady/flashing	Relevant Clause of IEC60073
Prohibited entry	Red	Steady	Clause 4.2.1.1, Table 2 and Table 6. *Meaning of colours for safety of persons and environment:* Red - *DANGER* Yellow- *WARNING/CAUTION* Green- *SAFE* Blue - *MANDATORY SIGNIFICANCE*
Restricted access	Amber	Steady	
Escape route	Green	Steady	
Mandatory route	Blue	Steady	
Ventilation failure	Red	Steady	
Station on overflow	Red	Steady	
Flood switch operated	Red	Steady	

Table 5.10.1 - Preferred indicating light colours with respect to the safety of persons, property and/or environment

5.12.3 Preferred indicating light colours with respect to the condition of process

Function	Colour	Steady/flashing	Relevant clause of IEC60073
Station on overflow	Red	Steady	Clause 4.2.1.1, Table 2, Table 7 *Meaning of colours for with respect to the condition of the process:* Red - EMERGENCY Yellow- ABNORMAL Green - NORMAL Blue-MANDATORY significance White & black & grey - No meaning assigned, example of application in Table 7-General information
Station inhibited	White	Steady	
Flood switch operated	Red	Steady	
Interlock operated	Amber	Steady	
Sequence failure	Red	Steady	
Station under emergency control	White	Steady	
Emergency control available	White	Steady	
ATWL level reached	Red	Steady	
ATWL test active	White	Steady	

Table 5.10.3 - Preferred indicating light colours with respect to the condition of process

5.12.4 Preferred indicating light colours with respect to the state of the equipment

Motors/starters & pumping station indications

The followings are preferred indicating light colours to monitor state of the equipment and to inform the operator to take appropriate action. If similar information to be used for warning and/or safety reasons, meanings must be assigned to colours according to the monitoring criteria based on the safety of persons or the environment.

Function	Colour	Steady/flashing	Relevant clause of IEC60073
Running	White	Steady	Clause 4.2.1.1, Table 2, Table 8 *Meaning of colours for state of equipment:* Red - FAULTY Yellow- ABNORMAL Green - NORMAL Blue- MANDATORY significance White & black & grey - No meaning assigned, example of application in Table 8 -status indication
Unit next to run	White	Steady	
Unit control disabled	White	Steady	
Automatic control inhibited	White	Steady	
Motor overloaded	Red	Steady	
Motor overtemperature	Red	Steady	
Unit failed	Red	Steady	
Pump seal failure	Red	Steady	
Bearing overtemperature	Red	Steady	
Pump start warning	White	Flashing	
Pump stop warning	White	Flashing	
Suction safety operated	Red	Steady	
Delivery safety operated	Red	Steady	
Motor/pump fault	Red	Steady	
Motor/pump alarm	Red	Steady	
Water in stator	Red	Steady	

Table 5.12.4.1 – Motors/starters & pumping station indications

Valves

The followings are preferred indicating light colours to monitor state of the equipment and to inform the operator to take appropriate action. If similar information to be used for warning and/or safety reasons, meaning must be assigned to colours according to monitoring criteria based on safety of persons or the environment.

Function	Colour	Steady/flashing	Relevant Clause of IEC60073
Valve fully open	white	Steady	Clause 4.2.1.1, Table 2, Table 8 *Meaning of colours for state of equipment:* Red - FAULTY Yellow- ABNORMAL Green - NORMAL Blue- MANDATORY significance
Valve opening	white	flashing	
Valve closed	white	Steady	
Valve closing	white	flashing	
Valve latched	White	Steady	
Mains power on	White	Steady	
Controls power on	White	Steady	
Low oil level	Amber	Steady	
Low oil pressure	Amber	Steady	
Torque overload	Amber	Steady	
Excessive operating time	Amber	Steady	

Position discrepancy	Amber	Steady	White & black & grey - No meaning assigned, example of application in Table 8 -status indication
Battery charger failed	Amber	Steady	
Low DC volts	Amber	Steady	
L1 stop operated	White	Steady	

Table 5.12.4.2 – Valve indication

5.12.5 Preferred pushbutton colours

Function	**Colour**	**Steady/flashing**	**Relevant Clause of IEC60073**
Emergency stop	Red	Steady	Clause 4.2.1.1, Clause 5.2, Table 2, Table 9 *General meaning of the codes for actuators:* Red - Action in case of emergency and danger Yellow- Action in case of abnormal condition Green - Action in case of safe situation or to prepare normal conditions. Blue- Condition which requires action - reset functions White & black & grey - general initiation of functions
Lamp test	Black	Steady	
Alarm resets	Blue	Steady	
Start unit - starter (see note 1)	Green	Steady	
Stop unit - starter (See note 1)	Red	Steady	
Open valve (See note 2)	White	Steady	
Close valve (see note 2)	Black	Steady	

Table 5.12.5.1 – Preferred pushbutton colours – illuminated or non-illuminated

Note 1: White, Grey and Black are the preferred colours for STOP/OFF and START/ON, with the main preference being BLACK for STOP/OFF and WHITE for START/ON in IEC 600073. However, the preferred colour by SWC is RED for STOP and GREEN for START - which are permitted by IEC 60073 Standard- for consistency within the site installations.

Note 2: WHITE is preferred colour for OPEN VALVE and BLACK is preferred colour for CLOSE VALVE for consistency with IEC 60073. RED for START/ON actuator and GREEN for STOP/OFF actuator as used in some of previous SWC applications are not permitted by IEC60073 Standard.

ADDITIONAL APPLICATION REQUIREMENTS- ACTUATION MODES

The same actuator serving for START and STOP or ON and OFF

BLACK is the preferred colour for actuators which, when actuated several times, act alternately as a START/ON and STOP/OFF actuator. The colour RED must be used in cases where the same actuator, other than a push-button, is used for both EMERGENCY-STOP/OFF and normal operation.

WHITE is the preferred colour for actuators which cause a movement while they are actuated and stop the movement when they are released (such as inching or jogging actuators).

Technical Specification

Part 6 – Section I – Field and Analytical Instrumentation

6.1 Field and Analytical Instrumentation

6.1.1 Introduction

This part of the 'Instrumentation and Control Standards Manual' contains instrument specifications covering equipment used for the monitoring and control of water and waste water facilities.

General requirements specified in sub-clause 6.1.2 are applicable to all instruments are specified in clause 6.1 and clause 6.2. The remaining sections specify the particular requirements associated with each instrument type.

The specification for each instrument type specifies the functional, performance, physical and installation requirements.

6.1.2 General Specification

6.1.2.1 Standard requirements

This general specification applies to all instruments and associated equipment in addition to the requirements as specified in other sections for the particular instrument or equipment.

Transmitters/controllers powered at 24V DC are to be used for standard applications. 230V AC powered equipment is only allowed if 24V DC version is not available or is not suitable for the specific application. Where 230V AC models are used, power supply must be taken from an appropriate RCD circuit breaker/GPO that is dedicated for the equipment. Equipment cable terminals must be touch free (covered and insulated) such that personnel cannot inadvertently touch live parts.

6.1.2.2 Functional Specification

a) Environmental conditions

The instrument must operate within the defined specification over the following range of environmental conditions:

(i) Ambient temperature:

indoors	-10 °C to + 55 °C
outdoors or chambers	-25 °C to + 70 °C

(ii) relative humidity: 5% to 95% non-condensing

(iii) atmospheric pressure: ± 5% of any mean local barometric pressure between 70kpa and 106kpa.

b) 4-20mA output and loop impedance

Where possible all field devices must have and isolated 4-20mA output. The instrument must be capable of driving all the devices connected in the loop. If insufficient, the Contractor must supply and install signal isolators to increase the signal output capacity of the instrument.

The minimum requirement is that instruments, which drive 4-20mA current loops, must be capable of driving 20mA through a 600 Ohm load at 24V DC.

c) 2-wire transmitters

2-wire transmitters are preferred. The transmitter must operate on 24V DC supply (loop powered). Reverse polarity protection must be included. Output must be 4-20 mA.

d) 4-wire transmitters

4-wire transmitters powered at 24V DC are allowed if a 2-wire version is not available. All transmitters must be UPS supported. Use of 230V AC transmitters is not preferred and will only be considered where a 24V DC version is not available. Written approval is required during the design stage and before product procurement.

e) local indication and alarms (excluding submersible hydrostatic level transmitters)

All instruments must be provided with an integral local indicator to display the measured quantity in engineering units. The indicators must be back-lit LCD or equivalent to ensure readability under low ambient illumination (e.g. fitted with a sun shield for easy reading if exposed to sunlight).

Four wire instruments comprising of a separate sensor and processing unit may also have the following additional facilities if required by the functional specification:

(i) two low and two high alarm relay changeover contacts with adjustable alarm limits and dead band

(ii) one power supply and/or hardware failure alarm relay changeover contacts

(iii) local indication of the operating status of the instrument by means of annotated indication lamps or electronic text display

f) hazardous area service

Hazardous area classifications have been applied to a number of sewage treatment processes and therefore the equipment installed must be designed and certified for operation within the zone designation given to the area concerned in accordance with the current version of AS 2380 and its constituent parts. Hazardous area design must be completed a competent person and comply to the Sydney Water Engineering Competency Standard. Refer to Sydney Water Technical Specification – Electrical section E2.5 Hazardous areas for requirements.

g) hazardous area design

Instruments supplied and installed by the Contractor must be tested and certified for use in Zone 0, 1 and 2 as required. Where barriers and other specific conditions form part of the conditions of certification, these must also be supplied and installed by the Contractor in accordance with the current version of AS 60079 and its constituent parts. Refer to Sydney Water Technical Specification – Electrical section E2.5 Hazardous areas for requirements.

h) safety and earthing

The instruments must meet the requirements of the current version of AS/NZS 3000 for safety and earthing. ELV instruments must be earthed to a dedicated ELV earth bar which must be separate to the LV power earth bar.

i) instrument availability, reliability and durability

Instruments and their installation must be chosen and installed for their reliability, accuracy, fit for purpose and the operating environment, low maintenance and easy calibration

The design of the instruments must be such that the replacement of any parts may be rapidly executed to reduce non-availability of any control or measuring loop to a minimum.

The instrument availability must be better than 99% including off-line duration for manual calibration and routine maintenance.

The instrument, excluding scheduled wearing parts, must have a mean time between failures of greater than 5 years.

The overall economic operating life of the instrument must be greater than 10 years.

j) fail safe operations

The instrumentation and control system must be designed to be of the fail-safe type. Intrinsic safety barriers must have a line check facility.

k) Documentation

The instrument must be supplied with detailed technical documentation written in English. This should consist of:

(i) health and safety information

(ii) measurement technique and principle of operation

(iii) technical specification

(iv) installation and commissioning instructions

(v) out of service requirements (e.g. during process shutdown)

(vi) manual calibration and routine service procedures

(vii) basic fault finding and confidence test

(viii) mechanical and electrical diagrams and layouts

(ix) schedule of consumables and routine spare parts

(x) calibration and test certificates

(xi) where applicable, a copy of SAA hazardous area certificates as described in part 13 of this manual.

l) labelling and identification

The instrument must be clearly labelled with the manufacturer's name, measured parameter, model number, serial number and application operating parameters such as maximum pressure rating for in-line instruments, hazardous area certification details (where applicable) and electrical power supply voltage, frequency and loading.

Each instrument must also be provided with a stainless steel tag identification plate engraved with the instrument tag number supplied by Sydney Water.

Chemical reagent containers must be clearly marked to identify the contents and associated hazards and handling precautions.

m) smart instrument features

Where the technology is available, the contractor must supply instruments featuring state-of-the-art smart functions such as remote configuration, re-ranging, output monitoring and forcing, and hardware self-diagnostics and alarming. The Contractor must supply hand held calibrators and/or personal computer software to communicate with smart instrument(s). The communication protocol must be HART. It is a mandatory requirement for transmitters to be provided with HART communications modules, unless specified otherwise in the specification

Profibus DP modules, for treatment plants, and Modbus modules, for IICATS sites, must be available as optional add on modules. All other available communication modules and/or advanced service ports must be listed in the technical specifications of the instrument.

The transmitters supplied must be capable of supporting all mandatory and optional modules.

The transmitter must be able to communicate with a hand held "smart" communicator for the adjustment of all parameters without breaking the instrument loop. It must be possible to perform output monitoring, configuration, re-ranging, forcing of the output to a selected value, diagnostic checks and calibration checks with the communicator.

Where Profibus or Modbus modules are selected registers must be available to provide a full signal set, as defined in this standard for hardwired instruments, as well as self-diagnostic and verification information and results.

The decision to use a data link, or to use hardwired I/O must only be made by Sydney Water.

The connection and signal set requirement must be defined during the design stage and approved, in writing, by Sydney Water prior to procurement:

• by an authorised IACS representative for IICATS RTU sites, or

• by an authorised SCADA Solutions representative for SCADA PLC sites.

Where a data link is used it must be:

• Modbus over serial, meeting the requirements defined in Part 16 Modbus of this standard, to an IICATS RTU at Networks sites, or

• Profibus DP, meeting the requirements defined in the SWC Treatment Plant SCADA standards, to a SCADA PLC at Treatment plants.

n) security

The instrument must be protected against unauthorised calibration and configuration changes. The calibration and configuration data must be protected against loss due to power supply failure.

o) device integration and data presentation tools

Where the technology is available, all instruments must be compatible with EDDL (Electronic Device Description Language) or FDT (Field Device Tool) technology. Preference will be given to suppliers providing support for FDT/DTM technology.

All instruments must be provided with DD/EDD (Enhanced Device Description) file and/or DTM (Device Type Manager) that offer full functionality, with no trail period, and any licencing (SWC Corporate) requirements to accomplish full DTM functionality. The DTMs must be also capable of being used by a wide variety of manufacturer’s frame tools.

The suppliers must commit to providing the future FDI (Field Device Interface) support.

6.1.2.3 Performance specification

a) operating conditions

The error resulting from a change within the defined operating conditions must be no greater than the following:

(i)	temperature:	0.1% of range
(ii)	atmospheric pressure:	negligible
(iii)	power supply fluctuations:	0.01% range per volt
(iv)	transmitter load effect:	0.1% over total load range

b) radio frequency interference

The instrument when correctly installed and with all covers fitted must exhibit negligible output variation when subjected to field strength of 10 V/m between 20 MHz to 1 GHz.

c) analogue output ripple and noise

The peak to peak amplitude of internally generated ripple currents, noise or any other unwanted component attributable to the equipment or its power supply, which may appear in the output signal, must not exceed 0.1% of the selected output range.

d) analogue output isolation

The analogue output must be electrically isolated from the rest of the circuitry and earth. It must have an insulation resistance to the rest of the circuitry and earth of greater than two mega-ohms, when tested with a 500V DC insulation tester for one minute.

The instrument must remain within its performance specification when each output terminal is earthed in turn.

e) analogue output regulation

When the load resistance across the output terminals is varied from 0 to 600 ohms the output signal current must not change by greater than 0.1% of range over the full output range.

f) supply variation

Variation of the power supply to the instrument within the range of -12% to +10% of the nominal supply voltage (i.e. 230V AC, 50Hz or 24V DC) must not cause the instrument to operate outside the performance requirements of this specification.

g) mounting position effect

Any changes resulting from variations in mounting position must be capable of being calibrated out by means of zero adjustment.

h) output meter accuracy

Integral output meters must have a resolutions and accuracy equivalent to the overall instrument accuracy.

i) alarm contact rating and mode

The alarm contacts must be de-energised-open to alarm and must be rated for 50V DC 2A resistive load.

j) self-diagnostics and verification

Instruments must be capable of performing continuous self-diagnostics. Where advanced self-diagnostic features are available, they should be provided. The alarm should be linked to a digital output or have the ability to drive the current output under range to indicate an alarm. The behaviour must be configurable within the instrument.

Where specified instruments must be capable of performing continuous self-verification based on parameters recorded within non-volatile onboard memory at the time of calibration and certification in the factory (e.g. flowmeters). If any of the monitored verification parameters fall outside the specified tolerances an alarm condition must be raised. The method of alarming must be provided by the Contractor. The alarm should be linked to a digital output.

The verification features must be enabled for unrestricted use by Sydney Water. It should not require any licences, keys, subscriptions, or similar. If a licence, key, subscription or similar is required they must be provided as free issue for an indefinite term at the time of purchase.

6.1.2.4 Physical specification

All instruments and devices supplied must be equipped with all installation brackets, supports, cables and accessories that are required for the normal operation of the instrument. No instrument and devices must contain any harmful or toxic material such as lead or mercury.

All instruments must be suitable to intended purpose and operate reliably under following conditions;

a) instruments for use in corrosive gaseous atmospheres:

All instrument parts and fittings must be non-rusting. They will also be treated to resist the corrosive effects of chlorine, lime, ammonia, pot-ash, sulphur dioxide and other chemicals typically found in water and sewerage facilities and meet the following requirements:

(i) the instrument must meet the performance requirements of this specification when continuously operated in atmospheres containing 1 PPM of chlorine, ozone, sulphur dioxide or ammonia

(ii) for instruments located in a confined space which may be subject to high concentrations of these gases under fault conditions. 24 hours per year exposure to atmospheres containing 10 PPM of any of these gases must not cause any damage to the instruments or cause the instrument to operate outside this specification

(iii) for sewage applications the instrument must meet the requirements of this specification when operated in atmospheres containing 10 ppm of hydrogen sulphide.

b) fittings

Fittings must be stainless steel.

c) enclosures

Instrument transmitters that are mounted outdoors must be protected with suitably designed weather shields, which protect the transmitter against solar radiation.

Instrument enclosures must be constructed of tough, durable materials and must provide protection against the ingress of dust and water to following ratings:-

- indoor installation: IP54
- outdoor installation: IP65

Dip or insertion sensor probes installed directly into the process stream must be protected to IP68.

d) seals and 'O' rings

Seals and 'O' Rings must be ‘Viton’ and ‘Buna-N’ respectively or approved equal.

e) mounting

All instruments must be mounted and made secure such that there is no detriment to the encapsulation or sealing of the instruments.

f) process connections

Process connections must be 1/4" BSP on process flanges and 1/2" BSP on flange adaptors. Where BSP connectors are not available the process connection must be NPT and a converter provided.

g) submersion

For installations where there is any possibility of flooding the degree of protection must be to IP68 at a depth of 5m. This protection must be maintained under all operating and fault conditions, including leakage of samples or reagents.

h) cable entries and connections

All cable entries must be via M20 cable glands and must terminate on screw terminal blocks suitable for up to two 1.5mm2 wires. Terminals operating at voltages greater than 50V AC must be shrouded and provided with warning labels.

i) Instruments used in drinking water applications

All parts of equipment in contact with drinking water must be approved for drinking water applications. A certificate must be provided that demonstrates compliance to the latest version of AS4020.

6.1.2.5 Installation specification

a) general requirements

All installation works must be carried out in accordance with the requirements as specified below:

(i) all tools, accessories and installation components must be of the correct size and type for the duty and only to be used for the purpose for which they were designed

(ii) all installed items must have the necessary covers and other protective items replaced as soon as work on them is completed

(iii) instrument installation should not start until heavy construction work in the vicinity has been completed to an extent that there is negligible chance of damaging the instruments concerned. Local panels must be suitably boxed for protection during installation work. All instrument items must be properly protected with covers during painting operations in their vicinity

(iv) before installation, all factory acceptance tests and/or inspections must be carried out and accepted as specified

(v) the installation of all instrumentation must strictly follow the recommendation of the manufacturer and this specification and must be suitable for the site situation to enable full functionality of the instrumentation to be applied in the processes

(vi) the general location of instruments will be defined in the 'Scopes of Work' but the precise location should be determined by observing the following principles:

a) indicating instruments must be readily readable from grade or permanent platform and where relevant also visible from any associated control item such as control valve station

b) operators must not have to stretch or stoop to adjust instrumentation. All calibration and adjustment points must be accessible from floor or platform level

c) instrument cases must be positioned so that doors may be fully opened, covers may be removed, vent holes are not impeded and all adjustments, controls and connections must be easily accessible

d) instruments must not obstruct walk-ways or any areas required for maintenance of other items or equipment

e) instruments must not be mounted adjacent to hot or vibrating equipment and should not be under drain points or above vent points of other instruments or equipment

f) effective means must be provided to prevent external vibrations being transmitted to the instrument through its mounting, connecting pipelines or conduits

g) impulse piping should be kept as short as possible.

h) all control and instrumentation that are located in the field must be conveniently grouped, where possible, for operational and maintenance ease

i) all instrumentation and appurtenances (e.g. gauges) must include isolation devices (e.g. valves) to allow for servicing and calibration without interrupting the process

j) the mounting of instruments must comply with the following requirements:

a) panel mounted equipment must be so arranged that it can be withdrawn from the front of the panel

b) instruments must not be bracketed off process piping unless specifically called for or agreed to in writing by the superintendent

c) instruments must not be mounted on handrails, unless specifically called for or agreed to in writing by the superintendent

d) post mounted instruments should generally be located with centre line at eye level approximately 1.2 m above grade or platform

e) posts or other supports must be manufactured from galvanised mild steel and must be secured to firm steelwork or masonry and not use floor gratings, access panels or similar.

b) instrument protection during installation:

(i) when instruments are held for a period prior to installation on the plant they should be kept in a clean and dry storage area specifically allocated to instrumentation

(ii) special precautions should be taken to guard against the ingress of dust or dirt into instrument connections and all temporary plugs etc. should be retained in place until replaced by the final connection. Throughout the construction period, instruments must be protected by covering with plastic bags drawn in at the bottom but not tightly closed

(iii) special care must be taken to prevent the ingress of moisture into instrument casings. Silica gel drying bags must regularly be inspected and revivified. Flameproof equipment must also be weatherproof but where necessary additional protection should be given during construction by sealing the flanges with silicon grease. Additionally the exterior surfaces may be painted provided aluminium paint is not used

(iv) shipping stops should be retained until the instrument is finally installed and required for pre-commissioning calibration

(v) where there is a possibility of fluids freezing within instruments they should only be filled when known to be safe and should generally be kept drained until all lines are finally traced and the system fully operable

(vi) process and instrument airlines must be capped or plugged when temporarily disconnected from the associated instruments

(vii) instruments should not be installed until all the necessary support structures are installed to protect the instrument. This includes supports for capillary connections and the like.

c) process impulse lines

Process impulse lines must be installed as per requirements in section 12 of this manual.

d) instruments attached to pipelines

Instruments attached to pipelines must be attached by means that allow disconnection, i.e. flanged or screwed connections. The instrument must not be welded straight to pipelines. No instrument cables or impulse lines are to be directly fixed to process pipes or vessels.

Attachment fittings on pipes must be fittings that attach to the pipe, such as:

- weldolets / thredolets on steel pipes
- new tee pieces into pipes
- with ABS (rigid, non-pressurized plastic pipe), use saddle fitting glued to the outside of the pipe. Do not tap and install the instrument straight into the pipe. Always add the connection fitting to the outside of the pipe.

6.1.2.6 Drawings

Instrumentation hook-up drawings must be provided showing the exact instrumentation location and installation procedure for Sydney Water's review and approval before commencement of installation work.

Reference to SWC's siteworks typical drawings listed in Appendix 1 is included at the end of each section. These detail the design intent as well as the format of drawings and the information that must be provided as part of the contractor's drawing submission.

6.1.3 Signal conditioning

6.1.3.1 General

This specification covers stand-alone signal conditioning loop elements, which provide various forms of signal processing, and/or conversion. The signal conditioners must comply with the requirements of sub-clause 6.1.2 and the following.

6.1.3.2 Functional specification

a) service

The signal conditioners must be used to provide various signal processing and/or conversion functions as follows:

- current to current repeaters
- voltage to current converters
- resistance (potentiometer) to current converters
- AC under-current relays.

(b) electrical requirements

Signal conditioners may be loop powered or powered from an auxiliary power supply and must be suitable for connection to the source voltage of the control circuit in which they are connected. Isolation must be provided between the power supply, the input and the output.

6.1.3.3 Performance specification

(a) current to current repeater/isolator

Current to current repeater/isolators must be fully solid state devices, capable of receiving a 0-20 mA, 24V DC input signal, and must provide an isolated output signal, proportional to the input signal, of 0-20 mA, 24V DC into 600 ohms (maximum) loop load. The current to current repeater/isolator must have a minimum power gain of 5:1, and must perform reversing of the sign of the output signal, where required.

- accuracy: ±0.05% of span
- repeatability: ±0.2% of span
- sensitivity: ±0.2% of span

(b) voltage to current converters

Voltage to current converters must be fully solid state devices, capable of receiving a 0-1V, 0-5V or 1-5V DC input signal, and must provide an isolated output signal, proportional to the input signal, of 0-20mA, 24V DC into 600 ohms (maximum) loop load.

- accuracy: ±0.05% of span
- repeatability: ±0.2% of span
- sensitivity: ±0.2% of span

(c) resistance (potentiometer) to current converters

Potentiometer to current converters must be fully solid state devices with no moving parts and capable of accepting a signal from an externally located three wire potentiometer or slide wire, and must provide an isolated output signal, proportional to the change in resistance (voltage) of the input signal, of 4-20 mA, 24V DC into 600 Ohms (maximum) loop load.

The potentiometer to current converter must provide the reference voltage for the external potentiometer, which may have any resistance from 0-1000 to 0-10,000 ohms.

- calibration accuracy: ±0.05% of span
- repeatability: ±0.2% of span
- sensitivity: ±0.2% of span

(d) AC under-current relays

AC under current relays must be microprocessor based suitable for connection to the 0-5 amperes AC input signal from the output of a current transformer, and must provide two sets of change over contacts with adjustable set point and operating time delay. Programming must be via a non - removable front panel keypad.

- operating time delay: adjustable range 0-60 seconds minimum
- linearity: better than +/- 0.1%
- temp. drift : <0.02% span per ^{0}C ±0.2% of span
- long term drift: 0.1% per 10,000hrs
- set point : adjustable over whole span
- contact rating: 230V AC, 3 A non-inductive
- display : 4 digit to display in % or engineering units
- supply: AC or DC (selected for application)

6.1.3.4 Physical specification

(a) mounting

The signal conditioners must be suitable for either DIN-Rail mounting within a panel or as a stand-alone device complete with enclosure for mounting on a wall or bracket.

(b) protection

All control panel mounted signal conditioners must be protected to IP54 and must be housed in an anodised aluminium enclosure. Wall or bracket mounted stand-alone devices must be protected to IP65.

6.1.3.5 Installation specification

Installation must comply with the requirements of Section 6.1.2.4. Terminals operating at voltages greater than 50V AC must be shrouded and provided with warning labels.

6.1.3.6 Drawings

Refer SWCs siteworks typical drawings listed in Appendix 1.

6.1.4 Phase failure relay

6.1.4.1 General

This specification covers phase failure relays to produce alarm signals on single and three phase electricity supply faults, which must comply with the applicable requirements of the sub-clause 6.1.2 and the following sub-clauses.

6.1.4.2 Functional specification

(a) service

The relay will be used to monitor incoming Electricity Authority supplies and reticulated SWC supplies. The relay will be capable of generating an alarm, in conjunction with telemetry if one or more of phases have failed or if the rotational direction is incorrect.

(b) input ranges

The relay must be suitable for 400V, 50 Hz, three-phase or 230V, 50 Hz, single phase operation, as required.

(c) fail-safe

The relay coil must be energised in the healthy condition, which must be indicated by an illuminated LED, and will de-energise to alarm. The alarm output contact must open to alarm.

(d) phase failure

The relay must be energised if the rotational direction of phases is correct and if all three phases are present. The relay must be de-energised in the event of failure of one or more of the phases or if the rotational direction is incorrect.

(f) self-resetting

When the supply returns towards its rated value, the relay will be re-energised and alarm will be cleared.

(g) alarm contacts

The relay must have a double pole changeover volt free alarm contact arrangement rated at 50V DC 2amps.

(g) trip time delay

Trip time delay will not normally exceed 100msec and under no circumstances will exceed 200msec.

6.1.4.3 Performance specification

(a) accuracy

Within the operational range, the stability and long term repeatability of the relay set point must be better than ± 0.5% of rated voltage.

(b) temperature effects

The relay must be suitable for operation over the temperature range of O°C to +60°C. Changes in ambient temperature within the operational range must result in a change of trip point of less than 1% of the rated voltage.

6.1.4.4 Physical specification

(a) housing and covers

The relay must be supplied mounted in a polycarbonate or similar enclosure for mounting external to switchboards. For installation inside switchboard DIN rail mounting units must be provided.

(b) protection

The relay enclosure ingress protection must be not less than IP50 with terminal cover. The enclosure for mounting external to switchboard must be not less than IP65.

6.1.4.5 Installation

The power failure relay must be provided with an isolation circuit breaker or fuse for protection and ease of maintenance.

6.1.4.6 Drawings

Refer the SWC's siteworks typical drawings listed in Appendix 1.

6.1.5 Level measurement

6.1.5.1 Level (buoyancy) switch

6.1.5.1.1 General

This specification covers the freely suspended buoyancy type level switches, which must comply with the applicable requirements of the sub-clause 6.1.2 and the following.

6.1.5.1.2 Functional specification

(a) service

The level switch must be used in conjunction with control systems to provide an open or closed contact dependent on level.

(b) switch contacts

The level switch must have a single/multi pole changeover switch as stated in the instrument data sheet of nominal rating 250V AC 2A, 50V DC 2A.

(c) pressure rating

The level switch must be capable of withstanding a water pressure in excess of 20m head without water ingress or degradation of performance for an indefinite period.

(d) hysteresis

The maximum permissible switching hysteresis is 75mm.

6.1.5.1.3 Performance specification

The single pole switch must be capable of greater than 10^6 operations without failure.

6.1.5.1.4 Physical specification

(a) protection

The buoyancy switch must be hermetically sealed and located inside a tough, impact resistant plastic float capable of withstanding all grades of water or effluent in the water/wastewater industry with pH ranging from 4 to 11.

(b) cable

The buoyancy switch must be supplied as standard complete with 3 (or more where applicable) core cable of sufficient length to reach the bottom of the vessel in which it is to be installed. The cable and any glanding arrangements must be impervious to water. It must be Flygt ENM 10 level regulator model No: 582 8880 with blue PVC cable or equivalent. External weights must not be accepted.

6.1.5.1.5 Installation specification

Buoyancy switches must be suspended in the liquid by their own cabling and a non-rusting gland or stainless steel hook. They must operate when the level of liquid is sufficiently high so as to tilt the float and activate a self-contained switch. The operating position of the buoyancy switch must be adjustable by raising or lowering the point of attachment of the electrical cable only.

Buoyancy switches and associated relays must be powered at 24V DC unless written dispensation is provided from an authorised Operational Technology Services (OTS) representative.

6.1.5.1.6 Drawings

Refer SWC's siteworks typical drawings listed in Appendix 1.

6.1.5.2 Level transmitter - submersible hydrostatic head

6.1.5.2.1 General

This specification applies to the measurement of liquid level in service reservoirs or wells associated with water and sewage facilities using the submersible hydrostatic head level measurement technique. The instrument must be loop powered, microprocessor based and use "smart" technology. The signal converter and transmitter may be integral to the sensor or remotely located from the sensor.

Submersible hydrostatic head level transmitters must comply with applicable requirements of sub-clause 6.1.2 and the following.

6.1.5.2.2 Functional specification

(a) service

The instrument must be used to measure the liquid level in service reservoirs, wells and vessels associated with water and sewage facilities.

(b) Input ranges

The instrument must be capable of measuring in ranges from as low as 0-1 m H_2O to as high as 0-25 m H_2O using different transducers or a single transducer with a wide turndown ratio providing that the performance specification is met when fully turned down.

(c) over pressure

The probe must be capable of withstanding a minimum of twice normal upper range limit pressure without change in calibration and four times normal upper range limit pressure without damage.

(d) surge protection

The transmitter must incorporate integral over-voltage surge protection and reverse polarity protection.

6.1.5.2.3 Performance specification

The probe and its associated adjustment unit must comply with the following:

- overall accuracy: ± 0.25 % of measuring range (including the effects of hysteresis, linearity)
- long term stability: < 0.05% per year
- temperature effect: ±0.01% of measuring range per °C
- repeatability: better than ± 0.25 % of measuring range.

6.1.5.2.4 Physical specification

(a) construction

The sensor body must be made of stainless steel (duplex) and the diaphragm material must be ceramic. The measuring cell must have a double seal. Wetted seal options for sewerage (FKM, or equivalent) and drinking water (AS4020 approved) applications must be available. Where the sensor is filled with a liquid medium, the fill liquid must be compatible with food applications.

(b) protection

The probe and integral transmitter must have IP68 protection. The remote transmitter must have a minimum of IP65 protection (IP67 if installed under the roof of a reservoir).

(c) calibration

The instrument must be supplied factory calibrated to the order specifications. User adjustment must be performed using a PC or a hand held communicator using "HART" protocol for all parameters adjustment without breaking the instrument loop. Potentiometer adjustments must not be acceptable.

6.1.5.2.5 Installation specification

The entry point of the level probe must be located in close proximity to an access hatch, with sufficient distance from the inflow and outflow pipe works and/or any mechanical agitation (e.g. mixer) to minimise the turbulence effects arising from these sources.

Suspension of the probe must be by the unit's special signal cable of suitable length and associated suspension clamp. The level probe must be attached securely to the roof or wall of the reservoir/well with a sufficient number of brackets properly attached and adequately spaced to hold the probe securely in place and provide accessibility for maintenance.

All installations must make provision to eliminate the effects of turbulence on the level probe and to hold the probe and the signal cable in the vertical position.

The method of eliminating the turbulence problem must be:

- provision of a stilling tube

- other methods of eliminating turbulence or variation to the above must be submitted and approved by Sydney Water prior to installation.

The material of all parts of the probe and associated installation assembly must be immune from corrosion.

Suitable provision must be made at the transmitter (or signal termination box in case of integral transmitter version) for termination of the atmospheric pressure reference capillary to ensure that it does not become blocked or kinked and that the breathing facility to atmosphere does not permit the ingress of water.

6.1.5.2.6 Drawings

Refer 'SWC's Site works Typical Drawings' listed in Appendix 1.

6.1.5.3 Level transmitter - ultrasonic

6.1.5.3.1 General

This specification applies to the measurement of level in tanks, wells and open channels in water and sewage treatment plants using the ultrasonic level measurement principle. The ultrasonic level measurement instrument must generally comprise a sensor and a signal converter and transmitter. The signal converter and transmitter may be integral to the sensor or remotely located from the sensor.

Ultrasonic level transmitters must comply with applicable requirements of sub-clause 6.1.2 such as HART communication protocol, FDT/DTM technology, other generic requirements and the following.

6.1.5.3.2 Functional specification

(a) service:

The level transmitter must be used to measure the level of liquids and solids in tanks, wells and open channels in water and sewage treatment plants.

(b) units of measurement

The units of measurement must be in metres.

(c) range

Transmitters must be available with suitable sensors for a number of different applications in waste water and water applications between the ranges of 0.3 to 30 metres. The transmitter must be configurable to measure level from the bottom of the vessel or distance from the surface of the liquid or solid to a reference point above the measured surface.

The supplier must clearly state the blocking distance applicable to the above sensors.

(d) measurement technique

The instrument must be based on non-contact ultrasonic level measurement technique in which the transit time of ultrasonic pulses reflected off the surface of the process liquids or solids is measured and converted to an equivalent level measurement.

(e) primary signal sensor

The ultrasonic signal sensor must be specifically designed and constructed for the intended application and must provide appropriate compensation for variations in ambient temperature, pressure and humidity within the specified limits.

In addition, the sensor and/or the transmitter must be designed to eliminate the effect of vapours, foam, froth and stray reflections from adjoining structures.

Performance specifications

(a) accuracy

Accuracy of the instrument must be better than ± 0.25% of the measurement span.

(b) repeatability

Repeatability must be better than ± 0.25% of the measurement span.

(c) response time

The instrument must respond (90% of final value) to any step changes in measured parameter in the process stream within five (5) seconds.

6.1.5.3.3 Physical specifications

The sensor must be completely encapsulated and made from durable and non-corrosive materials. Where instruments are supplied with integral transmitters, these must be protected to IP68 and supplied with a minimum of 25 metres of cable, which can be cut to suit site-specific length.

Instruments for sewage pumping station wet well and collecting manhole level monitoring application must feature compact and light weight construction to simplify installation and maintenance.

The instruments must be available with a number of different mounting styles and brackets to suit a variety of applications.

An optional submergence shield must be available for sensors to prevent false reading in case of flooding of the channel or vessel.

6.1.5.3.4 Installation specification

(a) level sensor selection

The level sensor should be selected to suit the expected conditions at the point of installation. These include the geometry of the plant structure, process medium, presence of foam and froth, corrosive and non-corrosive vapour and temperature and pressure variations. Following sensor parameters should be considered to match the application:

- signal frequency
- signal strength
- signal director shape
- blocking distance
- construction material
- temperature compensation.

(b) level sensor installation

An ultrasonic level transmitter can be set up to measure liquid level from the bottom of the tank or the distance from the surface of the liquid to the sensor. However, there are some restrictions imposed on the sensor installation dimensions by the manufacturers and these should be borne in mind when choosing the mounting location. These are as below:

- the sensor should be installed at least one blocking distance above the maximum level to be measured
- as far as possible the face of the sensor should be parallel to the surface of the level to be measured
- the sensor should be installed far enough from the walls of the tank and any other structures such as ladders, pipes and stirrers to prevent false echoes

- where nozzles are used to mount the sensor, these should be as wide as possible and free from any deposits and condensation on the inside
- for mounting above flumes and weirs refer to the Open Channel Flow Measurement Standard.

(a) level sensor commissioning

Level sensor commissioning involves ensuring that the sensor has been located and oriented properly so that the sonic signal path is perpendicular to the measured surface and free of obstructions. Once this is ensured manufacturer instructions should be followed to set up the measurement medium, span, fine tuning parameters and calibration of the instrument. The records of measurement and test results must be submitted to Sydney Water.

6.1.5.4 Level transmitter - radar

6.1.5.4.1 General

This specification applies to the measurement of level in tanks, wells and open channels in water and sewage treatment plants using the radar level measurement principle. The radar level measurement instrument must generally comprise a sensor and a signal converter and transmitter. The signal converter and transmitter may be integral to the sensor or remotely located from the sensor.

Radar level transmitters must comply with applicable requirements such as HART communication protocol, FDT/DTM technology and the other generic requirements of sub-clause 6.1.2 and the following.

6.1.5.4.2 Functional specification

(a) service:

The level transmitter must be used to measure the level of liquids and solids in tanks, wells and open channels in water and sewage treatment plants.

(b) units of measurement:

The units of measurement must be in metres.

(c) measurement technique:

The instrument must be based on non-contact pulsed radar level measurement technique in which the transit time of microwaves reflected off the surface of the process liquids or solids is measured and converted to an equivalent level measurement.

(d) range:

Transmitters must be available with suitable sensors for a number of different applications in waste water and water applications between the ranges of 0.5 to 35 metres. The transmitter must be configurable to measure level from the bottom of the vessel or distance from the surface of the liquid or solid to a reference point above the measured surface.

The areas where measurements are not recommended must be less than or equal to 150mm from lower end of the antenna.

The areas where the accuracy is reduced must be less than or equal to 0.5m from lower end of the antenna.

(e) primary signal sensor and transmitter:

The radar signal sensor must be specifically designed and constructed for the intended application and must provide appropriate compensation for variations in ambient temperature, pressure and humidity within the specified limits.

The sensor and transmitter system must identify true echo and must have auto false-echo suppression system.

The instrument must have condensation and dirt resistant antenna.

The radar sensors must operate in the high frequency range. The radar sensor must be designed to eliminate the effect of vapours, foam, froth and stray reflections from adjoining structures.

Performance specifications

(a) accuracy

Instrument accuracy must be better than ± 3mm.

(b) repeatability

Repeatability must be better than or equal to ± 2mm.

(c) step response time

The instrument must respond (90% of final value) to any step changes in measured parameter in the process stream within three (3) seconds.

(d) damping

Fully adjustable damping (typically 0 to 60 sec) must be provided.

(e) beam angle

The beam angle must be less than or equal to four (4) degrees.

(e) measuring frequency

The measuring frequency must use 80GHz technology.

6.1.5.4.3 Physical specifications

The sensor must be completely encapsulated and made from durable and non-corrosive materials. Instruments with integral transmitters are preferred, they must be protected to IP68 and be supplied with screened cable, with options of 15m and 25m, from the manufacturers standard range. The cable gland, or entry, must be fully encapsulated. The transmitter housing must be rated IP68 at 20m for 24 hours.

Instruments must feature compact and light-weight construction to simplify installation and maintenance. The instruments must be available with a number of different mounting styles and brackets to suit a variety of applications.

6.1.5.4.4 Installation specification

(a) level sensor selection

The level sensor should be selected to suit the expected conditions at the point of installation. These include the geometry of the plant structure, process medium, presence of foam and froth, corrosive and non-corrosive vapour and temperature and pressure variations. Following sensor parameters should be considered to match the application:

- signal frequency
- signal strength
- signal director shape
- transition zone (blocking distance)
- near zone distance (the zone where the accuracy reduced)
- construction material
- temperature compensation.

(b) level sensor installation

A radar level transmitter can be set up to measure liquid level from the bottom of the tank or the distance from the surface of the liquid to the sensor. However, there are some restrictions imposed on the sensor installation dimensions by the manufacturers and these should be borne in mind when choosing the mounting location.

(c) level sensor commissioning

Level sensor commissioning involves ensuring that the sensor has been located and oriented properly so that the radar signal path is perpendicular to the measured surface and free of obstructions. Once this is ensured manufacturer instructions should be followed to set up the measurement medium, span, fine tuning parameters and calibration of the instrument. The records of measurement and test results must be submitted to Sydney Water.

6.1.6 Flow measurement

This standard contains the flow measuring instrument specifications. Refer to HSS0005 Flow monitoring standards – (Flowmeters) TOG_TS05 for the installation requirements at Networks (IICATS) sites and custody transfer, regulatory or billing flowmeters at Treatment Plants.

6.1.6.1 Electromagnetic flow meters

Electromagnetic flowmeters must be sourced from an approved supplier. The make, model and configuration options for all Networks flow monitoring sites and custody transfer, regulatory or billing flowmeters at Treatment Plants must be approved by Sydney Water’s delegated IACS representative.

6.1.6.1.1 General

This specification covers bipolar pulsed DC electromagnetic flow meters. The equipment must comply with the General specification, clause 6.1.2 of this section, the requirements of ISO 6817 and the following.

6.1.6.1.2 Functional specification

(a) service

Electromagnetic flow meters must be used to measure flow of liquids in a closed conduit or pipe at water and sewage treatment plants. For Networks waste water, drainage water, recycled water, raw water and drinking water flow monitoring sites electromagnetic flowmeters should be used for most applications, refer to HSS0005 Flow monitoring standards – (Flowmeters) TOG_TS05 for details. The electromagnetic flowmeter must provide a current signal proportional to the measured flow rate.

The instrument must be capable of measuring flow in either direction (forward and reverse). The direction of flow must be indicated on the local display and by a switching contact rated at 50V DC 2A resistive or by a separate output signal for each direction, as specified by the user.

Electromagnetic flowmeters must also provide an option for the flow monitoring signals to be provided by connection to a data link. The datalink must be:

- Modbus RTU over serial, meeting the requirements defined in the SWC Instrumentation and Control Standards TOG TS01 part 16 Modbus, to an IICATS RTU at Networks sites, or
- Profibus DP, meeting the requirements defined in the SWC Treatment Plant SCADA standards, to a SCADA PLC at Treatment plants.

(b) measuring range

The system must employ an automatic zero facility and must measure the flow rate of liquids with velocities between 0.05m/s and 10 m/s.

(c) damping

The system must have an adjustable damping from 1 to 30 seconds.

(d) low flow cut off

The converter/transmitter must have an adjustable (0-10%) low flow cut off facility.

(e) pressure rating

The flow tube must be flanged and have a minimum pressure rating which meets the requirements of the hydrostatic pressures stated in the user requirements and notwithstanding must have a minimum rating of 1600kPA gauge. The flow tube must also have the capacity to withstand 50kPA pressure absolute.

(f) electrical

The four (4) wire converter/transmitter must be suitable for connection to a continuously powered 24V DC power supply. They must have dedicated 24V DC input terminals (i.e. no loop-powered, or 2-wire transmitters, will be accepted). The converter/transmitter flow output must be 4-20mA. A Pulse/frequency output is also required. An option for connection to a Modbus RTU over serial (RS485), or Profibus DP data link must also be provided.

The flow tube coil excitation must be a square wave bipolar pulse system and must not emit more than 1V/m RF interference in the frequency range 0.15 - 300 MHz.

Lightning and surge protection against damaging inducted and transient voltage spikes and high transient currents must be provided in accordance with the requirements in section-11 of this manual. Surge protection and earthing requirements specific to flowmeter installation must comply with HSS0005 Flow monitoring standards TOG_TS05.

(g) indicator

The converter/transmitter must be microprocessor based and use ‘Smart Technology’ and incorporate an integral local display. The flow indicator on the display must be calibrated in engineering flow rate units (Ml/d) for water applications and (l/s) for sewage applications. The display must incorporate all necessary adjusting and secondary calibration facilities via a key pad and the ability to drive and simulate flow and digital outputs. The converter/transmitter must also incorporate forward and reverse flow indication and must provide a forward/reverse contact as stated above.

(h) digital outputs

Flow transmitters must have minimum of 2 (two) digital outputs.

Digital outputs:

- must individual galvanically isolated
- can be individually set to suit a particular application
- must be programmable as alarm/logic, status, limit, reverse/forward flow indication
- short circuit protected
- must have minimum 1 (one) configurable pulse/frequency output with configurable frequency rate/pulse width to measure the flow rate of liquids with velocities between 0.05m/s and 10m/s
- preference must be given to transmitters that are directly connectable to current sink type PLC/RTU inputs with shared common input configuration
- must be suitable for failsafe alarm configuration
- preference must be given to devices that support three configurable pulse/frequency outputs (eg. forward and reverse flow and alarm).

The supplier must provide a flowmeter block diagram in detail for output configuration and installation.

(i) testing/verification

Accurate checking of flowmeter performance and functionality must be achievable without dismantling or removing the flowmeter from the site. Verification/testing equipment must be provided to Sydney Water to compare the routine operation of the flowmeter accuracy and performance against the parameters and conditions experienced during flow certification. These parameters must be recorded within non-volatile onboard memory at the time of calibration and certification in the factory. The verification system must be able to be referenced back to the factory calibration. A full verification report with the date of calibration must confirm meter performance according to Quality Standard ISO9001requirements.

Flowmeters must also be capable of performing continuous self-diagnostics based on parameters recorded within non-volatile onboard memory at the time of calibration and certification in the factory. If any of the monitored verification parameters fall outside the original tolerances an alarm condition must be raised. The alarm should be linked to a digital output as described in (h) above or, where a data link is used, to a Modbus register.

The verification features must be enabled for unrestricted use by Sydney Water. It should not require any licences, keys, subscriptions, or similar. If a licence, key, subscription or similar is required they must be provided to Sydney Water as free issue for an indefinite term at the time of purchase. The preferred method is via a HART DTM/FTD tool or a Modbus DTM if a Modbus capable device is used.

The flowmeter must be supplied as a minimum requirement with a three-point calibration certificate undertaken upon a NATA or equivalent accredited flowmeter test rig. Each flowmeter must be supplied with its unique calibration test certificate containing the primary device model and serial number, the test house and date of test along with the recorded test data and calibration result table.

6.1.6.1.3 Performance specification

The flow tube and associated converter/transmitter must comply with the following:

(a) accuracy: for flow velocity $\geq$ 0.5 m/sec, max uncertainty must be ≤ $\pm$ 0.25% of actual flow

for flow velocity < 0.5 m/sec, max uncertainty must be $\leqq$ $\pm$ (0.125 / V [m/sec]) % of actual flow where V is actual flow velocity in m/sec

(b) repeatability: better than ± 0.1% of measured value

(c) stability: better than ± 0.5% of span for twenty-four months.

6.1.6.1.4 Physical specification

(a) cable connection

Cable entry to the converter/transmitter must be by means of a threaded and plugged M20 connection. The flow tube must be supplied complete with a minimum 10 metre connection cable or cable set, or length to suit the specific application, already glanded, potted and terminated to the flow tube using clear, non-setting re-enterable gel, such as Sylgard 527.

(b) mounting (remote transmitters)

The converter/transmitter must be suitable for remote mounting employing a securing method that does not compromise the waterproof properties of the enclosure.

(c) flow tube liner and electrodes

The flow tube must have lining and electrode material suitable for the application (eg. only liner material that complies with Australian Standards/SWC standards for materials in contact with drinking water must be used).

Lining material such as ceramic, neoprene, teflon, polyurethane, ebonite hard rubber or approved epoxy liners must be used. The lining material selected must be suitable for the type and temperature of the fluid being measured. Liners for drinking water applications must comply with the latest version of AS4020. A hard rubber liner must be used for raw, recycled, drainage, drinking water and sewer applications.

Electrode material such as 316 stainless steel, hastelloy or platinum iridium must be used. The electrode material selected must be suitable for the type and temperature of the fluid being measured. Hastelloy electrodes must be used for raw, recycled, drainage, drinking water and sewer applications.

The manufacturer must provide a statement that the materials selected are suitable for the application.

The external body of the flow sensor must be metallic to provide protection against signal interference.

The pipework installation design should include an easy method of inserting and removing the flowmeter from the section of pipe. To this effect there should be a means of adjusting both the linear displacement between the pipework flanges as well as taking up any minor angular misalignment. Also the pipework installation should not impart excessive mechanical stresses onto the flowmeter primary element flanges or spool casing.

For applications that required periodic electrode inspection or cleaning, flow tubes must be fitted with removable electrodes.

(d) flanges and earthing rings

All flanges must be suited to the operating conditions, must comply with the requirements of AS4087, and must be supplied pre-drilled to suit the pipe work flanges.

Flange and electrode material must be suitable for the application. For standard water applications, grounding rings of 316 stainless steel for both upstream and downstream flanges must be supplied. The grounding rings must be designed to protect the lining material leading edges.

Adequate and suitable gaskets and 316 stainless steel bolts for connecting the flow tube into the pipe work must be supplied.

(e) size

The bore size of the flow tube must be as close as possible to the pipe diameter into which it is to be installed whilst maintaining velocity ranges that will provide accuracy in operation for the flow tube and associated converter/transmitter.

Special care is required when sizing flowmeters to optimise current and future hydraulic flow ranges. This is especially the case where designs have to take into account future urban development and system expansion.

Wherever flowmeters are selected to suit a lower present flow range than that of the designed maximum hydraulic capacity of the reticulation system that span and low flow design performance has to be carefully considered. Often under these common circumstances the ideal solution is to select a full bore magnetic flowmeter having a smaller internal diameter than the reticulation main at the point of measurement. This design practice is widely applied and can provide increased flow accuracy at the lower flow range and or a better flow turn down ratio without unduly compromising the overall system hydraulic capacity.

In all instances where undersized flowmeters are selected the overall design and installation should ensure minimum head lose and induced flow turbulence by fitting inlet and outlet reducing pipework tapers to either side of the flowmeter in accordance with the manufacturer’s recommendations and ISO 6817 requirements.

(f) protection

The converter/transmitter must be housed in an enclosure affording protection to IP65 in accordance with AS60529- Degrees of protection provided by enclosures (IP Code).

The flow tube must be protected to IP68 and the protection must remain effective continuously, at a minimum depth of four (4) meters with the flow tube submerged in water. An option for a flow tube to be rated IP68 continuously at ten (10) meters of water should be available from the manufacturers range.

6.1.6.1.5 Installation specification

(a) installation arrangement – general

The flowmeter and installation as a minimum must comply with ISO 6817 "Measurement of Conductive Liquid Flow in Closed Conduits- Method Using Electromagnetic Flowmeters." Where there is a conflict in specification, the highest specification should be applied and in all cases the manufacturer's recommendations should be fully met.

The flow tube may be installed in any position (vertical, horizontal, or at an angle) but it must run full of liquid to ensure accurate measurement. If mounted vertically, flow should be from bottom to top to assure a full pipe. When mounted horizontally, the electrode axis should not be in a vertical plane. (A small chain of bubbles moving along the top of the flow line could prevent the top electrode from contacting the liquid).

Vertical mounting with a straight run on the inlet side and upward flow is recommended if abrasive slurry is being measured. This arrangement distributes wear evenly.

Care should be exercised during installation to avoid damage to the flow tube and its lining.

During installation it is essential to avoid undue stress on the flow tube. It is desirable to bolt the flow tube to its upstream and downstream pipe work before completing pipe work assembly at a flange remote from the flow tube. Care should be taken to align the flow tube with its adjacent flanges and the fixing bolts should be tightened evenly.

All new electromagnetic flowmeters must be installed in full pits or above ground. Refer to HSS0005 Flow monitoring standards – (Flowmeters) TOG_TS05 for detailed installation requirements at Networks (IICATS) sites and custody transfer, regulatory or billing flowmeters at Treatment Plants.

(b) location and clear pipe diameters

Manufacturer's installation instructions must be followed; however the flow tube must have minimum upstream and downstream straight pipe runs as specified in Table 6-1 and 6-2. Responsibility for ensuring compliance to the specified performance remains the responsibility of the Contractor.

(i) Networks/IICATS applications.

For all Networks applications refer to Table 6-1. For series and parallel flowmeter offsets refer to the requirements listed in Table 6-2.

(ii) Treatment Plant applications.

For Treatment Plant applications refer to Table 6-2.

Table 6-1. Flowmeter minimum clear upstream and downstream diameters for Networks applications.

Flow disturbance	Minimum clear upstream diameters	Minimum clear downstream diameters	Additional comments
All Networks applications	10D	5D (10D for bidirectional)	
PRV (Pressure reducing valve)	25D	10D	PRVs should be installed downstream of the flow sensor.

Note: xD notation used where D refers to the pipe diameter (e.g. 10D for a 200mm pipe would be 10x200mm).

Table 6-2. Flowmeter minimum clear upstream and downstream diameters for Treatment applications.

Flow disturbance	Minimum clear upstream diameters	Minimum clear downstream diameters	Additional comments
90^{O} elbow or less	5D	3D	
T connections	10D	5D	
Screens	10D	5D	
Valves (butterfly, control or actuated)	10D	5D	Control valves should be installed downstream of the flow sensor.
Valves (knife gate, fully open, hand operated)	5D	3D	
PRV (Pressure reducing valve)	25D	10D	PRVs should be installed downstream of the flow sensor.
Pumps	10D	5D	
Series flowmeters	5D between flowmeter flanges.		Minimum 0.5m between flanges.
Parallel flowmeters	Min. 1 m separation from other flowmeter.	Min. 2D offset from other flowmeter.	Flowmeters must be offset.
Ball valves for instrument/tapping points (static)	5D	2D	Minimum 250mm downstream of flange.
Custody transfer, tariff, metering, and regulatory applications	10D	5D (10D for bidirectional)	

Note: xD notation used where D refers to the pipe diameter (e.g. 10D for a 200mm pipe would be 10x200mm)

(c) pipe work support

The manufacturer's recommendation for support structures must be followed, and all necessary support structures must be supplied and installed. Support fittings and structures must not apply any support loading to the flowmeter spool fitting or associated coil casing.

(d) electrical requirements

For accurate and reliable measurement it is essential that the process liquid be at earth potential. This must be achieved by the use of equi-potentially bonded metallic earthing rings.

The most stringent requirements of the manufacturer's instructions for earthing and/or drawing referenced in appendix 1 must be followed.

Electrical connections between the flow tube and a remote converter/transmitter must not exceed the maximum distance permitted by the manufacturer.

Terminals operating at voltages greater than 50V AC must be shrouded and provided with warning labels.

(e) storage

The flow meter equipment must be stored in a clean dry area until required for installation, and protective covers must not be removed until necessary to permit erection of the equipment. The flow tube should be stored in its packing or in a cradle; it should never be stood upright on its end flanges. The transducer, which may appear to be a conventional piece of flanged pipe is a precision-built instrument and should be treated as such.

(f) handling

Although the flow tube appears to be a robust pipe spool, care must be taken in handling it to avoid damage, particularly to the liner. Always lift using slings passed around the flow tube.

Liners damaged during handling must result in rejection of the flow tube which must be replaced by the Contractor.

Note: Eyebolts used for lifting must be test-house certified (they form part of the lifting equipment). As a general rule, slings which are regularly inspected, tested and certified for the normal working load) should be used instead of eyebolts.

(g) cleaning and purging

The flow tube must only be installed after the process pipe work has been cleaned and flushed.

6.1.6.1.6 Electrical installation

(a) cabling

The connecting cable between the flow tube and converter/transmitter must neither be installed close to power cables nor share a common conduit with power cables. Refer to section 9 of this manual for cable installation and segregation requirements.

(b) earthing

The importance of proper earthing cannot be over emphasised. It is necessary for the safety of personnel and for satisfactory flow measurement. The manufacturer's instructions on earthing and jumper arrangements must be followed carefully. Piping should always be earthed. A continuous electrical contact to the same earth potential is necessary between the flowing liquid, the piping and the flow meter. This continuous contact is especially important if the conductivity of the liquid is low. This connection must be achieved by means of metallic earthing rings between the two pipe flanges. This earthing connection is extremely important and must be installed if the system is to operate properly. Jumpers from the meter body to the piping must also be supplied and installed. Refer to HSS0005 Flow monitoring standards – (Flowmeters) TOG_TS05 and SSD-010 for detailed earthing requirements.

6.1.6.1.7 Drawings

Refer ‘SWCs Site works Typical Drawings’ listed in Appendix 1.

6.1.6.2 Battery powered electromagnetic flowmeters

All of the requirements listed in section 6.1.6.1 Electromagnetic flow meters of this specification apply to battery powered flowmeters unless stated otherwise in this section (6.1.6.2).

Battery powered flowmeters must only be used as specified in HSS0005 Flow monitoring standards – (Flowmeters) TOG_TS05.

6.1.6.2.1 General

The hardware used for battery powered flowmeters is different to continuously powered electromagnetic flowmeters. The battery powered flow tube and transmitter must be compatible and designed specifically for battery powered applications.

6.1.6.2.2 Functional specification

No differences to 6.1.6.1.2 except for part f) electrical requirements. Battery powered electromagnetic flowmeters do not need to be suitable for connection to a continuously powered 24V DC supply, which does not apply. Battery powered flowmeters do not need to provide a 4-20mA flow output. The converter/transmitter flow output must be a pulse/frequency output and a Modbus RTU over serial (RS485) data link must also be provided for IICATS installations. All other requirements apply.

6.1.6.2.3 Performance specification

All requirements form 6.1.6.1.3 apply.

6.1.6.2.4 Physical specification

All requirements form 6.1.6.1.4 apply.

6.1.6.2.5 Installation specification

All requirements form 6.1.6.1.5 apply. In addition, for IICATS installations, the transmitter must be mounted in a turret with an IP68 battery powered RTU. Refer to Part 7 – IICATS RTU and interface requirements of this standard for further details.

6.1.6.2.6 Electrical installation

All requirements form 6.1.6.1.6 apply.

6.1.6.3 Ultrasonic flow meters

6.1.6.3.1 General

This specification covers ultrasonic transducers and associated converter/transmitters for measuring water flow within a closed pipe using multiple path time of flight methods which must comply with the General Specification, clause 6.1.2, and the following.

6.1.6.3.2 Functional specification

(a) service

Ultrasonic flow meters, where nominated, must be used to measure flow of liquids in a closed conduit or pipe at water or sewage treatment plants.For Networks waste water, drainage water, recycled water, raw water and drinking water flow monitoring sites refer to HSS0005 Flow monitoring standards – (Flowmeters) TOG_TS05 for details on flow meter type selection. The ultrasonic flow meter must provide a current signal proportional to the measured flow velocity.

The instrument must be capable of measuring flow in either direction (forward and reverse). The direction of flow must be indicated on the local display and by a switching contact rated at 50V DC 2A resistive or by a separate output signal for each direction, as specified by the user.

Ultrasonic flowmeters must also provide an option for the flow monitoring signals to be provided by connection to a data link. The datalink must be:

- Modbus RTU over serial, meeting the requirements defined in the SWC Instrumentation and Control Standards TOG TS01 part 16 Modbus, to an IICATS RTU at Networks sites, or
- Profibus DP, meeting the requirements defined in the SWC Treatment Plant SCADA standards, to a SCADA PLC at Treatment plants.

(b) input ranges

The instrument must employ an automatic zero facility and must measure the flow rate of liquids with velocities of 0.05m/s to 10 m/s.

(c) span and zero

The transmitter must have facilities for continuous, non-interactive adjustment of span and zero.

(d) damping

Fully adjustable damping (typically 1 to 30 sec) must be provided.

(e) low flow cut off

The converter/transmitter must have an adjustable (0-10%) low flow cut off facility.

(f) electrical

The four (4) wire converter/transmitter must be suitable for connection to a continuously powered 24V DC power supply. They must have dedicated 24V DC input terminals (i.e. no loop-powered, or 2-wire transmitters, will be accepted). The converter/transmitter flow output must be 4-20mA. A Pulse/frequency output is also required. An option for connection to a Modbus RTU over serial (RS485), or Profibus DP data link must also be provided.

(g) indication and calibration

The converter/transmitter must be remote, microprocessor based, use ‘Smart Technology’ and incorporate an integral local display. The flow indicator on the display must be calibrated in engineering flow rate units (Ml/d) for water applications and (l/s) for sewage applications. The display must incorporate all necessary adjusting and secondary calibration facilities via a keypad and the ability to drive and simulate flow and digital outputs. The converter/transmitter must also incorporate forward and reverse flow indication and must provide a forward/reverse contact as stated above.

The manufacturer must provide a field verification procedure to compare the routine operation of the flowmeter accuracy and performance against the parameters and conditions experienced during flowmeter calibration at the time of commissioning. These parameters must be recorded within non-volatile onboard memory such as E^2PROM at the time of calibration.

6.1.6.3.3 Performance specification

The transducer(s) and associated converter/transmitter must comply with the following:

(a) accuracy:

For flow velocity ≥ 0.5 m/sec, max uncertainty must be ≤ ± 0.5 % of actual flow;

For flow velocity < 0.5 m/sec, max uncertainty must be ≤ ± (0.25 / V [m/sec]) % of actual flow where V is actual flow velocity in m/sec.

(b) repeatability:

≤ 0.25 % of measured value

(c) influence of temperature:

Accuracy dependence on temperature must be ≤ ± 0.05%/°C

(d) influence of supply voltage:

Accuracy dependence on supply voltage must be less than 0.05%/volt within ±10% of rated supply voltage.

6.1.6.3.4 Physical specification

(a) protection

The transmitter must be sealed to a minimum of IP65. The transducers must be sealed to IP68 to five (5) metres submersion.

(b) mounting

The transducers must be suitable for mounting to an existing pipe or supplied fitted to a stainless steel spool piece. The transducer holders must protrude through the pipe or spool piece wall, but must not obstruct free flow of the fluid within the pipe.

The transmitter must be suitable for remote mounting employing a securing method that does not compromise the waterproof properties of the enclosure.

(c) materials

The transducer body must be manufactured of stainless steel and all materials must be suitable for application (e.g. for water distribution applications, all materials to be used on wetted parts must be suitable for use in potable water).

(d) cable connection

Cable entry to the converter/transmitter must be by means of a threaded and plugged M20 connection, plain M20 clearance hole plugged, or fitted gland.

The transducers must be fitted with a terminal block and housing to enable connection of the manufacturer's recommended signal cable from the converter/transmitter. Such housing must be glanded and sealed to maintain the IP68 rating of the instrument.

6.1.6.3.5 Installation specification

(a) general

Ultrasonic flow transducers are calibrated for a fully developed flow profile and errors will occur when the flow profile at the point of measurement is disturbed. The manufacturer's installation recommendations must be followed. In addition, a minimum upstream straight length of at least ten (10) pipe diameters must be allowed after bends and tees and twenty (20) diameters after throttling valves or an increase in pipe diameter. A minimum downstream straight pipe length of at least five (5) pipe diameters must be provided.

Ultrasonic transducers sense vibration or noise generated in cavitating valves and they must be located on a vibration-free section of pipe as remote as possible from any upstream or downstream valve where cavitation noise may be generated.

(b) pipe work

Ultrasonic transducers may be pre-assembled on a spool piece or the transducers may be fixed to a suitable section of existing pipe work by transducer holder/adaptors screwed or welded to the pipe work.

Where ultrasonic transducers are fitted to existing pipes it is essential that the bore of the pipe is accurately known and that it is reasonably smooth and free from deposits. In all cases the manufacturer's instructions should be followed.

To minimise errors from entrained gases or from solid deposits the ultrasonic transducers should generally be arranged in a horizontal plane across the pipe.

(c) installation practice

Good coupling of ultrasound waves between the transducers and the liquid being metered is necessary to ensure reliable measurement. Where the transducers are fitted to existing pipe work this must be in accordance with the manufacturer's instructions.

(d) mounting alignment

Where two separate transducers are employed the relative positions of the two devices on the pipe work must be carefully checked before permanently fixing in accordance with the manufacturer's instructions.

(e) spool piece

Where ultrasonic transducers are mounted on a spool piece, the spool piece must be assembled with the pipe work. Suitable jointing materials must be used and care should be taken to avoid jointing material projecting into the bore of the pipe.

(f) electrical connections

The length of cable permitted between transmitter and transducers is generally limited and the manufacturer's instructions should be followed.

The electrical signals employed are at a low level and may be prone to interference. Consequently, transducer connections must be kept short and must be routed away from other cables which may be sources of interference.

The transmitter must be mounted in an accessible location suitable for the temperature rating of the equipment.

6.1.6.3.6 Drawings

Refer 'SWC's Site works Typical Drawings' listed in Appendix 1.

6.1.6.4 Differential pressure flow meters

6.1.6.4.1 General

This specification covers microprocessor based smart electronic differential pressure measuring transmitters for use in conjunction with differential pressure producing primary elements for the measurement of the flow rate of fluids in pipes. The equipment must comply with the General Specification, clause 6.1.2, and the following.

6.1.6.4.2 Functional specification

(a) service

The equipment must be used, together with existing primary elements, to measure the flow velocity of fluids in closed pipes.

(b) input ranges

The equipment to be supplied must have an adjustable measuring range from 0 to 10,000 mm H_20.

(c) span and zero adjustment

The span must be adjustable from at the most 6.25% to 100% of the range. The span and zero adjustments must be totally independent of each other.

(d) suppression and elevation

The equipment must include zero suppression and elevation facilities. The maximum suppression and elevation must be in excess of 50% the span limits for any of the set ranges

(e) damping

A variable time constant with an adjustable range of 0 to 32 seconds must be included.

(f) operating pressure limits

The operating pressure limits must be in excess of 2 kPa (20 millibar) absolute to 2000 kPa (20 bar).

(g) static and over pressure limits

A minimum of 5 kPa (0.05 bar) absolute to a maximum of 6000 kPa (60 bar) on either side without damage.

(h) indicator

The transmitter must incorporate a 3½ digit integral digital indicator calibrated in engineering units.

(i) lightning protection

The transmitter must incorporate integral over voltage protection.

6.1.6.4.3 Performance specification

(a) general

The performance specifications are based on the following reference conditions:

- Zero-based spans
- Static Pressure equal to atmosphere
- Stainless steel diaphragm.

(b) accuracy

The overall accuracy including the effects of hysteresis, repeatability, temperature and linearity must be ±0.10% of calibrated span.

(c) pressure effects

Within this overall accuracy figure the following parameters must also meet the indicated specifications:

(i) static pressure

A change of 3000 kPa (30 bar) must result in a zero shift of less than ± 2% at minimum input span.

(ii) over pressure

The zero shift for 3000 kPa (30 bar) on either side must be less than ± 3% at minimum input span.

(d) stability

The stability of the transmitter must be ±0.10% of the upper range limit for six (6) months.

(e) output

The output of the transmitter must be linear 4-20 mA 24V DC proportional to flow, 2- wire into a loop load 600 ohms (maximum).

6.1.6.4.4 Physical specification

(a) construction

Sensing capsule and body material must be constructed of a non-corrosive material suitable for the service detailed in 6.6.3.2 (a) above.

(b) protection

The transmitter must be housed in a watertight case with IP65 degree of protection.

(c) test calibration connection

The transmitter must incorporate a socket to enable the connection of a hand held communicator. The communication protocol must be HART.

6.1.6.4.5 Installation specification

(a) mounting

The equipment must be suitable for surface mounting, and must be supplied with the necessary wall or pipe mounting bracket.

(b) seals

Where it is necessary to protect the instrument from the process fluid, diaphragm seals must be used.

(c) manifold

Five valve stainless steel manifolds must be supplied and installed. Equalising and venting valves on the heads of the instruments may be of the instrument manufacturer's standard. Vent valves must be arranged with drain lines where necessary to ensure that the operation of these valves does not create a hazard to personnel and adjacent plant.

6.1.6.4.6 Drawings

Refer 'SWC's Siteworks Typical Drawings' listed in Appendix 1.

6.1.6.5 Insertion type electromagnetic flow meters

6.1.6.5.1 General

This specification covers insertion type electromagnetic flow meters with separate transducer and converter/transmitter for measuring the flow rate of a liquid within a pipe. The equipment must comply with the General Specification, clause 6.1.2, and the following.

6.1.6.5.2 Functional specification

(a) service

Insertion electromagnetic flow meters must be used to measure clean water flow in a pipe with internal diameter up to 300 mm with 10 pipe diameters upstream and 5 pipe diameters down stream, and larger internal diameter pipes with uniform flow profile across the pipe.

(b) span and zero

The system must employ an automatic zero facility and must measure the flow rate of liquids with velocities between 1 m/s and 3 m/s.

(c) damping

The system must have an adjustable time constant between 0.2 and 10 seconds or an inherent time constant between these values.

(d) turndown ratio

The minimum acceptable turndown ratio is 10 to 1.

(e) low flow cut off

The converter/transmitter must have an adjustable (0-10%) low flow cut off facility, nominally set to 0%.

(f) electrical

The four (4) wire converter/transmitter must be suitable for connection to a 230V, 50 Hz single phase power supply or 24V DC power supply as per user requirements. Converter/transmitter output must be 4-20mA.

(g) indicator

The solid state electronic converter/transmitter must incorporate an integral indicator calibrated in engineering flow rate units, and must incorporate all necessary adjusting and calibration facilities. The converter/transmitter must also incorporate forward and reverse flow indication and must provide a forward/reverse volt free contact.

6.1.6.5.3 Performance specification

The flow tube and associated converter/transmitter must comply with the following:

(a) accuracy:	better than ± 2% of measured value (the flow velocity between 1m/s and 3m/s)
(b) repeatability:	better than ±1% of measured value
(a) stability:	better than ±0.5% span for twelve months
(b) output:	Linear 4-20 mA, 24V DC, proportional to flow rate into a loop load of 600 ohms maximum

6.1.6.5.4 Physical specification

(a) protection

The transmitter must be sealed to a minimum of IP65. The transducers must be sealed to IP68.

(b) mounting

The insertion electromagnetic transducer must be suitable for mounting to an existing or new pipe via a transducer holder/adaptor which must be screwed or welded to the outside of the pipe. The transducer holder/adaptor must be suitable for the specific pipe diameter in which flow is to be measured, so as to ensure that the transducer is inserted into the pipe at the manufacturer's recommended distance (proportion of pipe internal diameter).

The transmitter must be suitable for remote mounting.

(c) cable connection

Cable entry to the converter/transmitter must be by means of a removable gland plate, threaded and plugged M20 conduit connection, plain M20 clearance hole plugged, or fitted gland.

The transducers must be fitted with a terminal block and housing to enable connection of the manufacturer's recommended signal cable from the converter/transmitter. Such housing must be glanded and sealed to prevent entry of water in the event of immersion over extended periods.

6.1.6.5.5 Installation specification

(a) general

Insertion electromagnetic flow meters are calibrated for a fully developed flow profile and errors will occur when the flow profile at the point of measurement is disturbed. Manufacturer's recommendations must be followed but for most types of measurement an upstream straight length of at least ten pipe diameters must be required after bends and tees and twenty diameters after throttling valves or an increase in pipe diameter. A downstream straight pipe length of at least five (5) pipe diameters must be required.

(b) cleaning and purging

Transducers mounted in holder/adaptors in the wall of the pipe may be left in position during cleaning provided that excessive corrosion is not present and abrasion or heating is not employed. The manufacturer's instructions must be followed in this case.

(c) electrical connections

The length of cable permitted between transmitter and transducer is generally limited and the manufacturer's instructions should be followed.

The electrical signals employed are at a low level and may be prone to interference. Consequently, transducer connections must be kept short and must be routed away from other cables which may be sources of interference.

The transmitter must be mounted in an accessible location suitable for the temperature rating of the equipment.

6.1.6.5.6 Drawings

Refer 'SWC's Site works Typical Drawings' listed in Appendix 1.

6.1.6.6 Flow switch - paddle type

6.1.6.6.1 General

This specification covers paddle type flow switches which must comply with the General specification, clause 6.1.2, and the following:

6.1.6.6.2 Functional specification

(a) service

The flow switch must be used to provide an open or closed contact dependent on the flow or no flow in pipes.

(b) type

The flow switch must be of paddle operated type, fitted with double pole change over contacts rated at 50V DC 2A

6.1.6.6.3 Performance specification

The switch must be capable of greater than 10^6 operations without failure.

6.1.6.6.4 Physical specifications

The switch must be enclosed in a waterproof housing with IP65 degree of protection.

The paddle must be stainless steel and must be of suitable length to suit the application and pipe size in accordance with the manufacturer's requirements.

6.1.6.6.5 Installation specification

The switch must be suitable for mounting to a pipe via an in line threaded pipe tee or via a threaded pipe coupling welded to the pipe. The method of installation will depend on the pipe diameter and if the flow switch is being fitted to a new or existing pipe.

6.1.6.6.6 Drawings

Refer ‘SWC’s Siteworks Typical Drawings’ listed in appendix 1.

6.1.6.7 Flow measurement in open channels

6.1.6.7.1 General

This specification applies to the measurement of flow in open channels over flumes and weirs in water and sewage treatment plants. In addition, this specification also applies to flow measurement in open channels using the velocity-area method, which uses flow velocity, channel depth and channel geometry to determine the flow.

This specification excludes the design and installation of open channel flow gauging structures such as flumes and weirs.

6.1.6.7.2 Functional specification

(a) service

The flow meter must be used to measure volumetric flow rate of liquids in open channels in water and sewage treatment plants.

(b) units of measurement

The volumetric flow rate must generally be measured in ML/d (megalitre/day), however, it must be possible to scale the measurement to read the flow rate in alternate units of measurement such as litres/second and cubic meters/day etc.

The primary sensor measurements must be expressed in the following units:

- liquid head metres
- flow velocity metres/second

(c) range

The flow meter measuring range must be user selectable to suit a number of diverse applications within the water and sewage treatment plants. The measurement range of the flow meter must only be limited by the limits placed on the primary sensor measurements. The flow meter must be provided with a low flow cut-off setting adjustable between 0-10% of the span setting.

The primary sensors must be available for the following measurement ranges:

- level sensor configurable with ability to range from 0-0.3 meters up to 0-15m
- velocity sensor 0-10 meters / second.

(d) measurement technique

The flow meter for measurement of flow over flumes and weirs must consist of a non-contact radar level sensor to measure the up stream level of the liquid flowing over the gauging structure, constructed and installed in accordance with British Standard BS3680, and an electronic transmitter which converts and transmits the level sensor signal to a flow rate in accordance with BS3680.

In the case of velocity-area method the flow meter must consist of an radar level sensor to measure the depth of the liquid in the channel and a pair of submerged ultra-sonic sensors (transmitter-receiver pair) to determine the flow velocity using the transit time principle. Respective electronic transmitters must convert and transmit the liquid depth and flow velocity signal to the user supplied remote control system for conversion to volumetric flow rate.

(e) primary signal sensors

The primary signal sensors (level and flow velocity) must be specifically designed and constructed for the intended application and must provide appropriate compensation for variations in ambient temperature, pressure and humidity within the specified limits.

In addition, the level sensors must be designed to eliminate the affect of vapours, foam, froth and stray reflections from adjoining structures. Refer to part 6.1.5.4 of this document for radar sensor requirements.

The supplier must clearly state the blocking distance applicable to the level sensors.

6.1.6.7.3 Performance specifications

(a) accuracy

Accuracy of the primary signal sensors, excluding the gauging structure, must be better than ±1.0% of the measurement span.

(b) repeatability

Repeatability of the primary signal sensors must be better than 0.5% of the measurement span.

(c) response time

The primary signal sensors must respond (90% of final value) to any step changes in measured parameter in the process stream within 5 seconds.

6.1.6.7.4 Physical specifications

The primary sensors must be completely encapsulated and made from durable and non-corrosive materials. Where instruments are supplied with integral transmitters, these must be protected to IP68.

6.1.6.7.5 Installation specification

(a) gauging structure

Correct design and construction of the gauging structure is of primary importance in obtaining accurate open channel flow measurements. As these are not in the scope of this specification the installation designer should consult the site/project hydraulic engineer for guidance.

(c) level sensor installation

Correct level sensor installation and commissioning are also critical to the accuracy of the open channel flow measurement. Following points should be observed during planning and installation design stage:

- install the sensor 3 to 4 times the maximum depth upstream of the weir of flume throat
- install the sensor just above the top water mark in the channel plus the blocking distance
- position the sensor perpendicular to the surface of water and right above the centre line of the flume/weir
- install the level sensor under a protective hood
- install the sensor over a stilling well only if absolutely necessary as these may be difficult to keep clean.

(c) level sensor commissioning

The level sensor should be correctly calibrated and referenced to the hydraulic datum (crest elevation of the weir or flume) of the flow gauging structure. It may be useful to install a depth gauge referenced to the crest elevation of the gauging structure adjacent to the sensor position to periodically compare the level sensor reading with the depth gauge.

6.1.6.7.6 Drawings

Refer 'SWC's Sitework Typical drawings' listed in Appendix1.

6.1.7 Pressure measurement

6.1.7.1 Pressure transmitter

Pressure transmitters must be sourced from an approved supplier. The make, model and configuration options must be approved by Sydney Water's delegated IACS representative.

6.1.7.1.1 General

This specification defines the requirements for microprocessor-based smart electronic pressure transmitters with primary transducers for the measurement of pressure, and providing a current output directly proportional to pressure.

6.1.7.1.2 Functional specification

(a) Service

This instrument must be used to measure gauge pressure in pipelines and vessels.

(b) Electrical

Power Supply:

Transmitter must be capable to operate on 12V to 40V DC with no load for 4-20mA output (generally, it must operate on 24V DC supply-loop powered). Reverse polarity protection must be included.

Output Signal:

Output signal must be two-wire 4 to 20mA isolated analogue output. The minimum requirement is that the instrument must be capable of driving 20mA through a 600 Ohm load at 24V DC without an additional signal isolator.

(c) Measuring range

The instrument must be available over a wide input range to suit a variety of applications in water and wastewater applications.

(d) Span and zero adjustment

The span must be adjustable to any value within the range limits as long as calibrated span is greater than the minimum span. The zero adjustment must be minimum of $\pm$10% of the set span. The span and zero adjustment must be totally independent of each other.

(e) Suppression and elevation

The Instrument must include zero suppression and elevation facilities.

(f) Damping

A variable time constant with an adjustable range of 0 to 16 seconds (minimum) must be included.

(g) Pressure rating

The instrument must be capable of withstanding a minimum of twice normal upper range limit pressure without change in calibration and four times normal upper range limit pressure without damage for normal applications.

(h) Indicator

If required, the transmitter must incorporate a $3^1/_2$ digit integral digital indicator scaled in engineering units.

(i) Lightning protection

The transmitter must incorporate integral over voltage protection.

(j) Smart instrument features and communication

The contractor must supply instruments featuring state-of-the-art smart functions such as remote configuration, re-ranging, output monitoring and forcing, and hardware self-diagnostics and alarming.

The instrument must allow the 4-20mA analogue output to be scaled to any user defined unit (e.g. mH_2O).

Hardware/software failure alarm must be selectable as high, low or custom defined values. When pressure exceeds the calibrated analogue output span, the analogue output must go to user defined saturation levels.

The contractor must supply a hand held calibrator and/or personal computer software must be used to communicate with the smart instrument(s). The protocol must be HART.

The transmitter must be provided with HART communication module as mandatory.

Profibus PA, Profibus DP and Modbus modules must be available as optional add on modules.

The supplier must state other available communication modules and/or advanced service ports.

The transmitter must be able to communicate with a hand held "smart" communicator and laptop PC for the adjustment of all parameters without breaking the instrument loop.

(k) Configuration and calibration

It must be possible to perform output monitoring, configuration, parameter setting, re-ranging, forcing of the output to a selected value, diagnostic checks and calibration checks with the communicator.

It must be possible to verify the complete configuration of the pressure transmitter without using a communicator.

The instrument must store the serial number, materials of construction and tag number in non-volatile memory and must retain original factory calibration settings in a permanent memory.

It must be possible to store last calibration date and next calibration due date in the instrument memory.

(l) Environmental conditions

The instrument must operate within the defined specification over the following range of environmental conditions:

<u>ambient temperature:</u>

Indoors: -10 °C to + 55 °C.

Outdoors or chambers: -25 °C to + 70 °C

<u>relative humidity:</u>

5% to 95% non-condensing

<u>atmospheric pressure:</u>

± 5% of any mean local barometric pressure between 70kpa and 106kpa

(m) Instrument availability, reliability and durability

Instruments and their installation must be chosen and installed for their reliability, accuracy, fit for purpose and the operating environment, low maintenance and easy calibration.

The design of the instruments must be such that the replacement of any parts may be rapidly executed to reduce non-availability of any control or measuring loop to a minimum.

The instrument availability must be better than 99% including off-line duration for manual calibration and routine maintenance.

The instrument, excluding scheduled wearing parts, must have a mean time between failures of greater than 5 years.

The overall economic operating life of the instrument must be greater than 10 years.

(n) Documentation

The instrument must be supplied with detailed technical documentation written in English. This should consist of:

(i) health and safety information

(ii) measurement technique and principle of operation

(iii) technical specification

(iv) installation and commissioning instructions

(v) out of service requirements (e.g. during process shutdown)

(vi) manual calibration and routine service procedures

(vii) basic fault finding and confidence test

(viii) mechanical and electrical diagrams and layouts

(ix) calibration, verification and test certificates

(x) where applicable, a copy of SAA hazardous area certificates.

(o) Labelling and identification

The instrument must be clearly labelled with the manufacturer's name, measured parameter, model number, serial number and application operating parameters such as maximum pressure rating for in-line instruments, hazardous area certification details (where applicable) and electrical power supply voltage, frequency and loading.

(p) Security

The instrument must be protected against unauthorised calibration and configuration changes. The calibration and configuration data must be protected against loss due to power supply failure.

6.1.7.1.3 Performance specification

(a) Reference accuracy and stability

General monitoring and control applications

Overall accuracy including hysteresis, linearity, repeatability: better than $\pm$ 0.25% of calibrated span ;

Stability: better than + 0.2% of upper range limit for five years

Critical and high performance applications

Overall accuracy including hysteresis, linearity, repeatability: better than $\pm$ 0.15% of calibrated span;

Stability: better than + 0.2% of upper range limit for 10 years

(b) Response time and turn-on (warm up) time

The supplier must provide the test data demonstrating that the instrument conforms to the following requirements.

General monitoring and control applications

Turn-on time (warm up period): Performance within specification less than 3 seconds after power is applied;

Total response time: 250 msec or less

Critical and high performance applications

Note: Any battery power supplied installation must be regarded as a high performance application.

Turn-on time (warm up period): Performance within specification less than 1.5 seconds after power is applied

Total response time: 150 msec or less

(c) Operating Conditions

The error resulting from a change within the defined operating conditions in Section 6.7.1.2.12 must be no greater than the following:

(i) temperature : 0.1% of range

(ii) atmospheric Pressure: negligible

(iii) effect of supply voltage: $\leq$ 0.005% of measured value on 1% change

(iv)transmitter load effect: less than 0.1% over total load range;

(d) Radio frequency interference

The instrument when correctly installed and with all covers fitted must exhibit negligible output variation when subjected to a field-strength of 10 V/m between 20 MHz to 1 GHz.

(e) Analogue output ripple and noise

The peak to peak amplitude of internally generated ripple currents, noise or any other unwanted component attributable to the equipment or its power supply, which may appear in the output signal, must not exceed 0.1% of the selected output range.

(f) Analogue output isolation

The analogue output must be galvanically isolated.

(g) Analogue output regulation

When the load resistance across the output terminals is varied from 0 to 600 ohms the output signal current must not change by greater than 0.1% of range over the full output range.

(h) Supply variation

Variation of the power supply to the instrument within the range of -12% to +10% of 24V DC supply must not cause the instrument to operate outside the performance requirements of this specification.

6.1.7.1.4 Physical specification

(a) Cable connection

All cable entries must be via M20 cable glands and must terminate on screw terminal blocks suitable for up to two 1.5mm^2 wires.

(b) Process connection

Process connections must be 1/4" BSP on process flanges and 1/2" BSP on flange adaptors. Where BSP connectors are not available the process connection must be NPT and a converter provided.

(c) Mounting

The converter/transmitter must be suitable for remote mounting employing a securing method that does not compromise the waterproof properties of the enclosure.

(d) Flanges and adapters

All flanges must comply with the requirements of AS4087, and must be supplied pre-drilled to suit the pipe work flanges.

(e) Drain/vent valves

Gauge pressure instruments must be supplied with 2 valve manifolds or block and bleed valves. The instruments must be calibrated and tested with the manifold fitted.

(f) Protection

The converter/transmitter must be housed in an enclosure affording protection to IP65 (minimum) in accordance with AS60529-Degrees of protection provided by enclosures (IP Code).

For installations where there is any possibility of flooding the degree of protection must be to IP68 at a depth of 1m for a period of 24 hours. This protection must be maintained under all operating and fault conditions.

6.1.7.1.5 Installation specification

The instrument must be suitable for wall or pipe mounting and must be supplied with the necessary mounting bracket and pipe work adaptations.

New pipe work tapping points where specified must be into the horizontal axis of the pipe work. This will avoid excessive collection of air or suspended solids. On pipelines which contain fluids with suspended solids, rodding facilities must be provided.

Where it is necessary to protect the instrument from the process fluid, diaphragm seals must be used.

Pipe work:

(i) pressure tapping pipe work must be furnished and installed with the piping and materials suitable for the service involved. The materials used must be corrosion resistant and be sized to suit the application. Carbon steels with protective coatings must not be used

(ii) the first isolating valve at the process tapping connection must be suitably rated for the application. Where the instrument is local to this valve a vent/drain valve must also be provided. Where the instrument is remote, two isolation valves are required, one provided at the process tapping connection and the second at the instrument location, together with a vent/drain valve

(iii) The pipe work must be supported to allow for vibration and expansion. Where necessary, pulsation dampers must be used to dampen pulsations due to pumps etc.

6.1.7.1.6 Drawings

Refer 'SWCs Siteworks Typical Drawings' listed in Appendix 1.

6.1.7.2 Pressure switch

6.1.7.2.1 General

This specification applies to diaphragm actuated pressure switches which sense a change in process pressure and open or close a pair of contacts when a preset pressure is reached. The instruments must comply with the General Specification, clause 6.1.2, and the following.

6.1.7.2.2 Functional specifications

(a) service

The pressure switch must be used to provide an open or closed voltage free contact when a preset pressure is reached.

(b) type

The pressure switch must be diaphragm actuated adjustable differential action type, fitted with double pole changeover contacts rated at 50V DC 2A.

6.1.7.2.3 Performance specification

The switch must be capable of greater than 10^6 operations without failure.

The minimum switching differential must be 5% of the duty point setting.

The pressure switch must be capable of withstanding an overpressure of 4 times the operating range continuously and 10 times the operating range for short durations.

6.1.7.2.4 Physical specification

The diaphragm material must be as follows:-

(i)	for chlorinated water	-	Teflon
(ii)	for potable water	-	Stainless Steel
(iii)	for waste water	-	Stainless Steel

The switch must be enclosed in a waterproof housing protected to IP65.

6.1.7.2.5 Installation specification

(a) The instrument must be suitable for wall mounting and must be supplied with the necessary mounting bracket and pipe work adaptors

(b) new pipe work tapping points where specified must be into the horizontal axis of the pipe work. This will avoid excessive collection of air or suspended solids. On pipelines which contain fluids with suspended solids, rodding facilities must be provided

(c) where it is necessary to protect the instrument from the process fluid, diaphragm seals must be used

(d) pipe work:

- (i) pressure tapping pipe work must be furnished and installed with the piping and materials required for the service involved. The materials used must be corrosion resistant and be sized to suit the application. Carbon steels with protective coatings must not be used

- (ii) the first isolating valve at the process tapping connection must be suitable rated for the application. Where the instrument is local to this valve, a vent/drain valve must be provided. Where the instrument is remote, two isolation valves are required, one provided at the process tapping connection and the second at the instrument location, together with a vent/drain valve

- (iii) the pipe work must be supported to allow for vibration and expansion. Instruments must be mounted in such a manner that they remain unaffected by pulsations due to pumps etc.

6.1.7.2.6 Drawings

Refer 'SWC's Siteworks Typical drawings' listed in appendix 1.

6.1.7.3 Differential pressure transmitters

This instrument must be used to measure differential pressure in pipelines and vessels. The instrument must comply with all applicable requirements listed under clause '6.1.7.1- pressure transmitters' of this manual.

6.1.8 Temperature measurement

6.1.8.1 Pt100 RTD temperature transmitters

6.1.8.1.1 General

This specification applies to the measurement of temperature in tanks, pipes, wells and open basins in water and sewage treatment plants using the platinum resistance (Pt100) thermometers. The temperature measurement instrument must generally comprise a Pt100 thermometer and a signal converter and transmitter. The signal converter and transmitter may be integral to the thermometer or remotely located from the thermometer. The Instrument must comply with the general specification clause 6.1.2 and the following:

6.1.8.1.2 Functional specification

(a) service

The instrument must be used to measure the temperature of slurries, liquids and gases in tanks, wells and open channels in water and sewage treatment plants.

(b) units of measurement

The units of measurement must be in Celsius (deg C).

(c) range

The instrument must be available with suitable Pt100 thermometers for a number of different applications in water and sewage treatment plants between the range of –50 to 250 deg C.

(d) measurement technique

The instrument must be based on platinum resistance (Pt100) thermometry principle. The transmitter must be user configurable for up scale or down scale burnout and must be designed to minimise measurement error due to self-heating of the thermometer.

(e) primary signal sensor

The platinum resistance thermometer must be a 3-wire Pt100 element enclosed in a stainless steel sheath and conform to AS 2091.

The thermometer must be available in a number of different immersion lengths complete with mounting and mechanical protection (thermowell) accessories to suit a variety of applications in water and sewage treatment plants.

6.1.8.1.3 Performance specifications

(a) accuracy

Overall accuracy of the instrument must be better than ± 1.0 deg C.

(b) repeatability

Repeatability must be better than ± 0.5 deg C.

(c) response time

The instrument must respond (90% of final value) to any step changes in measured parameter in the process stream within 30 seconds. This must include any delays introduced due to enclosure of the thermometer in a thermowell.

6.1.8.1.4 Physical specifications

(a) materials of construction

The transmitter must be constructed from materials compatible with the sewage treatment plant environment, process fluids and chemical reagents they are likely to be in contact with. This must include any accidental spills and splashes.

The Pt 100 RTD probes must be clad with stainless steel sheath and connection heads must be made from high strength, corrosion resistant material. Thermowells must be made from stainless steel bar stock and must have a tapered profile unless otherwise stated.

6.1.8.1.5 Installation specification

(a) temperature probe selection

A Pt 100 temperature probe (also called a RTD) is capable of measuring fluid temperatures accurately over a wide range from –185 deg C to +650 deg C. For most measurements within closed pipes a RTD is installed inside a thermowell to protect it from the process fluid and enable its removal during plant operation. A bare temperature probe may be used for temperature measurement in open tanks, basins or wells. However, mechanical protection should still be provided to the probe to prevent excessive stress due to flow currents. Sheath and thermowell material should be compatible with the wetting fluid.

The thermowell and Pt 100 RTD immersion length and mounting style should be selected to suit the application. A spring loaded RTD should be selected when it is to be installed in a thermowell to ensure that there is good contact between the tip of the Pt 100 RTD and the thermowell.

(q) temperature probe installation

The Pt 100 RTD and thermowell should be installed rigidly and to ensure proper contact with the process fluid. Thermowells should invariably be used for measurements in pipes and these may be screwed into threaded sockets welded on to pipes or flange mounted depending on the application. Insertion depth should be at least half of the pipe diameter.

Bare Pt 100 RTD probes for temperature measurement in tanks, basins and open channels may be bracket mounted with the bracket attached to tank wall. Where possible probe location should be in the cross-flow and mechanical support should be provided to the probe to prevent stress and vibration due to flow currents. The RTD connection should be IP68 rated to prevent water ingress in the event of flooding or spills and splashes.

(c) temperature transmitter commissioning

Commissioning crew should verify that Pt 100 RTD installation is as per above guidelines and all electrical connections are tight. The transmitter should be calibrated by using a temperature bath or an accurate resistance box using 3 wire Pt 100 RTD configuration.

6.1.9 Local indicators

6.1.9.1 Level indicators

This section is not applicable to treatment plants.

6.1.9.1.1 General

This specification covers indicators used to display level (e.g. at a pumping station) of a remote site (e.g. reservoir). The level will be measured at the reservoir and transmitted via the telemetry system for indication at a pumping station (as well as remote work station etc).

It should be noted that in general separate indication of analogue values will not be required, however in exceptional circumstances, and when directed by SWC OTS representative, the Contractor may be required to install a separate indicator.

The equipment must comply with the General Specification, Section 6.1.2 and the following:

6.1.9.1.2 Functional specification

(a) service

The indicators must be used to display the level of reservoirs, tanks, SPSs and channels in percentage of full scale value or in engineering units (meters).

(b) input range

The equipment must accept an input of:

(i) 4-20mA

(ii) 1-5V DC

(c) electrical

The indicator must be suitable for connection to a 24V DC supply or must be loop powered incurring a maximum volt drop in the loop of 10V DC.

6.1.9.1.3 Performance specification

The indicator must comply with the following:-

(a) accuracy

This must be 0.5% or better of reading

0.1% or better of full scale

(b) update

Update time must be 1 per sec or better.

(c) common mode rejection

CMRR must be 80 dB or better.

6.1.9.1.4 Physical specification

The indicator must be protected to a minimum of IP55.

The indicator must be a micro-processor based 3 + ½ digit (minimum) scalable 7 segment LCD display. The indicator must be configurable to display the process value in the range 0-100%.

The indicator must provide isolation between input/power/earth.

6.1.9.1.5 Installation

The indicator must be suitable for panel mounting and must be supplied with the necessary mounting brackets etc.

6.1.10 Fire/smoke, chlorine gas detection and security alarms

Security equipment and Fire detection systems must be provided in accordance with the latest SWC Technical Specification Part 3-Electrical Works part E4.5. For general and technical requirements contact the SWC Emergency Management and Security Group.

Any alarm system installed for the protection of personnel must not rely on IICATS and/or SCADA systems to raise an alarm for personal safety.

For some critical assets/processes and operational reasons other than personal safety, alarms like smoke warning and/or site access monitoring can be configured on IICATS as a 'for information only' alarm to notify the asset owner. Such applications are considered non-standard applications and site specific IICATS I/O lists with alarm handling protocols must be prepared in consultation with the IACS Project Engineer.

Technical Specification

Sydney WATER

Part 6 – Section 2 – Analytical Instrumentation Technical Specification

6.2 Analytical Instrumentation Technical Specifications

6.2.1 Introduction

This part of the Instrumentation and Control Standards Manual contains analytical instrument specifications covering equipment used for the monitoring and control of water and wastewater facilities.

General requirements applicable to all instruments are specified in clause 6.2.2. The remaining sections specify the particular requirements associated with each analytical instrument type.

The specification for each analytical instrument type specifies the functional, performance, physical and installation requirements.

6.2.2 General Specifications

6.2.2.1 General

This general specification applies to all analytical instruments and associated equipment in addition to the requirements as specified in chapter 6.1, clause 6.1.2.

6.2.2.2 Functional specification

In addition to the functional requirements as specified in chapter 6.1 sub clause 6.1.2.2, all analytical instruments must also comply with the following:

a) analytical instrument sensors

Analytical instruments comprising of a sensor and a processing unit may operate on the remote sampling principle using a flow cell, or the sensor may be installed directly into the process stream as required by the purchaser.

The following sensor installations are covered by this specification:

(i) flow cell

(ii) dip probe for open channel or tank

(iii) insertion probe for closed pipes.

For instruments comprising of a separate sensor and processing unit, the maximum permissible separation between the sensor and the processing unit must not exceed the manufacturer's recommendation.

Dip or insertion probes installed directly into the process stream must be safely and easily removable without requiring the shutting down of the process.

b) analytical instruments reagent and buffering systems.

Analytical instruments, which do not require a reagent or a buffering system are preferred. However, where these are necessary due to the measurement technique employed, they must meet the following requirements:

(i) remote indication of low reagent level must be provided via a voltage free changeover contact rated at 50V DC 2A resistive. The alarm output contact must open to alarm (failsafe)

(ii) the reagents, buffer solutions and the analyser effluent must not pose any health or environmental risk

(iii) the supplier must provide all details of the chemical composition and handling precautions associated with the reagents

(iv) the effluent from the analysers must be disposed of in a safe manner

(v) the sampling system must be designed to prevent any accidental mixing or back flow of reagents and/or analyser effluent into the process stream.

c) analytical instruments calibration and maintenance

The analysers must operate within the performance requirements of this specification for a period not less than four weeks without manual calibration or routine maintenance. The design of the instrument and sizing of reagent containers must be such as to allow unattended operation for a minimum period of 4 weeks.

The supplier must provide all details of instrument calibration and maintenance requirements and procedures including a list of tools, spare parts and reagents.

d) optional features

Analysers with automatic sensor cleaning and calibration features must be favourably considered provided the supplier is able to demonstrate the benefits of the feature(s) vis-à-vis additional costs.

6.2.2.3 Performance specification

As per requirements specified in chapter 6.1 sub clause 6.1.2.3.

6.2.2.4 Physical specification

All analytical type instruments must be supplied with the necessary sample pumps, piping, tubing, reagent and associated accessories which are required for the normal functioning and operation of the instrumentation.

In addition to the functional requirements as specified in chapter 6.1 sub clause 6.1.2.2, all analytical instruments must also comply with the following:

<u>Analyser sampling systems</u>

Analyser sampling systems and sensors must be designed to withstand the temperature and pressure of the process stream and must meet the performance requirements of this specification when the sample temperature and pressure vary as follows:

- temperature variations 0-30°C
- sample flow velocity 0-2m/s
- pressure variation

  flow cells - 25kpa within the range of – 50 kPag to 200 kPag.

  dip sensors - 0-50kPag

  insertion sensor- ± 50% of nominal pressure

6.2.2.5 Installation specification

As per requirements specified in chapter 6.1 sub clause 6.1.2.5.

6.2.3 Water quality monitoring

6.2.3.1 General

Note: This section is not applicable to water /wastewater treatment Plants.

This specification covers water quality monitoring equipment as listed below which must be mounted on a common equipment panel and installed in a water quality monitoring station building.

i. Chlorine residual

ii. pH
iii. turbidity
iv. pressure
v. flow rate
vi. temperature.

The equipment must comply with the general specification clause 6.2.2, and the following.

6.2.3.2 Functional specification

a) Service

Specific instruments must be used to measure the above stated water quality parameters and to provide a current signal proportional to the measured parameter. Please refer to the individual instrument specifications for more details of service and other functional requirements.

a) Electrical

~~The four (4) wire Chlorine residual analyser, turbidity transmitter and pH transmitter must be suitable for connection to a 240 V, 50 Hz, signal phase power supply via a surge protection unit.~~

~~The two (2) wire flow, temperature and pressure transmitters must be suitable for connection to a 24 V DC power supply.~~

Transmitters/controllers powered at 24V DC are to be used. 230V AC powered equipment is only allowed if 24V DC version is not available or is not suitable for the specific application. Where 230V AC models are used, power supply must be taken from an appropriate RCD circuit breaker/GPO that is dedicated for the equipment. Equipment cable terminals must be touch free (covered and insulated) such that personnel cannot inadvertently touch live parts.

6.2.3.3 Performance specification

Please refer to the individual measurement specification.

6.2.3.4 Physical specification

Please refer to the individual measurement specification.

6.2.3.5 Installation specifications

a) mounting

The instruments must be mounted on an instrument rack complete with all sampling and impulse piping.

Cabling from the instruments to the instrument power supply distribution board and all signal output cabling to a local termination box must be installed and terminated.

The contractor must supply, install and terminate all cabling from the instruments to the instrument power supply distribution board and all signal output cabling to a local termination box.

b) local termination box

The contractor must supply and install a local signal termination box complete with all terminals (including 25% spares) necessary to terminate the water quality monitoring instrument outputs.

6.2.3.6 Drawings

Refer SWCs siteworks typical drawings listed in appendix 1.

6.2.4 pH analysers

6.2.4.1 General

This specification applies to on-line analysers for the measurement of pH in water and sewage treatment plants. The analyser must generally consist of a sampling system (where required), a sensor and an electronic transmitter, which converts and transmits the sensor signal to a remote location.

The equipment must comply with the general specification clause 6.2.2 and the following:

6.2.4.2 Function specification

a) service

The analyser must measure the pH of water and sewage treatment process streams as identified by the purchaser in the specific instrument data sheet.

b) units of measurement

The pH of a solution is a relative measure of its acidic or alkaline character and is expressed in dimensionless units in a range of 0 to14 with 0 pH indicating strong acid and 14 pH indicating strong base.

c) range

Ideally the analyser must measure over the entire range of 0 pH to 14 pH however the minimum range must not be less than 2 pH to 12 pH.

The zero and span settings must be user selectable within the measurement range to cover a variety of different applications in the water and sewage treatment plants.

d) measurement technique

The analyser must be based on potentiometric measurement technique employing a matched pair of a pH sensitive glass electrode and a reference electrode. The measurement electrode must be provided with a Pt100 temperature compensation element.

The supplier must provide a choice of measurement and reference electrodes for a wide range of applications in the water and sewage treatment plants.

6.2.4.3 Performance specifications

a) accuracy

Accuracy of the analyser must be better than ± 0.2 pH over the entire measurement span.

b) repeatability

Repeatability must be better than ± 0.1 pH over the entire measurement span.

c) response time

The analyser must respond (90% of final value) to any step changes in measured parameter in the process stream within 30 seconds.

6.2.4.4 Physical specifications

a) measurement electrodes

Measurement electrodes must be a heavy duty general purpose glass membrane type.

b) reference electrode

Reference electrode must be a heavy-duty liquid electrolyte filled Silver Chloride (AgCl) wire type. Porous ceramic junction must be used for potable water applications and porous PTFE junction must be used for sewage applications.

6.2.4.5 Installation specification

a) the signal transmitter should be located as close as possible to the electrodes due to the extremely low level signals generated during measurement of the pH

b) insulation and screening of all cables and connections between the electrodes and the transmitter should be of the highest order and ingress of moisture should be prevented in the connection chamber of the transmitter

c) do not shorten the preformed electrode cable by cutting it as it compromises the insulation of the cable. Order a cable length suitable for the application

d) to get reliable pH measurements it is important to earth the process liquid at the point of measurement. This is easily achieved where metallic brackets and/or sampling system are used. A metallic earth electrode should be provided near the point of measurement when plastic fittings are used.

6.2.5 ORP/redox analysers

6.2.5.1 General

This specification applies to on-line analysers for the measurement of oxidising or reducing potential (ORP) of process streams in water and sewage treatment plants. The analyser must generally consist of a sampling system (where required), a sensor and an electronic transmitter which converts and transmits the sensor signal to a remote location.

The equipment must comply with the general specification sub clause 6.2.2 and the following:

6.2.5.2 Functional specification

a) service

The analyser must measure the ORP of water and sewage treatment process streams as identified by the purchaser in the specific instrument data sheet.

b) units of measurement

ORP measurement of a solution is an indication of the oxidising or reducing strength of the solution and is expressed in millivolt units (mV).

c) range

The analyser must be capable of measuring ORP in a range of '-1500 mV to +1500 mV'.

The zero and span settings must be user selectable within the above range to cover a variety of different applications in the water and sewage treatment plants.

d) measurement technique

The analyser must be based on potentiometric measurement technique employing a matched pair of a metallic measurement electrode and a reference electrode.

The supplier must provide a choice of measurement and reference electrodes for a wide range of applications in the water and sewage treatment plants.

6.2.5.3 Performance specifications

a) accuracy

Accuracy of the analyser must be better than ± 1.0 mV over the entire measurement span.

b) repeatability

Repeatability must be better than ± 0.5 mV over the entire measurement span.

c) response time

The analyser must respond (90% of final value) to any step changes in measured parameter in the process stream within 30 seconds

6.2.5.4 Physical specifications

a) measurement electrodes

Measurement electrodes must be a heavy-duty metallic electrode type. Choice of the measurement electrode material is dictated by the process medium. Gold electrode should be used for oxidising medium and platinum for reducing medium.

b) reference electrode

Reference electrode must be a heavy-duty liquid electrolyte filled silver chloride (AgCl) wire type. Porous ceramic junction must be used for potable water applications and porous PTFE junction must be used for sewage applications.

6.2.5.5 Installation specifications

a) The signal transmitter should be located as close as possible to the electrodes due to the extremely low level signals generated during measurement of the ORP.

b) Insulation and screening of all cables and connections between the electrodes and the transmitter should be of the highest order and ingress of moisture should be prevented in the connection chamber of the transmitter.

c) Do not shorten the preformed electrode cable by cutting it as it compromises the insulation of the cable. Order a cable length suitable for the application.

6.2.6 Conductivity analyser

6.2.6.1 General

This specification applies to on-line analysers for the measurement of conductivity of liquids in water and sewage treatment plants. The analyser must generally consist of a sampling system (where required), a sensor and an electronic transmitter which converts and transmits the sensor signal to a remote location.

The equipment must comply with the general specification subclause 6.2.2 and the following:-

6.2.6.2 Functional specification

a) service

The analyser must measure the conductivity of liquids in water and sewage treatment plants as identified by the purchaser in the specific instrument data sheet.

b) units of measurement

Conductivity of a solution is a combined measure of the concentration and mobility of all ions in the solution and is expressed in micro Siemens per centimetre (uS/cm).

c) range

The analyser must be capable of measuring conductivity in a range of 0-10,000 uS/cm.

The zero and span settings must be user selectable within the above range to cover a variety of different applications in the water and sewage treatment plants.

d) measurement technique

Conductivity analysers must be based on alternating current measurement technique employing two electrode measuring cells for clean water applications and electrode-less inductive measurement cells for waste water applications. In both cases the measurement cells must be provided with an integral Pt.100 automatic temperature compensation element.

The supplier must provide a choice of geometry and sensitivity of measurement electrodes for a wide range of applications in the water and sewage treatment plants.

6.2.6.3 Performance specifications

a) accuracy

Accuracy of the analyser must be better than +/- 1.0 % of the measurement span.

b) repeatability

Repeatability must be better than +/- 0.5 % of the measurement span.

c) response time

The analyser must respond (90% of final value) to any step changes in measured parameter in the process stream within 30 seconds.

6.2.6.4 Physical specifications

a) the measurement electrodes for water applications must be made from high-grade stainless steel suitable for mounting in flow cells and pipelines

b) the measurement electrodes for sewage applications must be made from strong non-corrosive material suitable for mounting in flow cells, pipelines and open channels.

6.2.6.5 Installation specification

a) selection of conductivity cells

Conductivity of a liquid solution is influenced by the following factors:

- total ion concentration
- mobility of ions
- temperature

Following factors should be considered in choosing a conductivity cell:

- type of cell- choose a standard two electrode stainless steel cell for clean water applications and an electrode-less (toroidal) inductive measurement cell for applications prone to fouling the cell e.g. waste water
- cell constant- choose the cell constant to suit the measurement range of interest. Use manufacturer charts for this
- temperature compensation- different liquid solutions have different temperature v/s conductivity response. The automatic temperature compensation feature of the conductivity cell references all measurements to 25 ^{0}C. Ensure that the analyser temperature v/s conductivity response is set up correctly for the liquid being measured and all measurements are being referenced to 25 ^{0}C.

b) installation of conductivity cells

- choose proper fittings and mounting hardware to suit the sampling method selected for the application i.e. flow cell, dip cell and insertion probe
- the measuring cell should be mounted in the process or sample stream such that the sample flow through the cell is continuous and truly representative of the liquid composition
- the installation should enable easy removal of the cell for maintenance
- ensure that the cell and the mating cable connectors are fitted securely and relieved of tension. Also ensure that moisture is not allowed to enter the connectors during installation or maintenance.

c) commissioning of conductivity cells

Commissioning of the cell involves ensuring that the installation is as per above recommendations and verification of the instrument functionality and calibration. Calibration may be verified by using KCl solution of known strength. It should be noted that conductivity of the KCl solution used for calibration will be influenced by ambient temperature.

6.2.7 Dissolved oxygen analyser

6.2.7.1 General

This specification applies to on-line analysers for the measurement of dissolved oxygen in water and sewage treatment plants. The analyser must generally consist of a sampling system (where required), a sensor and an electronic transmitter which converts and transmits the sensor signal to a remote location.

The equipment must comply with the General Specification, clause 6.2.2 and the following:-

6.2.7.2 Functional specification

a) service

The analyser must measure the concentration of dissolved oxygen (DO) in water and sewage treatment process streams as identified by the purchaser in the specific instrument data sheet.

b) units of measurement

Concentration of dissolved oxygen must be measured in milligrams of dissolved oxygen per litre of process fluid (mg/L). In special cases as identified by the purchaser in the specific instrument data sheet, it may be measured as percentage saturation of the process fluid with dissolved oxygen (%). The analyser must be capable of displaying the dissolved oxygen measurement in either or both units as chosen by the purchaser.

c) range

The analyser range must be available for the following measurement ranges:

- DO concentration : 0-10 mg/L
- DO saturation: 0-100%

The analyser must be capable of withstanding and recovering from an over-range exposure of DO concentrations up to 200% of the full scale value.

d) measurement technique

The analyser must be based on optical or galvanic measurement technique for on-line water and sewage applications. The measurement must be automatically compensated for sample stream temperature variations and ambient atmospheric pressure variations within the purchaser specified range.

The DO sensor must be protected against poisoning by sulphides present in the sewage treatment process streams.

6.2.7.3 Performance Specifications

a) accuracy

Accuracy of the analyser must be better than the greater of ± 0.1 mg/l or 1% saturation across the measurement span.

The above accuracy of the measurement must include the influence of pH, conductivity, temperature and flow rate of the sample or the process stream as long as these are within the specified range of variations.

b) repeatability

Repeatability must be better than the greater of ± 0.05 mg/l or ± 0.5% across the measurement span.

c) response time

The analyser must respond (90% of final value) to any step changes in measured parameter in the process stream within 30 seconds.

6.2.7.4 Physical specifications

The DO sensor must be designed for quick disassembly and re-assembly to facilitate cleaning, replacement of sensor cap/cartridge and regeneration.

(Note: self-cleaning (air or water) required).

6.2.7.5 Installation specification

a) self- cleaning (air or water) is required
b) unless otherwise stated in purchaser’s data sheet, the sensor must be supplied with suitable hardware for “dip probe” installation in open basins
c) the dip probe must be located at the nominated point and supported from the instrument stand or plant structure in a manner to enable easy maintenance access to the sensor. The dip probe must enable adjustment of the immersion depth of sensor in the process stream
d) the transmitter must be installed as close to the sensor as practical on an instrument stand or supported off suitable plant structure and must be protected by a weather-shield.

6.2.8 Chlorine residual analysers

6.2.8.1 General

This specification applies to on-line analysers for the measurement of free or total (sum of free and combined) residual chlorine concentration in water and sewage treatment plants. The analyser must generally consist of a sampling system (where required), a sensor and an electronic transmitter which converts and transmits the sensor signal to a remote location.

The equipment must comply with the general specification clause 6.2.2 and the following:-

6.2.8.2 Functional specification

a) service

The analyser must measure the concentration of free or total residual chlorine in water and sewage treatment process streams as identified by the purchaser in the specific instrument data sheet.

b) units of measurement

Concentration of residual chlorine in free or combined form is measured in milligrams of chlorine per litre of solution (mg/l).

c) range

The analysers must be available for the following user selectable measurement ranges:

- 0-1.0 mg/l
- 0-5.0 mg/l
- 0-20 mg/l.

d) measurement technique

The analyser must be based on amperometric measurement technique for measurement of free or total residual chlorine in on-line water and sewage applications. The measurement must be independent of the stated range of variations in temperature and pH in the process/sample stream.

The supplier may propose instruments based on alternate principle of measurement such as colorimetric and direct absorption, provided they can demonstrate the overall suitability and performance of the proposed alternative for the intended application.

6.2.8.3 Performance specifications

a) accuracy

Accuracy of the analyser must be better than the greater of ± 4.0% of the span or ± 0.04mg/l .

b) repeatability

Repeatability must be better than the greater of ± 2.0% of the span or ± 0.02 mg/l.

c) response time

The analyser must respond (90% of final value) to any step changes in measured parameter in the process stream within 30 seconds.

6.2.8.4 Physical specifications

As per clause 6.2.2

6.2.8.5 Installation specifications

Good sampling practice is very important to obtain reliable readings from a residual chlorine analyser. It is important to note that the amount of residual chlorine in a sample can be reduced very quickly due to decomposition and consumption by stray causes.

For best results chlorine residual analysers should be installed in analyser huts or other suitable indoor location to reduce the impact of sunlight, heat and humidity on its operation.

Sampling system:

- use small bore short run sample pipe to reduce the dead time
- where necessary, use pressure and flow regulators in sample line to obtain the manufacturer recommended sample flow and velocity
- where it is necessary to use a pump to deliver the sample to the analyser, use a flexible impeller type sample pump to minimise agitation of sample

- sampling point should be selected to ensure a representative and stable sample is available to the analyser under all operating conditions
- the sample probe should be inserted into the pipe to a depth of one third of the diameter and the sample port should face downstream
- stainless steel tube should be the first choice for sample lines. Opaque nylon tubing may also be used, however, clear plastic pipes should not be used as these encourage biological growth.

Please refer to sampling system schematic drawing for more information.

6.2.9 Turbidity analysers

6.2.9.1 General

This specification applies to on-line analysers for the measurement of turbidity in potable water treatment plants. The analyser must generally consist of a sampling system (where required), a sensor and an electronic transmitter, which converts and transmits the sensor signal to a remote location.

The equipment must comply with the general specification clause 6.2.2 and the following:

6.2.9.2 Functional specification

a) service

The analyser must measure turbidity in potable water treatment plants as identified by the purchaser in the specific instrument data sheet.

b) units of measurement

Turbidity is a measure of cloudiness of a liquid (water in this case). It is measured relative to a standard solution of formazin in pure water in formazin turbidity units (FTU) of measurement. 1 FTU is equal to 2.5 mg/l of silica.

For low range (up to 100 FTU) applications turbidity may be measured in nephelometric turbidity units (NTU) by measuring the 90 degree scatter of incident light on the sample. 1 NTU is equal to 1 FTU in this range of measurement.

c) range

The analysers must be available for the following measurement ranges:

- product water 0-1 to 0-10 FTU (or NTU)
- clarified water 0-10 to 0-100 FTU (or NTU)
- raw water 0-10 to 0-500 FTU
- coagulation control 0-10 to 0-500 FTU
- filter backwash 0-200 to 0-2000 FTU.

d) measurement technique

The analyser must be based on nephelographic measurement technique in accordance with ISO7027 for on-line potable water treatment applications. The measurement must be compensated for the colour and absorption effects of the sample by employing ratiometric measurement technique and not be affected by ambient light.

6.2.9.3 Performance specifications

a) accuracy

Accuracy of the analyser must be better than ± 2.0% of the span for instruments up to 100 FTU (or NTU) and ± 5.0% of the span for higher ranges.

b) repeatability

Repeatability must be better than the greater of ± 1.0% of the span for instruments up to 100 FTU (or NTU) and ± 2.5% of the span for higher ranges.

c) response time

The analyser must respond (90% of final value) to any step changes in measured parameter in the process stream within 30 seconds.

6.2.9.4 Physical specifications

As per general requirements clause 6.2.2

6.2.9.5 Installation specifications

- the analyser and its sensor must be located so as to be easily accessible for calibration and maintenance
- sample lines must be large enough and maintain a sample flow velocity high enough to minimise plugging
- a sample valve should be provided near to the sensor for sample collection for calibration checks
- locate sample line taps where air bubbles are less likely to be present. Alternatively, bubble traps should be installed in the sample line.

6.2.10 Suspended solids analysers

6.2.10.1 General

This specification applies to on-line analysers for the measurement of suspended solids concentration in sewage treatment plants. The analyser must generally consist of a sampling system (where required), a sensor and an electronic transmitter which converts and transmits the sensor signal to a remote location.

The equipment must comply with the general specification clause 6.2.2 and the following:-

6.2.10.2 Functional specification

a) service

The analyser must measure the concentration of suspended solids in sewage treatment plants as identified by the purchaser in the specific instrument data sheet.

b) units of measurement

Concentration of suspended solids is defined as the mass of dry filterable solids in a solution and is expressed as milligrams of solids per litre of solution (mg/l).

c) range

The analysers must be available for the following measurement ranges:

- sewage final effluent: 0-100 mg/l
- settled sewage: 0-1,000 mg/l
- mixed liquor: 0-10,000 mg/l.

d) measurement technique

The analyser must be based on well proven optical absorption or scatter technique for on-line sewage applications. The measurement must not be affected by ambient light, colour of the sample and aging of the sensor components.

6.2.10.3 Performance specifications

a) accuracy

Accuracy of the analyser must be better than ± 5% of the measurement span.

b) repeatability

Repeatability must be better than ± 2.5% of the measurement span.

c) response time

The analyser must respond (90% of final value) to any step changes in measured parameter in the process stream within 30 seconds.

6.2.10.4 Physical specifications

It must be equipped with air, water or ultrasound cleaning and must comply with the requirements in general specification clause 6.2.2.

6.2.10.5 Installation specification

- the analyser and its sensor must be located so as to be easily accessible for calibration and maintenance
- sample lines must be large enough and maintain a sample flow velocity high enough to minimise plugging
- a sample valve should be provided near to the sensor for sample collection for calibration checks
- locate sample line taps where air bubbles are less likely to be present. Alternatively, bubble traps should be installed in the sample line.

6.2.11 Sludge density analysers

6.2.11.1 General

This specification applies to on-line analysers for the measurement of sludge density in sewage treatment plants. The analyser must generally consist of a sampling system (where required), a sensor and an electronic transmitter which converts and transmits the sensor signal to a remote location.

The equipment must comply with the general specification clause 6.2.2 and the following:-

6.2.11.2 Functional specification

a) service

The analyser must measure the sludge density in sewage treatment process streams as identified by the purchaser in the specific instrument data sheet.

b) units of measurement

Sludge density is defined as the mass of dry solids minus the mass of dissolved solids in a given volume of solution and is expressed as percentage of dry solids in a solution (%).

c) range

The analysers must be available for the following measurement ranges:

- primary de-sludging: 0-5%

- secondary de-sludging: 0-5%
- sludge thickening and de-watering: 0-15%.

d) measurement technique

The analyser must be based on microwave phase shift technology or ultrasonic technology for on-line sewage applications. The measurement must not be adversely affected by temperature, ambient light, colour of the sample or aging of sensor components.

6.2.11.3 Performance specifications

a) accuracy

Accuracy of the analyser must be better than ± 5% of the measurement span.

b) repeatability

Repeatability must be better than ± 2.5% of the measurement span.

c) response time

The analyser must respond (90% of final value) to any step changes in measured parameter in the process stream within 30 seconds.

6.2.11.4 Physical specification

- the sensor probe must be of insertion type construction suitable for quick installation and removal from process pipelines without the need to stop the process flow
- the probe construction must enable on-line flushing of the sensor with clean water.

6.2.11.5 Installation specification

- the analyser and its sensor must be located so as to be easily accessible for calibration and maintenance
- mount the sensor on the sides of horizontal pipe runs, to avoid air bubbles at the top and or grit deposits at the bottom
- a sample valve should be provided near to the sensor for sample collection for calibration checks.

6.2.12 Sludge blanket level analysers

6.2.12.1 General

This specification applies to on-line analysers for the measurement of sludge blanket level (SBL) in sewage treatment plants. The analyser must generally consist of a sensor and an electronic transmitter that converts and transmits the sensor signal to a remote location.

The equipment must comply with the general specification clause 6.2.2 and the following:-

6.2.12.2 Functional specification

a) service

The analyser must measure the sludge blanket level in sewage treatment plants as identified by the purchaser in the specific instrument data sheet.

b) units of measurement

The analyser must indicate the height of the top of the sludge blanket from the bottom of the tank in meters (m).

c) range

The analyser must be available for 0.2 meters to 6.0 meters measurement range.

d) measurement technique

The analyser must be based on ultrasonic level measurement technique for on-line water and sewage applications. It must comprise of a fixed ultrasonic transmitter-receiver that hangs in the top of the tank and monitors the ultrasonic waves reflected off the bottom of the tank to determine the SBL.

Instruments that track the SBL by winching a sensor into the sludge are not acceptable.

Ultrasonic level measurement technique may sometimes not be suitable for primary settling tank SBL detection due to poorly defined blanket. The supplier may propose suitable alternatives such as multiple (usually 2 or 3) optical suspended solids sensors hanging in the tank at predetermined depths for those applications.

6.2.12.3 Performance specifications

a) accuracy

Accuracy of the analyser must be better than ± 5% of the measurement span.

b) repeatability

Repeatability must be better than ± 2.5% of the measurement span.

c) response time

The analyser must respond (90% of final value) to any step changes in measured parameter in the process stream within 5 minutes.

6.2.12.4 Physical specification

- the sensor must be suitable for continuously submerged operation in clarifiers and must be designed to discourage deposits and biological growth on its surface.
- the sensor design must be suitable for use in tanks with rotating scrapers without the need for any external arrangements to prevent the sensor from becoming entangled with the rotating scraper.
- the sensor must optionally be provided with auto-cleaning mechanism with user programmable cleaning interval.

6.2.12.5 Installation specification

- clarifiers with a fixed bridge and rotating skimmer should be provided with a swing-out sensor probe to prevent fouling with the rotating skimmer
- where the sensor is prone to biological growth and build-up, the sensor should be provided with auto-cleaning arrangement.

6.2.13 Total ammonia analyser

6.2.13.1 General

This specification applies to on-line analysers for the measurement of total (sum of ionised and unionised) ammonia concentration in water and sewage treatment plants. The analyser must generally consists of a sampling system, a means of cleaning the sample filtration system (where required), a sensor and an electronic transmitter which converts and transmits the sensor signal to a remote location.

The equipment must comply with the general specification clause 6.2.2 and the following:-

6.2.13.2 Functional specification

a) service

The analyser must measure the concentration of total ammonia in water and sewage treatment process streams as identified by the purchaser in the specific instrument data sheet.

b) units of measurement

Concentration of total ammonia must be measured in milligrams of ammoniacal nitrogen (NH3-N) per litre of solution (mg/l).

c) range

The analysers must be available for the following measurement ranges:

- water treatment applications 0-0.5 mg/l to 0-20 mg/l (NH3-N)
- sewage treatment applications 0-5.0 mg/l to 0-100 mg/l (NH3-N).

d) measurement technique

The analyser must be based on proven measurement technique including ion selective electrode (ISE) and colorimetric for on-line water and sewage applications. The measurement must be independent of the stated range of variations in temperature and constituents in the process/sample stream.

The supplier must state the principle of measurement employed by the analyser and any other technical details that may have an impact on its suitability and performance for the intended application.

6.2.13.3 Performance specifications

a) accuracy

Accuracy of the analyser must be better than the greater of ± 5.0% of the reading or ± 0.1mg/l .

b) repeatability

Repeatability must be better than the greater of ± 2.5% of the reading or ± 0.05 mg/l.

c) response time

The analyser must respond (90% of final value) to any step changes in measured parameter in the process stream within 5 minutes.

6.2.13.4 Physical specifications

As per general requirements clause 6.2.2.

6.2.13.5 Installation specifications

- the analyser should be installed inside a weather proof and ventilated area located close to the sampling point
- nutrient analysers usually require appropriate sample conditioning (e.g. dual micro-filtration), sample flow and pressure regulation and sample head tank. In additions, suitable arrangement should be made to back flush the filtration units
- some analysers also require clean water and instrument air supply in addition to AC mains supply
- suitable arrangement should be made for the disposal of analyser effluent which may contain hazardous chemicals.

6.2.14 Nitrate analyser

6.2.14.1 General

This specification applies to on-line analysers for the measurement of nitrate ion concentration in water and sewage treatment plants. The analyser must generally consist of a sampling system (where required), a sensor and an electronic transmitter which converts and transmits the sensor signal to a remote location.

The equipment must comply with the general specification clause 6.2.2 and the following:-

6.2.14.2 Functional specification

a) service

The analyser must measure the concentration of nitrate ions in water and sewage treatment process streams as identified by the purchaser in the specific instrument data sheet.

b) units of measurement

Concentration of nitrate ions must be expressed as milligrams of elemental nitrogen (NO3-N) per litre of solution (mg/l).

c) range

The analysers must be available for the following measurement ranges:

- water treatment applications 0-5 mg/l to 0-50 mg/l (NO3-N)
- sewage treatment applications 0-5 mg/l to 0-50 mg/l (NO3-N).

d) measurement technique

The analyser must be based on well proven measurement technique including ion selective electrode and ultra-violet absorption for on-line water and sewage applications. The measurement must be independent of the stated range of variations in temperature and constituents in the process/sample stream.

The supplier must state the principle of measurement employed by the analyser and any other technical details that may have an impact on its suitability and performance for the intended application.

6.2.14.3 Performance specifications

a) accuracy

Accuracy of the analyser must be better than the greater of ± 5.0% of the reading or ± 0.1mg/l .

b) repeatability

Repeatability must be better than the greater of ± 2.5% of the reading or ± 0.05 mg/l.

c) response time

The analyser must respond (90% of final value) to any step changes in measured parameter in the process stream within 3 minutes.

6.2.14.4 Physical specifications

As per general requirements clause 6.2.2

6.2.14.5 Installation specification

- the analysers may be either in-situ or ex-situ. If ex-situ, analyser should be installed inside a weather proof and ventilated area located close to the sampling point. In-situ sensors should be supplied with suitable hardware for installation in open basins and installed in a manner to enable easy maintenance. The transmitter should be as close as practicable to the sensor and protected by a weather shield.

- ex-situ nitrate analysers should be provided with appropriate sample conditioning (e.g. dual micro-filtration), sample flow and pressure regulation and sample head tank. In additions, suitable arrangement should be made to back flush the filtration units
- some analysers also require clean water and instrument air supply in addition to AC mains supply
- suitable arrangement should be made for the disposal of analyser effluent which may contain hazardous chemicals
- a self-cleaning system should be provided.

6.2.15 Phosphate analysers

6.2.15.1 General

This specification applies to ex-situ analysers for the measurement of phosphate ion concentration in water and sewage treatment plants. The analyser must generally consist of a sampling system, a cleaning/self-cleaning system for sample filter systems (where installed), a sensor and an electronic transmitter which converts and transmits the sensor signal to a remote location.

The equipment must comply with the general specification clause 6.2.2 and the following:-

6.2.15.2 Functional specification

a) service

The analyser must measure the concentration of phosphate ions in water and sewage treatment process streams as identified by the purchaser in the specific instrument data sheet.

b) units of measurement

Concentration of phosphate ions must be expressed as milligrams of elemental phosphorus (PO4-P) per litre of solution (mg/l).

c) range

The analysers must be available for the following measurement ranges:

- water treatment applications 0-5.0 mg/l to 0-25 mg/l (PO4-P)
- sewage treatment applications 0-5.0 mg/l to 0-25 mg/l (PO4-P).

d) measurement technique

The analyser must be based on well proven measurement technique including colorimetric analysis for on-line water and sewage applications. The measurement must be independent of the stated range of variations in temperature and constituents in the process/sample stream.

The supplier must state the principle of measurement employed by the analyser and any other technical details that may have an impact on its suitability and performance for the intended application.

6.2.15.3 Performance specification

a) accuracy

Accuracy of the analyser must be better than the greater of ± 5.0% of the reading or ± 0.1mg/l.

b) repeatability

Repeatability must be better than the greater of ± 2.5% of the reading or ± 0.05 mg/l.

c) response time

The analyser must respond (90% of final value) to any step changes in measured parameter in the process stream within 5 minutes.

6.2.15.4 Physical specifications

As per general requirements clause 6.2.2.

6.2.15.5 Installation specification

- the analyser should be installed inside a weather proof and ventilated area located close to the sampling point
- nutrient analysers usually require appropriate sample conditioning (e.g. dual micro-filtration), sample flow and pressure regulation and sample head tank. In additions, suitable arrangement should be made to back flush the filtration units
- some analysers also require clean water and instrument air supply in addition to AC mains supply
- suitable arrangement should be made for the disposal of analyser effluent which may contain hazardous chemicals.

6.2.16 Total organic carbon analyser

6.2.16.1 General

This specification applies to on-line analysers for the measurement of total organic carbon concentration in water and sewage treatment plants. The analyser must generally consist of a sampling system (where required), a sensor and an electronic transmitter which converts and transmits the sensor signal to a remote location.

The equipment must comply with the general specification clause 6.2.2 and the following:-

6.2.16.2 Functional specification

a) service

The analyser must measure the concentration of total organic carbon in water and sewage treatment process streams as identified by the purchaser in the specific instrument data sheet

b) units of measurement

Concentration of total organic carbon must be expressed as milligrams per litre of solution (mg/l)

c) range

The analysers must be available for the following measurement ranges:

- water treatment applications 0-20 mg/l
- sewage treatment applications 0-100 mg/l to 0-500 mg/l.

d) measurement technique

The analyser must be based on well proven measurement technique including non- destructive infra-red (NDIR) analysis for on-line water and sewage applications. The measurement must be independent of the stated range of variations in temperature, pH and other constituents in the process/sample stream.

The supplier must state the principle of measurement employed by the analyser and any other technical details that may have an impact on its suitability and performance for the intended application.

6.2.16.3 Performance specifications

a) accuracy

Accuracy of the analyser must be better than the greater of ± 5% of the reading or ± 0.2 mg/l

b) repeatability

Repeatability must be better than the greater of ± 2.5% of the reading or ± 0.1 mg/l.

c) response time

The analyser must respond (90% of final value) to any step changes in measured parameter in the process stream within 5 minutes.

6.2.16.4 Physical specifications

As per general requirements clause 6.2.2

6.2.16.5 Installation specification

- the analyser should be installed inside a weather proof and ventilated area located close to the sampling point.
- nutrient analysers usually require appropriate sample conditioning (e.g. dual micro-filtration), sample flow and pressure regulation and sample head tank. In additions, suitable arrangement should be made to back flush the filtration units.
- Some analysers also require clean water and instrument air supply in addition to AC mains supply
- suitable arrangement should be made for the disposal of analyser effluent which may contain hazardous chemicals.

6.2.17 Gas detection and alarming

6.2.17.1 General

This specification applies to the detection and alarming of flammable and toxic gases in water and sewage treatment plants using one or more field installed specific gas detector(s) and a centrally located gas alarm monitoring unit. This specification does not apply to portable/personal gas detection and alarming units.

The equipment must comply with the general specification clause 6.2.2 and the following:-

6.2.17.2 Functional specification

a) service

The specific gas detector(s) and gas alarm monitoring unit must be used for the detection and alarming of flammable and toxic gases likely to be present inside or outside of plant installations in water and sewage treatment plants. The toxic gases of interest are hydrogen sulphide (H2S) and chlorine (Cl2); flammable gas of interest is methane (CH4).

b) units of measurement

The units of measurement must be as follows:

- toxic gases- parts per million (ppm)
- flammable gases- percentage of lower explosive limit (%LEL).

c) range

The specific gas detectors must be available with suitable sensors to detect the presence of the gas over the following range:

- hydrogen sulphide (H2S) 0 to 100 ppm
- chlorine (Cl2) 0 to 10 ppm
- methane (CH4) 0 to 100% LEL.

d) measurement technique

The detectors must be based on well proven measurement technique to ensure continuous and reliable detection of the specific gas free from interference by other coexisting gases and/or vapours in water and waste water plant environment. The measuring cell must be a diffusion type (no sample draw), long life (2 to 3 years minimum) and maintenance free component. The measuring cell must be capable of recovering from short term signal over load without any permanent damage and within 30 minutes of return of signal to normal level.

e) specific gas detectors

The specific gas detectors must be self-contained and compact units suitable for indoor and outdoor installation. Hazardous area certified units must also be available where required.

The detector(s) must be powered from the alarm monitoring unit and must return a 4 to 20mA DC current signal to the alarm monitoring unit corresponding to the concentration of the specific gas.

f) alarm monitoring unit

The gas alarm monitoring unit must be a self-contained wall mountable unit capable of interfacing with remotely installed gas detector(s). The unit must be available in single and multi-channel versions to suit a variety of applications in the water and waste water plants. Multi-channel versions must be capable interfacing with both toxic and flammable gas detectors in any combination within the overall channel capacity of the unit.

The gas alarm monitoring unit must provide separate visual alarm indications for every channel and a common audible alarm to indicate the presence of high and very high levels of the monitored gas(es) in the field. The alarm limits must be user adjustable and must be provided with a variable time delay prior to activation of the alarm.

g) output signal

The output signal from gas detectors must be an electrically isolated 4 to 20mA DC current proportional to the concentration of the monitored gas. The output signal must be free of any unwanted ripple and noise and must be capable of driving a load up to 600 Ohms.

The gas alarm monitoring unit must, as an option, provide repeat outputs for the 4-20mA detector signals.

h) alarm and status indications

The gas monitoring unit must provide a visual indication of the operational status of the remote gas detectors and the monitoring unit hardware. Any hardware failure must be indicated via visual and audible alarms. In addition the unit must provide the following voltage free contact outputs (contacts open to alarm –failsafe):

- one high and one very high alarm contact output per channel
- one common gas alarm contact
- one common hardware failure alarm contact.

i) power supply

The gas monitoring unit must be designed to operate from ~~one of the following power source:~~

- ~~240V 50 Hz AC mains supply with a variation of ± 10%~~
- The specific gas detectors must be designed to operate from a 24V DC supply to be provided by the gas monitoring unit.

j) calibration

The gas detector design must allow manual calibration of its sensor in a simple and convenient manner. Preference must be given to designs that are based on pre-calibrated field replaceable sensors.

k) diagnostics

The gas monitoring unit and specific gas detectors must be provided with self-diagnostic features to detect and alarm hardware and sensor failure.

l) security

The gas monitoring unit must be protected against unauthorised calibration and configuration changes. The calibration and configuration data must be protected against loss due to power supply failure.

6.2.17.3 Performance specifications

a) accuracy

Overall accuracy of the specific gas detectors must be better than ± 5.0% of the span.

b) repeatability

Repeatability must be better than ± 2.5% of the span .

c) response time

The detectors must respond (90% of final value) to any step changes in monitored gas concentration within 30 seconds. This must include any delays introduced due to the type of enclosure.

d) stability

The instrument must meet its performance criteria continuously over a period of 6 months without the need for any manual adjustments.

e) availability

The instrument must operate continuously except when it is undergoing calibration or diagnostic checking. These operations must not significantly affect its availability. The overall availability must be better than 99%.

f) warm up time

Warm up time for a ‘cold-start’ (initial start-up or major repairs/overhauls) must be less than 30 minutes. For ‘warm-start’ (short interruptions in power supply) the warm up time must be less than 15 minutes.

6.2.17.4 Physical specifications

The equipment must comply with the general specification clause 6/2/2 and the following:-

a) ingress protection

The gas monitoring unit and specific gas detectors must be protected against the ingress of dust and moisture to a degree compatible with the intended location as below:

- indoor location IP54
- outdoor location IP54

b) materials of construction

The gas monitoring unit and specific gas detectors must be constructed from materials compatible with the sewage treatment plant environment, process fluids and chemical reagents they are likely to be in contact with. This must include any accidental spills and splashes.

c) modularity

The gas monitoring unit and specific gas detectors must be of modular construction and allow easy access to field replaceable components and calibration/configuration controls.

d) earthing and shielding

The gas monitoring unit and specific gas detectors construction and site installation must ensure protection against electric shock to personnel and interference from stray electrical and magnetic fields.

e) hazardous area installation

Detectors intended to be installed in a hazardous area (explosion hazard due to combustible gases) must be SAA certified for the applicable area classification and installed in accordance with the current Australian Standards.

6.2.17.5 Installation specifications

The equipment must comply with the general specification clause 6.2.2 and the following:

a) gas detector selection

The gas detector should be selected to suit the specific gas and the gas concentration level to be monitored.

The selected gas detector should be a robust, reliable, low maintenance and long life device in view its plant and personnel safety function.

b) gas detector installation

- install the gas detector at locations close to the likely source of the gas. However, it should not be installed in locations where it is likely to cause unnecessary and false alarms
- install the gas detector at a location where it can be in contact with freely moving mass of air as opposed to locations where the air mass is likely to be still. This is necessary because the gas detectors depend on diffusion of air sample into the measuring cell for proper measurement
- consider installing a redundant pair of detectors requiring high reliability
- the gas detectors and alarm monitoring unit should be wired and installed as self- contained independent system and powered from an un-interruptible power supply
- the gas alarm monitoring unit should be located in a central location and the external common alarm contact should be wired to the plant alarm system.

c) Commissioning

Commissioning crew should verify that all detectors have been correctly located and installed. All detectors should be tested with specific gas bottles after connection to the alarm monitoring unit to verify integrity of the equipment and its installation. An ongoing test regime should also be set up to ensure that the system is functional at all times.

Technical Specification

Part 7 – IICATS RTU Interface Requirements

7. IICATS RTU Interface Requirements

7.1 IICATS RTU

IICATS is an acronym for integrated instrumentation, control, automation and telemetry system. IICATS is used by SWC to remotely monitor and control the operation of its geographically distributed water and waste water assets on a systemic basis. IICATS encompasses instrumentation and control equipment, wide area communication network, site based remote terminal units (RTUs), work stations, and telemetry computers.

The main component of the IICATS system on the site is the remote terminal unit (RTU). It is the RTU which monitors and controls the site and communicates site information to the telemetry system.

SWC IACS group must supply the RTU(s) and modem. Refer to the 'SWC supplied items' or 'Principal supplied items' in the site-specific instrumentation and control standards for details.

There are two types of RTUs used for IICATS system. One type is for critical assets require continuous monitoring and control of the assets such as SPSs and WPSs. Another one is designed for battery-powered operation and used for the monitoring-only sites such as WG and WF sites.

7.2 Standard IICATS RTU hardware for continuous monitoring and control of the IICATS assets

7.2.1 General

A standard model RTU which monitors as well as controls the site is mode up of cards, or modules. A full RTU has 8 cards with a communications card, power supply card, CPU card and five (5) I/O cards. The full I/O count includes 32 digital inputs (channels per common: 8), 16 relay outputs (3 terminal connections: NO/common/NC), 12 isolated analogue inputs and 4 isolated analogue outputs. It is suitable for the majority of water and wastewater standard sites to meet the requirements of telemetry and control applications. RTU digital inputs are current sink type with shared common input configuration and digital inputs 7, 8, 15, 16, 23, 24, 31 and 32 can be utilised as high speed counter inputs. Standard digital input configuration for the RTU must be via voltage free contacts. Where additional I/O is required additional expansion RTUs, with the same I/O configuration, are used and connected by an I/O expansion cable. This RTU is a compact unit which is approximately 120mm high x 200mm wide x 100mm deep. Additional space is required for cable bending radius and labels.

The typical components of the standard IICATS RTU for continuous monitoring and control of assets on site consist of the following items:

- RTU(s)
- 24V DC power supply unit with back up batteries
- external modem
- serial cable from RTU to modem
- power cable from RTU to modem
- antenna for wireless communications.

Refer to 'Part 8- Telecommunications' of this manual for technical details and to site-specific instrumentation and control standards for the selection of the type of communication link for standard sites.

The IICATS RTU, all RTU digital and analogue inputs and modem must be supplied by the 24V DC battery backed power supply unit installed in the RTU cubicle.

The Contractor must provide PSUs that comply with the requirements outlined in ‘Part 4; clause 4.4-Power supplies, 24V DC power supply/battery chargers’ of this manual.

The Contractor must ensure a minimum of 8 hrs battery backup is provided for all stations, with a minimum of two (2) 20Ah back up batteries on each PSU, whichever will provide the longest back-up time must be provided.

The RTU software and configuration is provided by SWC, Operational Technology. OT must be engaged at the beginning of each project to enable budget estimate and the scope of work to develop software and system configuration.

7.2.2 RTU Cubicle

A floor mounted RTU/marshalling cubicle must be installed to house RTU(s), surge protection units, power supply unit(s), RTU terminals, marshalling terminals and changeover terminals (if applicable) and telemetry interface equipment. Each RTU cubicle must be provided with at least 20% spare space for future use. The RTU cubicle must have enough space to install an additional RTU and its full set of terminal blocks (A&B) for the majority of IICATS applications (refer to sample control panel layout drawing SSD82). Contact OT for additional RTU space requirements for future upgrades.

RTU cubicles must consist of two compartments; one section is for extra low voltage powered equipment such as RTU/PLC and the other one is for 230V AC powered equipment such as 24V DC power supply units, SPUs and a load centre. The compartments must be separated via an insulated and perforated material.

230V AC powered electrical equipment such as switches, display units including terminals must not be installed on the cubicle door.

All 230V AC equipment including RTU/PLC DC power supply units must be powered through discrete RCBO circuit breakers.

General power socket-outlets (GPO) in the cubicle must be protected by a RCBO device.

RTUs must be mounted on steel, galvanised 35mm x 7.5mm slotted DIN rail. Refer to ‘Part 3-Control cubicles and enclosures’ of this manual for control cubicle design and construction details.

7.2.3 RTU Wiring

The RTU I/O must be interfaced to the field I/O via knife-disconnect terminals, which have socket screw for test plugs. All spare RTU digital inputs and outputs, analogue inputs and outputs must be wired to the knife disconnect terminals unless specified otherwise. RTU I/O must be terminated on the left-hand side of the terminals, field wiring must be terminated on the right-hand side (when looking at the terminals and standing in front of the RTU cubicle). Wiring must enter the terminals from the adjacent duct work, no under wrapping of terminal blocks will be accepted.

All 0.5mm^2 RTU wiring must be flexible cable with minimum 0.6/1kV PVC V90 0.8 mm thick insulation and cable stranding 16/0.2 (number/mm):

- All digital input signals including commons between knife-disconnect terminals and the RTU are to be wired using 0.5mm^2 250V tinned, grey coloured cable.
- All digital output signals between knife-disconnect terminals and the RTU are to be wired using 0.5mm^2 250V tinned, grey coloured cable.
- Each individual analogue signal between knife-disconnect terminals and the RTU are to be wired using 0.5mm^2 250V tinned, white/black twisted pair.

The wiring identification system between knife disconnect terminals and RTU I/O must consist of input/output numbers with wire identifier (e.g. AI-006(+), AI-006(-), DI-001, DO-001-1, DO0001-2, AO(+), AO(-) etc.). Wire number 1 always starts at the 24V DC fused terminal for DOs and at the RTU (+) terminal for DIs. Ferrules must be visible from cubicle access point.

Wire number labels must be laser printed with black text on a white tube. The tube internal diameter must be matched to the OD of the cable so they do not slide on the cable in the installation conditions. For pin number orientation and loom binding details refer to Appendix 1, 'Drawing SSD101- RTU I/O cabling'.

7.3 Battery powered IICATS RTU for monitor-only IICATS assets

7.3.1 General

Another type of IICATS RTU designed for battery-powered operation has been chosen by SWC to meet an economical specific monitor-only need. Their main function is to monitor water pressures, levels and flows in the pressure-reduced zones. They are also used to monitor some sewer mains to detect/prevent dry weather overflows.

The benefit of this product lies mainly with the fact there is no need for mains power or any telemetry line. The key functions of this RTU are:

- currently operates utilising a mobile network to connect to the IICATS servers via internal antenna or optional external antenna
- has internal lithium battery pack with a battery life in excess of five (5) years if it calls in IICATS server once per day. The battery pack not only runs itself but also provides loop power for 4-20mA transmitters and all other RTU inputs
- accepts an external supply between 5V DC to 8V DC for some special applications due to particular monitoring frequency requirements e.g. continuous 15min. monitoring and reporting
- IP 68 enclosure suitable for submersion to 4m for 4 days
- internal submersion sensor to detect when the unit is submerged under water
- up to 5 programmable external I/O channels (note: refer the site- specific instrumentation and control standards for I/O configuration details).

For battery powered RTU sites the instrument transmitter and RTU must be installed in a single turret. The turrets must comply with part 7.3.2 of this specification. All cable entries to the instrument transmitter, and to the other equipment, must be protected to IP68 rating 2m for a minimum of 4 days.

Mains power supply, and associated monitoring, and site access door or entry monitoring are not required for battery powered RTU sites.

7.3.2 Turrets

Turrets must only be used for battery powered IP68 RTUs. Turrets must be HDPE (High Density Polyethylene) type plastic or fibreglass polyester resin. Turrets must be fire retardant and UV stabilised, or with UV stabilised gel coating, and designed for continuous outdoor exposure. Turrets must be minimum 760H x 450W x 330D mm, vented with a single lockable door and a minimum IP44 rating. Turret colour must be environmental green.

Turrets must be mounted on a matching base made of the same material and colour as the turret. The base must be a minimum 310H x 565W x 335D mm with minimum opening of 450W x 250D mm. The base must be secured by a 200H x 1000W x 750D mm concrete plinth grade N32 and tied to the base with at least 2 N12 ties LAP 300 on each side. The plinth must be level and protrude 50mm above the finished ground level and finish at the shoulder of the base. It must allow unobstructed access to the connection between the base and turret for removing and securing the turret to the base. (Refer to sample drawing sets for details). The finished surface level of the plinth must be 300mm above the 1% AEP flood level.

Turrets must be legibly and permanently labelled on the cover to distinguish them from other services. A 316 stainless steel plaque with the following information and layout must be permanently attached to the side of the turret. It must not be attached to the door.

SYDNEY WATER WFXXXX LOCATION NAME FLOWMETER RL

(*Use the appropriate asset code as required)

The turret must be lockable with a Sydney Water Bilock as per Sydney Water Security keys & locks document D0000688. The locking system must be easily unlockable for maintenance and must tolerate sand and mud.

All areas in the turret are classified as a wet area and are subject to a high level of corrosion. 316 stainless steel or other authorised corrosion resistant products of the same material must be used for all supports and fasteners.

Conduits entering turrets must be filed smooth to eliminate damage to cables during cable pull. All gaps around the conduit entry to the turret must be sealed. External conduits and above ground conduits subject to the possibility of damage must be mechanically protected.

All equipment in turrets must be mounted on a corrosion resistant non-metallic panel such as a polycarbonate sheet with a minimum of 10mm thickness and positioned such that it is easily detachable and readily accessible for operation, inspection, replacement, modification and maintenance.

All equipment must be positioned and mounted to allow bottom entry of cables. All cables must be arranged in a neat appearance and such a way that damages to the cable and sockets are prevented. Cables must not be bent in a radius less than 12 times of their outside diameter.

7.3.3 Specific application requirements

For specific application requirements for battery RTUs refer to the relevant IICATS Standalone Stations Instrumentation and Control Standards:

- HSS0005 Flow Monitoring Station Standards TOG_TS05
- HSS0006 Potable Water Pressure Monitoring Station Standards TOG_TS04
- HSS0004 Sewer Odour and Corrosion Control Standards TOG_TS08

Part 8 – Telecommunications

8. Telecommunications

8.1 General

All Data and telecommunications cabling, equipment and installation work must comply with the latest version of Australian Communications and Media Authority (ACMA) Technical Standards AS/CA, AS/CA S003, AS/CA S008, , AS/CA S009, AS/NZS1768, AS/NZS 3835.1 and AS/NZS 3835.2. Installation work must be carried out by, or supervised by, an ACMA registered cabler.

The Contractor must design, supply and install telecommunications equipment as listed in the Scopes of Work and as specified within this standard.

SWC utilises a range of telecommunications technologies for Telemetry or SCADA applications. The selection of a particular technology depends on a range of criteria including criticality of site, lifecycle cost, poll frequency and functionality. The contractor must seek direction from Sydney Water as to the type of telecommunications technology that will be used to connect the SWC facility equipment to a SWC Telemetry or SCADA network.

Technology solutions available to provide this connectivity include:

- Telstra Remote Telemetry (TRT) via an integral 4G wireless primary interface with a diverse 4G secondary media interface (where dual media is required);
- Telstra Remote Telemetry (TRT) via an integral 4G wireless primary interface and a Telstra provided Satellite backup service using a Telstra provided satellite unit and antenna. This option applies where dual media is required where CPE is within an EPR zones or carrier infrastructure for wireline primary media cannot be provisioned.
- 4G Wireless Cellular Packet Data via carrier cellular wireless infrastructure;
- Fibre LAN– within plant or asset boundaries;
- Fibre WAN Telemetry services when viable carrier product offerings become available;
- Legacy TRT ADSL(for upgrades to existing assets);
- Radio (Serial and LAN within plant or asset boundaries);
- Satellite TRT (either as single primary media where alternate options are unavailable).

Only Sydney Water must make application to the Carrier for new telecommunication services or cancellation of existing services. Installation and termination of lead in cables for new services, or for relocation of existing services, must be performed by the Carrier. Completion of this scope of work is the responsibility of the contractor.

Where a single media TRT Wireless/satellite, dual media TRT Wireless/Wireless or Non-TRT Wireless 4G Cellular packet data solution is stipulated, in accordance with the Scope of Work for each site the Contractor must install:

- Contractor supplied, SWC specified antenna.
- SWC issued TRT modem or Wireless 4G Cellular modem, power lead and RTU serial cable.
- SWC issued TRT Satellite modem, antenna and lead-in cable.

Where a Fibre or Copper solution is stipulated, in accordance with the Scope of Work for each site the Contractor must:

- Supply and install on site the required Carrier specific conduits and pits
- Seek direction from Sydney Water as to the type of carrier service to be installed
- Determine the earth potential rise (EPR) status of the CPE modem socket, distributor, pits and conduit locations

- Ensure that where technically feasible the distributor, lead-in cable, CPE socket and CPE socket to distributor cabling are completely located outside the EPR zone in order to avoid the need for an EPR isolation solution. (CPE – customer premises equipment)
- Perform detail design and installation of an appropriate Telecommunication Distributor where wireline services are required
- Perform installation of appropriate Satellite antenna mount in accordance with requirement in section 8.9.5 where an EPR zone or lack of carrier infrastructure prevents wireline service installation;
- Supply and install on site all other required telecommunication cabling
- Complete a Telecommunications Record Book for each Copper or Fibre Distributor.

Sample distributor and telecommunications cable lead-in conduit layout drawings must be provided to the contractor by Sydney Water. These sample drawings must provide necessary detail on SWC requirements for:

- Enclosure layout and dimensions;
- Conduit spacing;
- Other requisite design implementation content.

The provision of these sample drawings must not relieve the Contractor of the responsibility for the correctness and standards compliance of any implemented design.

8.2 Distributors

8.2.1 General

Where copper-based telecommunications services are to be hosted, a new main distribution frame (MDF) or other distributor must be provided at each site in a location specified in the Scope of Work for the respective site.

The MDF or other distributor must include a distribution frame, generally Krone 10 pair type 6455 1 042-00 for copper telecommunication services, using insulation displacement contact modules, complete with arrestor magazine including ten arrestors, one for each position on the magazine as specified in Drawing SSD/110 – MDF General Arrangement.

The MDF or other distributor must be installed in compliance with AS/ACIF S009, Section 12 – "Distributors".

All cabling connected to the ‘A’ and ‘B’ side of a distribution frame (MDF or other distributor) must be protected and isolated from hazardous voltages and interference in accordance with AS/ACIF Standards.

Where a copper services distributor is at an EPR zone boundary or falls within an EPR zone, an alternative AS/NZS 3835: 2006 certified distributor design is required to be installed to ensure appropriate isolation of the carrier network and protection of personnel maintaining the distributor. Refer to ‘clause 8.7-Earth Potential Rise’ for details.

All distributors must be provided with earthing that complies with the requirements detailed in section 8.6.

8.2.2 Distributors

8.2.2.1 Distributor Hierarchy

An MDF is the first distributor within a building, structure or kiosk. The MDF may form the network boundary if the building, structure or kiosk is the only distributor between the device and the carrier network. If an additional distributor is present between an MDF and the network boundary, then the MDF that connects to the carrier network must be known as the Site MDF and forms the Carrier-SWC network boundary. The carrier may refer to this distributor as the Designated Distributor.

8.2.2.2 Distributor Types

A Main Distribution Frame (MDF) must be established when there is no existing MDF at a site, and a connection to one or many communications devices is required.

An MDF may be established as:

<u>Internal to an existing structure:</u> Service is located away from the network boundary where internal building access is available to the carrier at the Network Boundary.

<u>External to an existing structure or kiosk:</u> Service is located away from the network boundary where external building access or kiosk access is available to the carrier at the Network Boundary.

An existing MDF may be utilised provided that it meets or exceeds the specifications for equipment clearance, weather protection, ventilation and security for:

- Internal MDFs as per drawing SSD110 for external distributors and the requirements detailed in section 8.2.1.
- External MDF as per the requirements of section 8.2.1.

An external type is the preferred distributor type due to the normally improved access this configuration provides for service provision and maintenance.

<u>Free Standing:</u> Free standing may be used where:

- Services are to be located within a heritage building where an external frame is not permissible;
- The network boundary located away from outdoor kiosk and no suitable building exists near the network boundary;
- There is a requirement to place an MDF outside an EPR zone or away from nearby equipment or structures for the purposes of housing EPR isolation equipment. (Refer to clause 8.7 Earth Potential Rise).

8.2.2.3 Establishment of additional Distributors

Where a telecommunications device within a building is required to be located more than 10 metres from an existing distributor, a new distributor must be required to be established. This distributor must be located adjacent to the telecommunications device.

8.2.3 Distributor Enclosures (non-HV Isolation Type)

<u>Distributor – Outdoor Kiosk</u>

The distributor must be housed within an enclosure that forms part of the outdoor kiosk with degree of protection not less than IP56. Enclosure must be constructed of the same material as the kiosk itself to prevent dissimilar metal corrosion. The kiosk Distributor must be externally accessible and secured using a Selectrix 1107SSSU3-45 swing handle lock fitted with a Stainless-steel Krone L331 “Profile” style lock barrel. Two keys must be provided per lock. Selectrix type swing handle lock must secure the door at 3 (three) locations (top, centre and bottom) as per drawing SSD110 MDF General Arrangement

<u>Distributor for External Enclosure on Building or Structure</u>

The Distributor must be housed within a stainless-steel enclosure of protection not less than IP56. Enclosure must be made of 2 mm 316 stainless steel.

The Distributor enclosure must be fitted with a Selectrix 1107SSSU3-45 swing handle lock fitted with a Stainless-steel Krone L331 “Profile” style lock barrel. Two keys must be provided per lock. Selectrix type swing handle lock must secure the door at 3 (three) locations (top, centre and bottom) as per drawing SSD110 MDF General Arrangement.

Distributor Minimum Clearances

The minimum clearances to be provided around the terminations inside the Distributor enclosure and the enclosure construction must comply with AS/CA S008 Item 5.4.1 "Common Requirements", AS/CA S009, Section 13 "Main Distribution Frame" and AS/CA S009 Appendix D "Recommended access clearances for MDFs and NTDs" with the exception of the Distributor enclosure height above the floor/ground surface.

The minimum clearance to the underside of a distributor enclosure above the floor/ground surface must be 1200mm (refer to drawing SSD111) unless:

- A different dimension is specified in an HSS standards drawing
- Dispensation is given in writing by an authorised HSS representative.

8.2.4 Distributor Enclosures – EPR HV Isolation Type

Sydney Water no longer permits installation of new copper communications services within an EPR zone. This information covers the maintenance or upgrading of assets with existing copper services with an existing EPR isolator or that require installation of an EPR isolator to make safe an existing copper communication service.

Where a copper telecommunications service is to be terminated within an EPR zone the Contractor must implement an appropriate distributor design that meets SWC requirements and complies with relevant Australian Standard (Refer to 'clause 8.7- Earth Potential Rise' for details).

For details on construction and location of 'EPR HV Isolation Type Distributors' refer to clause 8.7.2 'EPR Distributors'.

8.3 Cabling

8.3.1 General

Telecommunication multi-pair cables (defined by terminating at a distributor) must be circular section, with twisted pairs formed from cores of a single copper conductor of minimum diameter of 0.64 mm and with each pair a different colour. Cables installed within buildings must be PVC insulated and sheathed. Cables installed external to a building must be Polyethylene insulated and sheathed. Underground cables must be grease filled, black medium density Polyethylene insulated and sheathed. Cables must comply with

- AS/ACIF S009 Section 16 "Indoor Cabling",
- AS/ACIF S009 Section 17 "Outdoor cabling",
- AS/ACIF S009 Section 18 "Underground cabling",
- AS/ACIF S009 Section 19 "Aerial cabling"

All telecommunication conduits must be white colour. Exposed conduit external to structures must be protected with a bolted in place galvanised steel cover of minimum 1.5mm in thickness and protection must start from 300 mm below ground and be continuous to the underside of the distributor. For overhead lead-in cabling, where specified, the method of protection must be compliant with Carrier's regulations and must be agreed on by Sydney Water.

The conduit and pit system must be complete with draw wires and possess sealing to prevent ingress of soil or water. The conduit and pit system must be equipped with provision for drainage to permit the egress of any water that does enter the pit & conduit system. Materials and installation must comply with AS/CA S009 Section 18 – "Underground Cabling", AS/CA S008 Section 5.3 "Underground Conduit" and AS/CA S008 Section 5.8 "Cabling Products for Underground and Aerial Installation".

8.3.2 Lead-in Cabling

Lead-in cabling denotes the Carriers cables from the Carrier's Customer Access Network (CAN) to the Network Boundary at the customer's property.

The “Network Boundary” is the ‘A’ side of the site distributor that terminates the lead-in cable from the Carrier’s network.

The Carrier’s lead-in cable enters SWC property via a ‘property or development boundary pit’ located on the SWC property side of the boundary between SWC property and a public place (footpath or other place). The lead-in cable traverses from the public place into SWC property or easement via this pit and terminates on a distributor located on the SWC property or easement. Refer to drawing SSD/111 for details.

The Contractor must provide trenching, pits, conduit and draw wire between the distributor and the property or development boundary. The Carrier will utilise this contractor provided trenching and conduit to install the lead-in cable to the ‘Network Boundary’ distributor. It is the responsibility of the Carrier to provide trenching, conduit and pits from the public place into the ‘property or development boundary pit’.

Lead-in cabling always remains the responsibility of the Carrier. All telecommunications cabling from the ‘B’ side of the Distributor that forms the Network Boundary is the responsibility of SWC.

The Contractor must:

I. Provide trenching for the Carrier’s lead-in conduit and pit(s) between the “property or development boundary” pit and the Network Boundary Distributor ‘A’ side. Trenching by the Contractor must be carried out in accordance with the Siteworks Scope of Work; The location of the “property or development boundary” pit and ‘Network Boundary Distributor’ must be agreed between the carrier and the authorised Sydney Water representative and must be defined in the Scope of Work;

II. Provide conduits, pit(s), cable, draw cord and materials as defined in the Scope of Work (Note: All installation work must be carried out in accordance with drawing SSD/111 requirements);

III. Provide trenching between the property boundary and the ‘Network Boundary’ distributor in accordance with the Scope of Work.

IV. Provide all telecommunications cabling as defined in the Scope of Work (Note: Sydney Water require all telecommunication cable to be underground unless written dispensation is provided from an authorised OT representative. Where the carrier service is provided via aerial cabling the SWC lead-in cable must be underground to the new demarcation pit located at the base of carrier’s pole. Refer to drawing SSD/111).

V. Make application to the Principal for a new service after the lead-in conduit and pit installation to the site boundary has been completed.

The Carrier may, without notice, inspect the prepared trench and witness backfilling of the trench by the Contractor.

The Contractor must advise SWC prior to backfilling to allow the SWCs Representative an opportunity to inspect the prepared trench and witness backfilling of the trench by the Contractor.

8.3.3 Ethernet LAN Cabling

Copper UTP Ethernet LAN cables used to connect devices within equipment rooms must be minimum 1000-BASE-T shielded Category 6 (EIA/TIA Class 6-1000 MHz) cables. Standard RJ-45 quick connectors, for use with shielded cables, must be provided to connect to LAN resident devices. RJ-45 connectors must meet minimum EIA/TIA Class 6 (1000 MHz) characteristics. Solid conductor cable is to be used for all cabling run from socket to socket, or patch panel to socket. Patch cables between equipment and the socket or patch panel must use stranded conductor cable and must utilise terminations designed for use with stranded conductor cable cores only. Patch cables must not be used to connect equipment in different rooms or areas.

8.3.4 Fibre Optic LAN Cabling

Fibre optic telecommunication cable installed within a SWC facility that is not a Carrier lead-in cable must meet the following requirements:

Multimode (MM) fibre requirements

a) Fibre type... OM1 or OM3/OM4 Multimode, graded index

b) Material.. ....Glass

c) Core diameter…………62.5microns at existing OM1 62.5micron fibre equipped sites

.... 50 micron at OM3/4 equipped sites

d) Cladding diameter...125 microns

e) Minimum number of fibres .... Treatment Plants – 24

.... All other applications – 12

f) Minimum Number of spare fibres... 4

g) Strain Bearing/central strength member.......................Non-metallic, Semi-rigid type

h) Durable impact, crush, vermin (rodent and termite) resistant cable with UV resistant outer sheath

i) Conductive elements ....All non-metallic construction

Where Multi-Mode fibre equipment to be used is capable of distances exceeding 2 km, segments of Multi-Mode cable may exceed 2 km provided written approval by OTS is provided. Equipment, cable and segment length data must be provided to OTS to allow an appropriate technical assessment to be made.

Where no pre-existing OM1 62.5um fibre-optic cable is present within a SWC facility the contractor may utilise 50um OM3/OM4 fibre optic cable in place of 62.5um OM1 fibre optic cable. All Fibre optic distributors terminating 50um fibre must be labelled as such in clear and durable manner specifying which cable positions are 50um terminations.

A detailed site audit must be undertaken to determine the presence of any existing 62.5-micron fibre before installation of 50-micron fibre at an asset is permitted.

Where a cable has an optional abrasion resistance sheath this should be used for any cable used in underground pits, trenches, or conduits to protect against potential abrasion of the outer vermin (rodent and termite) resistance layer.

Single mode (SM) fibre requirements

a) Fibre type... OS2 loose tube Single mode core

b) Material.. ....Glass

c) Core diameter .... 9 microns

d) Cladding diameter...125 microns

j) Minimum number of fibres .... Treatment Plants – 24

.... All other applications – 12

e) Minimum Number of spare fibres... 4

f) Strain Bearing Non-metallic member ....Semi-rigid type, Required

g) Durable impact, crush, vermin (rodent and termite) resistant cable with UV resistant outer sheath

k) Conductive elements .... All non-metallic construction

h) 1310nm wavelength active devices must be utilised where possible to ensure compatibility and wider availability of spares & hardware devices.

The detailed specification for the fibre cable must require that the cable be suitable for installation in conduit that is permanently flooded with dirty water. Spare fibres in each cable must be specified to provide an adequate number of spare fibres should a fibre fail in operation.

Where a cable has an optional abrasion resistance sheath this should be used for any cable used in underground pits, trenches, or conduits to protect against potential abrasion of the outer vermin (termite) resistance layer.

Fibre type selection

Fibre type selection for Treatment Plant applications must be as specified in the Treatment Plant SCADA Standards.

For all other applications SM fibre should be used for new installations. SM fibre must be used for installations where individual segments exceed 2 km @ 100mbps or exceed 500m@1Gbps.

Mixing Single Mode and Multimode at a single asset/installation

Where a site with existing multimode fibre has a requirement for a segment of link budget longer than 2km@100Mbps or a link of greater than 500m link budget at 1gbps or faster, installation of a Single Mode (OS2) fibre optic segment is permitted with the following restrictions:

a) Single mode fibre must be installed on separate patch panels (or separate panel Mini-fobot) to any existing Multimode fibre

b) The separate mini-fobot or patch panel is clearly labelled “Single Mode fibre 9/125um”

c) The patch panel must use Duplex LC sockets (to differentiate from Multimode SC or ST in use on site)

d) Patch leads must be yellow in colour Duplex LC of OS1/OS2 9/125um type.

e) Dark Blue - Bale clasp single mode (SM) DUPLEX SFP must be utilised (1310nm wavelength) in core switches and other pluggable fibre module devices.

f) 1310nm SM devices should be utilised where possible to ensure compatibility with existing devices and to ensure greater availability of spares and available devices options.

8.3.4.1 Termination of Fibre Optic Cables

Fibre cables must be terminated in fibre distribution panels;

1. To simplify the testing of fibre;
2. Allow equipment to be isolated;
3. To readily take advantage of spare fibres;
4. To protect core terminations;
5. Provide strain relief for fibre trunk/cores.

All Multimode fibre must be terminated with SC Female type connectors to allow quick connection of spares for maintenance purposes in the event of a fibre failure. Where existing or legacy installations, or specific equipment, requires the use of ST type connections trunks must be terminated as ST with an appropriate patch lead to adapt to connected equipment utilised.

All single mode fibre (SM) must be terminated with Duplex LC Female type connections

8.3.4.2 Fibre Optic cable and Termination Hardware

All Fibre Optic cable, terminations and patch panels must comply with the optical and mechanical performance characteristics detailed in ISO/IEC 11801.

In particular:

I) Fibre must meet the requirements outlines in ISO/IEC 11801 Section 9.4 "Fibre Optic Cables";

II) Terminations on fibre tails and within patch panels must comply with ISO/IEC 11801 Section 10.3 "optical fibre connecting hardware".

8.3.4.3 Testing of Fibre Optic Cables and Termination

Testing of fibre optic cable and terminations must be carried out in accordance with IEC/ISO 14763-3. Testing must be performed and results provided with reference to-:

- Continuity of the optic fibre within a cable or link;
- The length of an optic fibre within a fibre or link;
- Propagation delay of the fibre or link;
- The distances between the installed components such as embedded connecting hardware;
- The attenuation of a fibre or link.

8.3.4.3.1 Link Attenuation

The specific attenuation of each installed link is based upon the type and quantity of connecting hardware components and the type and length of optical fibre cable installed.

The measured values of attenuation should not exceed the sum of allowable attenuation as specified in ISO/IEC 11801, of each component of the link.

8.3.4.3.2 Propagation Delay

ISO/IEC 11801 specifies a maximum propagation delay for a given type of cable. The propagation delay of any cable installed must not exceed the recommended delay.

8.3.4.4 Test Methods

Prior to testing all connector faces must be cleaned in accordance with manufacturer instructions prior to mating. The use of temporary index matching materials (gels and/or fluids) in mated connectors under test is not permitted where the introduction of such materials may invalidate any measurement or test result.

Optic fibres must be tested in the following manner:

I. Using a simple light source to determine continuity;

II. An optical power source and power meter combination or equipment providing the function of an optical time domain reflectometer (OTDR) operating at the relevant wavelength of the fibre.

For links containing a single connection at each end it is necessary for a measurement to be made from the direction of each individual termination. Where a link contains through patching/coupling bi-directional testing must be carried out for each segment that forms a part of that link.

8.3.4.5 Telecommunication Panels (Fibre Optic Distributor)

Telecommunication panels (Fibre Optic Distributor) must comply with AS/CA S009 Section 11 Optical fibre and coaxial systems and Section 12 Distributors.

Fibre Optic Distributors must:

- Be housed within an enclosure or cubicle;
- Contain a fibre patch panel with integral core strain relief provided;
- Have an appropriate Class 4 Laser Radiation warning labels fitted in accordance with AS NZS IEC 60825;
- Have all unused ports capped;
- Be mounted at a height of over 1900mm or below 1350mm with regards to ground level where the FOBOT (Fibre Optic Breakout Tray) or Patch Panel has outward facing ports, to ensure ports are installed outside adult human eye level. Where this cannot be achieved written approval from Sydney Water must be gained before mounting a fibre optic distributor with outward facing ports at a height that differs to the above.

The enclosure or cubicle housing the Fibre Optic Distributor must:

- Allow sufficient space for the installation of any Optical Network Terminator (ONT) device, Ethernet switches or Media converters required to be housed within the distributor enclosure;
- Allow sufficient space for the installation of any associated Ethernet UTP patch panel;
- Allow sufficient space for any power supply equipment and terminals required for the fibre optic equipment;
- Have all unused incoming fibre cores terminated with SC-SC style connector for MM fibre;
- Have all unused incoming fibre cores terminated with LC-LC (Duplex-LC) style connector for SM fibre
- Have a minimum of three (3) metres of coiled slack available in the nearest pit or tray adjacent to the entry point of each panel or kiosk for any fibre optic trunk cable entering that panel or kiosk;
- Ensure adequate ventilation within the panel to ensure internal temperatures do not rise above the maximum operating temperature of any component within the panel or 500C, which ever value is the lower.
- Single Mode (SM) fibre cables must be installed in a separate patch panel or FOBOT where existing MM fibre is already installed at a location
- SM patch panels or FOBOT must be clearly marked with a clearly visible Yellow identifier label stating “SINGLE MODE FIBRE”

Where forced ventilation is required, the hardware providing this ventilation must have an MTBF of greater than 100,000 hours. A replaceable or serviceable method of filtration must be provided to ensure dust and particulates are not drawn into the enclosure.

8.3.4.6 Fibre Optic within Electrical Equipment Panels

8.3.4.6.1 Fibre Optic Patch Leads

The Contractor must ensure that the correct installation practices are observed. Fibre optic patch leads are fragile and incorrect installation can result in:

- Higher than acceptable light loss resulting in intermittent telecommunications;
- Immediate failure of patch lead;
- Long term failure of the patch lead;
- Failure of the patch-lead during maintenance disconnection/reconnection when replacing equipment.

8.3.4.6.2 Fibre Optic Patch Leads – Installed State

Fibre optic patch leads in their long term installed state must be installed such that patch leads are:

- Fully enclosed in dedicated finger duct that is shared with no other cabling;

- Supported along their entire length (excepting patch lead ends) when connecting to equipment;
- Installed without tensile loading of fibre patch lead;
- Installed with an unsupported length between equipment and ductwork no greater than 120mm;
- Supported by Velcro ties or a similar cable support mitigation measure where a tensile load is unavoidable (such as in a long section of vertical finger duct);
- Not subjected to a bend radius of less than 10x cable diameter when not tensile loaded;
- Not subjected to a bend radius of less than 15 x cable diameter when subjected to unavoidable tensile load of a maximum 50N/cm or 50% of the stated manufacturer maximum (whichever is lower);
- Not crossing any sharp non-radiused edge or ridge such as a metal lip on a cable tray.

Finger duct utilised to enclosure fibre optic patch leads must be sized such that the fibre patch lead bending radius must not be exceeded for looped excess patch lead length contained within that duct (for example a 3mm patch lead not under tension requires a minimum space of internal diameter 60mm to be looped in this case).

Where a fibre optic patch cable duct is required to cross another duct containing other cabling, it must:

- Be kept mechanically separated by a fixed rigid barrier protecting from impact;
- Provide sufficient clearance to house all required patch leads;
- Permit free and clear removal of patch leads for maintenance purposes making allowance for present and future patch lead requirements.

Fibre Optic Ducts and patch leads may be run adjacent to any other cabling provided mechanical separation and sufficient clearance for the connection/disconnection/removal activities detailed in this section is provided.

Patch leads must not be used to connect equipment in different rooms or areas.

Fibre Optic Patch Leads - During Installation

During installation into ducts, removal from ducts, connection to equipment or disconnection from equipment, fibre optic patch leads must not be subjected to:

- A tensile load of more than 100N/cm or the manufacturer maximum (whichever is lower);
- A bending radius of less than 15 x cable diameter where tensile load on patch panel terminations is not present;
- A bending radius of less than 20 x cable diameter where tensile load on patch lead terminations is present.

8.3.4.6.3 Fibre Optic Patch Panels within Electrical Panels

Must be located within a panel so as to:

- Allow any Patch Panel or Fibre Optic Breakout Tray (FOBOT) to be opened fully without obstruction or interference to other equipment;
- Allow clear straight entry for the Fibre optic trunk cables to ensure manufacturer bending radius is not exceeded;
- Allow fibre optic trunk cables to be adequately protected from accidental impact and interference;
- Allow connection of fibre optic patch leads without tensile loading of the patch lead termination or cable.

8.3.4.7 Fibre Optic Cabling within a 19inch Rack Enclosure

A 19inch rack enclosure used to house fibre optic equipment must be equipped with integral vertical cable management suitable for the installation of fibre optic patch leads in a secure manner that permits physical separation from all other cables and fully encloses the fibre patch leads.

Installation of fibre optic patch panels, cable managers and patch leads, within a 19inch rack cabinet must:

- Meet the requirement of section 8.3.4.5;
- Contain a 19inch rack-mounted fibre optic patch panel with integral core strain relief for the incoming terminated fibre trunk cable;
- Ensure incoming fibre trunk cable is securely affixed to the side of the enclosure and cannot interfere with the installation and removal of equipment to be housed in the rack;
- Ensure incoming fibre cable has a minimum of 3 metres of coiled slack available adjacent to the entry point to the 19inch rack;
- Ensure that the fibre patch panel is installed with patch lead ports aligned to the side of the rack containing other patch panels and equipment ports;
- Provide a 19inch fibre optic cable managers at the fibre optic patch panel;
- Provide additional 19inch fibre optic cable managers for all equipment to be connected via fibre optic patch leads;
- Ensure that the distance between patch lead exit from cable manager to equipment or patch panel is less than 120mm;
- Ensure that where fibre optic patch leads utilise the integral vertical cable management of the 19inch enclosure that the fibre patch leads are supported by Velcro ties or a similar cable support mitigation measure to minimise tensile loading of fibre patch cable.

8.3.5 Cable Installation

8.3.5.1 Cable Segregation – Telecommunication Cables

The segregation between copper telecommunication cables and power or intrinsically safe cables must be 300 mm minimum throughout regardless of that cable's location within a conduit, duct or panel. Telecommunication copper multi-pair cables and signal cables must be separated from single core HV cables by a minimum distance of 450mm.

Where a cross over is unavoidable cables must be arranged to cross at right angles to each other and must comply with AS/CA S009 Section 18.7 "Crossing another service" and AS/CA S009 Section 19.5 "Crossings and shared poles (Joint Use) with aerial power lines".

Other than cross overs, the only other permitted exceptions to the 300mm rule are:

a) When authorised in writing by Sydney Water (e.g. if 250mm clearance only is available and the power cable will not carry high fault or starting current).

b) When it is necessary to use existing panel wire ducts, or existing wall, floor or ceiling penetrations, or existing cubicle gland plates, or terminate to non-ELV equipment. In such cases, the route, or location of the penetration, will be chosen so as to maintain the maximum possible segregation between the signal cables and the power cables capable of carrying the most current. If the separation is less than 150mm, a permanently rigidly fixed panel earth connected steel barrier of minimum thickness 0.8mm extending at least five (5) cable diameters beyond either side of the cable to be protected must be installed. Where a permanent rigidly fixed steel barrier is installed within a panel it must be earthed to the panel's earthed equipment tray or back-plate at both ends and every 1200mm where its length exceeds 1800mm.

In addition to the above requirement detail, telecommunication multi-pair cable segregation must otherwise comply with AS/CA S009.

All cables must be separated from lightning down conductors in accordance with the requirements of AS1768 and AS/CA S009 Section 9.4 "Separation from lightning down-conductors".

8.3.5.2 Installation of Fibre Optic Cables

Fibre optic cabling may share conduit or pit systems with existing or new copper telecommunications services provided that:

- Authorisation in writing from Sydney Water is gained for the installation of fibre optic cables into existing conduits or cable trays;
- Authorisation in writing from Sydney Water is gained for the installation of Single mode fibre optic cables into existing site with legacy Multimode (MM) fibre installations already installed/in service
- Sufficient clearance is available to safely draw the new cable into the existing pit/conduits.

In addition:

- Fibre optic cable must be run in continuous lengths without splices;
- Fibres within the cable must be colour coded and labelled so that each fibre can be individually identified;
- Each fibre cable length to have a minimum of one metre of extra cable at each end that will be coiled to allow re-termination, which may occur due to damage during installation or during the life of the cable;
- Fibre cable that is to be run between buildings must be underground type cable with a durable, UV and vermin resistant polyethylene sheath and suitable for installation in buried conduit;
- Fibre cable must not be subjected to a bend radius less than 20x cable outside diameter whilst being installed and 15x cable outside diameter when in place and fixed to an appropriate cable support structure with no tension present on the cable. Pits and cable systems must be sized appropriately;
- For new SWC facilities or new assets within existing SWC facilities, new fibre installations must be run in separate conduits and must be segregated as defined in clause 8.3.5.1 of this section from any existing telecommunication and power services unless written dispensation is given by an authorised IICATS or SCADA group's representative.

Installation of telecommunication cables underground is the SWC preferred method for reasons of long-term reliability and reduced physical interference. Where an aerial telecommunications cable solution is proposed permission must be sought from Sydney Water.

Where installation of aerial fibre optic cable has been approved, the installation must comply with the requirements of AS/CA S008 and AS/CA S009. Fibre optic cable to be installed as an aerial is required to be suitable for aerial installation according to the cable manufacturer's specifications. Installation of underground type fibre optic cable via looming to a catenary is not permitted.

8.3.5.3 Existing Cables

In cases where the Scopes of Work indicate that existing telecommunications cables are to be reused, the Contractor, after ensuring that the cable is safe to be worked on, must fully test the cable and all cores, to ensure that the cable is suitable for the particular application.

Prior to commencing work (testing) on existing cables the Contractor must notify Sydney Water.

In the event that existing cables fail the Contractor's tests, Sydney Water must be notified in writing with an accompanying test certificate and all work must cease on the cable(s). Any further work on the cable(s) must be carried out at Sydney Water's specific instructions.

8.4 Internal Cabling Conduits

8.4.1 General

All Conduits including the carrier's lead-in conduit to an MDF or other distributor must be white and continuous. In locations where elbows or bends cannot be installed or through gland plates, flexible white conduit may be used. At all times segregation requirements as defined in Sections 8.3.5 and Section 9 of this document must be maintained.

8.4.2 IICATS RTU Specific Internal Cabling Conduits

A separate continuous telecommunication white coloured conduit (or duct) of minimum 25mm size must be supplied and installed from the distributor to the ADSL/PSTN RTU RJ12 socket. At all times segregation requirements must be maintained. Telecommunications cabling, components and ducts must be installed in compliance with AS/CA S009, Section 16 - "Indoor Cabling".

Refer to drawing SSD/110 'MDF Enclosure General Arrangement' for conduit sizing and installation details.

A Cat.5 UTP telecommunications cable must be supplied, installed and terminated from the "B" side of the BD to the 6-pin modular socket (RJ12) located on the RTU Cubicle back-plate. This cable must be run in the above conduit (or duct).

The Cat 5 UTP cable between the distributor and the RTU RJ12 socket must be wired in accordance with the following drawings:

- SSD/112 for ADSL or PSTN RTUs in a reduced size cubicle;
- SSD/112 for ADSL/PSTN sites in conventional installations.

Refer to 8.7 for sites assessed as affected by possible Earth Potential Rise issues.

Sites serviced by fibre optic lead-in cables must be wired in accordance with the following drawings:

- SSD/112B is applicable for fibre optic sites

8.5 External Cabling Conduits

8.5.1 General

Where the Siteworks Contractor performs any cable installation or cable re-termination within a new or existing distributor, the Contractor must:

- Be accredited to work on telecommunications cabling;
- Terminate all incoming and outgoing pairs, jumper all pairs, and reconnect live services;
- Identify and record all line details in the Distributors Record Book;
- Supply, install, terminate, document and test all cable, conduit and pits connecting the Distributor from the Network Boundary to the telecommunication connection box associated with the Customer equipment enclosure in any instances where such a cable is required, prior to the carrier service being terminated on the Network Boundary distributor "A" side.

Underground telecommunications cabling must have pits installed on conduit change of direction locations or every 50 metres where continuous conduit runs are present.

Underground telecommunication cables must be installed in conduits of a minimum 50mm internal diameter size.

Conduits and pits for underground telecommunication cables must have a minimum bend radius of 300mm for all change of direction.

Pit conduit entry and exit locations must ensure that the 300mm bend radius can be achieved for any cable installation.

Where a fibre optic cable with a bend radius requirement of greater than 300mm is to be installed, all conduit bend radius for conduit change of direction and entry &exit locations must be increased to suit the specific cable required to be installed.

8.5.2 IICATS RTU Specific Connection Requirements, External Cabling and Conduits

8.5.2.1 Telstra Remote Telemetry (TRT) Specific Carrier Network Connection Requirements

I. IICATS RTU equipment utilises a Telstra based product "Telstra Remote Telemetry" to provide connectivity for IICATS RTUs into the SWC Telemetry network;

II. The RTU must be provided with a copper based or fibre lead-in cable to the Telstra network boundary, in accordance with section 8.3 of this document. A dedicated 5 (five) pair copper or 6 (six) core fibre optic lead-in cable must be run between the IICATS RTU location and the nearest Carrier Network connection point that supports a Telstra (VDSL or Fibre NBN) wire-line service;

III. Where Telstra Network cabling is not present or cannot be connected, an alternative method of providing a Telstra TRT compatible and Telstra TRT maintainable service must be effected;

IV. Where the IICATS RTU is in a location where another (Non-Telstra) carrier or entity has exclusive control of provision and maintenance of Telecommunication services, provision must be made to provide access to Telstra, so Telstra can connect and maintain a Telstra TRT service to the RTU location. This includes the provision of a satellite and cellular antenna mounting arrangement to support provision of Telstra TRT via a 4G Primary / Satellite secondary TRT media solution,

8.5.2.2 External Cables and Conduits

New external cable must be run in dedicated telecommunications conduits and pits. Exclusions from this requirement must be specified in the Scope of Work.

Where a new asset requires a new carrier service connection, a new dedicated telecommunication cables must be installed between the site MDF and the new asset distributor. This cable must comply with clause 8.3 of this section and be ACMA compliant.

Where no carrier service is required and an RTU has a local cable connection to another RTU or telecommunication device within a single site all connections are to be recorded in the MDF or other Distributor Record Books on site with clear reference to the RTU Asset Identification.

8.5.3 Underground Cables-Telecommunications Cables

Telecommunications cable and power cable may share the same trench subject to compliance with AS/CA S009 Section 18 Table 4 "Underground customer cabling separation from power cabling" and any special regulations of the power cable owner. **Under no circumstances must power and copper telecommunications cable share the same conduit or pit.**

The installation and type of underground conduits for telecommunication cables must comply with the requirements of AS/CA S009, Section 18 'Underground Cabling'.

The minimum depth of cover for telecommunications cables should be 500mm. Where this cannot be achieved the minimum depth of cover specified in AS/CA S009 Section 18.6 "Underground cabling- depth of cover" of 300 mm for telecommunications cable in non-trafficable area and 450 mm in public place or trafficable area, subject to conditions, must be provided.

8.6 Telecommunications Earthing

8.6.1 Earthing Definitions

For the purposes of this document the following definitions apply:

CES (Communications Earth System) - a CES is a system of earthing using common elements to provide earthing facilities for electrical and telecommunication equipment within the premises. A CES may be used for protective and functional earthing for telecommunications purposes.

CET (Communications Earth Terminal)- A CET is a terminal provided for the purpose of equipotential bonding of the CES to the main earthing bar, main earthing conductor or sub-main earthing conductor of the electrical installation and was formerly known as the Telecommunications Earth Bonding Terminal (TEBT).

DEC (Differential Earth Clamp) A differential earth clamp is a device that electrically connects two earthing systems under over-voltage conditions but remains electrically disconnected under normal operating conditions.

8.6.2 Distributor Earthing

General requirements for Communications Earth System (CES) must comply with AS/CA S009 Section 20 "Telecommunications Earthing and power distribution" are:

I. Internal Enclosure - A Communications Earth Terminal (CET) must be supplied and installed on the wall near the building electrical switchboard. Connection must be made from the CET to the protective earth bar on the building electrical switchboard using a 6-mm^2 (minimum diameter) green/yellow PVC insulated conductor in accordance with the requirements of AS3000 and such connections must only be made by an appropriately licensed electrical worker.

II. External Enclosure - A Communication Earth Terminal (CET) must be supplied and installed in the main body of the outdoor enclosure or cubicle. Connection must be made from the CET to the protective earth bar on the outdoor cubicle or enclosure electrical earth bar using a 6-mm^2 (minimum diameter) green/yellow PVC insulated conductor in accordance with the requirements of AS3000. Such connections must only be made by a licensed electrical worker.

III. Connection from the CET to the MDF or other Distributor back-mount must be made using a 6-mm^2 (minimum diameter) green/yellow PVC insulated conductor. Such connections must only be made by an ACMA licensed cabler.

IV. The resistance of the earth cable between the point of connection to the protective earth system (electrical earth) and the earth bar or terminal on the MDF or other Distributor must not exceed 1 ohm.

    Where necessary the nominal cable area must be increased to meet the minimum resistance criteria. AS/CA S009 Section 20.21 "Earthing of surge suppression devices" states that the total length of the bonding conductor, CET and connection cable should not exceed 10 metres where surge suppression devices are fitted to a Distributor.

V. Where the distance between the Distributor and the nearest electrical switchboard earth bar is greater than 10 metres, or there is a potential of current flowing in the bonding cable a separate CES system must be provided in accordance with AS/CA S009 Section 20.20.1 Note 3 using a Protective Earthing Conductor independent of that servicing the switchboard earth.

    Connection from the Distributor back-mount to the CET must be made using a minimum 6-mm^2 green/yellow PVC insulated conductor. Provision of a CET for this purpose must only be made by a licensed electrical worker.

VI. Where a distributor requires the provision of a separate CES it must be equipotential bonded to the site MEN link by means of a differential earth clamp if both earthing systems are located in the same building or structure.

VII. Where a DEC (differential earth clamp) is used, appropriate warnings must be displayed indicating the presence of the separate earthing systems.

    For example:

    WARNING! This earthing system is connected to a separate earthing system via a Differential Earth Clamp. Hazardous Voltage may exist between these earthing systems under fault or transient conditions.

VIII. Telecommunications cabling, including change of direction pits or pull through pits, in shared trenches with HV underground cables are allowed subject to compliance with AS/CA S009, Section 18.9 "Shared Trenches with other Services". Also refer to AS/CA S009 Section 18 Table 4 “Underground customer cabling separation from power cabling”. Separate pits and conduit runs must be used where telecommunications cables and conduits sharing a trench. Pits and conduit installation must comply with AS/CA S009 Section 18 Table 3 “Conduit curves, bends and distances between access points”.

IX. Where a distributor is located remotely from a building or cubicle. A CET must be provided inside the MDF enclosure and connected to the nearby M.E.N must be provided. Where an M.E.N connection is not available an earth rod may be established provided approval is sought from the authorised Sydney Water HSS representative.

8.6.3 Earth Cable Conduit or Duct

All telecommunications protective earth cable must be run in separate, dedicated white coloured telecommunications conduit or duct. A dedicated minimum $6mm^2$ earth cable must be run from the C.E.T to the site main earth bar. If power at the distribution location is connected to a local earth stake, then the C.E.T must be connected to this local earth.

8.6.4 No Mains Power

Where a site has no mains power, that is, there is no power system site earth, a CES must be supplied and installed to the requirements of AS3000 to provide an earth for the distributor surge protection devices. The provision of this CES may only be made by a licensed electrical worker.

8.7 Earth Potential Rise (EPR)

Sydney Water no longer permits installation of new copper communications services within an EPR zone. Refer Section 8.2.4 for further detail regarding upgrade of existing copper services within an EPR zone.

Installation of services into an area affected by Earth Potential Rise (EPR) is subject to the conditions stated in AS/CA S009 Section 20.5 "EPR Hazard zones" and AS/CA S009 Appendix H "Interference from HV power systems".

A telecommunications service must not be installed onto a site without performing an assessment of the locations EPR status. Where that location is identified as being subject to EPR the service must not be installed into that location without an appropriate EPR isolation device.

The contractor must ensure that where technically feasible the distributor, lead-in cable, CPE socket and CPE socket to distributor cabling is completely located outside the EPR zone in order to avoid the need for an EPR isolation solution. (CPE: customer premises equipment).

The assessment of any EPR zone and the implementation of EPR isolation devices or other engineer solutions must be performed in accordance with AS/NZS 3835 Part 1 “Code of Practice” and Part 2 “Application guide”.

The Contractor must apply to the Electricity Supply Authority and the relevant Telecommunications Carrier to determine the extent of any EPR hazard zone that will impact on the provision of any Telecommunication service over copper cable.

The following applies for installations affected by EPR:

I. Customer equipment, distribution equipment (including MDFs and Distributors) pits, access holes or cable joints should not be placed in locations where under fault conditions Earth Potential Rise (EPR) may exceed 430 VAC. In the context of a building remote from a power substation, this means that if the building is served by 415 VAC or 240 VAC, there will be no need to consider EPR unless the proposed installation is within the hazard zone of a power substation, as defined under section 8.7 (ii) below.

II. Where an installation is served with an electricity supply that exceeds 430 VAC, the ACMA licensed installer must check with the electricity supply authority as to the presence of an EPR affected area in the proposed customer equipment locations. Where an installation cannot be placed in a location where the EPR hazard is less than 430 VAC, the installation must only proceed on the basis of an engineered design prepared in compliance with the relevant Codes agreed between the carrier and the supply authority. The ACMA licensed installer of any such proposed installation must notify the Carriers providing communication services at the location.

Note: The electricity supply authority will assess the EPR situation in accordance with the jointly agreed Electricity Supply Association of Australia (ESAA) and Telecom "Code of Practice for the Protection of Personnel and Equipment against Earth Potential Rises caused by High voltage Power System Faults". ". An EPR zone is typically defined as being within a 15 metres radius of any HV transformer, HV pole top transformer, HV switchboard, cabling or other HV equipment; where supply is greater than 430V AC, however in some cases the EPR zone may extend further. The contractor must apply the Supply Authority for an assessment to be performed on sites where HV assets are present.

The copper telecommunications cable between the ‘Carrier Cable Network’ and the ‘Distributor EPR Isolation Equipment’ must have a continuous unbroken cable sheath. Jointing of this cable for any purpose within the EPR zone is not permitted.

Unless HV line isolation equipment is installed as part of an engineered solution, a Carrier’s lead-in cable can only be connected and terminated on a Distributor in a building or cubicle outside the 15metre EPR zone. HV Line Isolation Systems are commercially available and must be used in lieu of a conventional distributor frame in situations where service termination is within an EPR zone.

8.7.1 Carrier Cables within an EPR Zone and Isolation devices within the EPR zone

Where a lead-in cable traverses an EPR zone on SWC property, a distributor with appropriate EPR isolation must be established between the Carrier network and the EPR zone, even if the service termination point is beyond the declared EPR zone. The distributor (EPR isolation device) established between the Carrier network and the EPR zone must form the network boundary distributor.

Where a copper telecommunication cable exists within a designated EPR zone the following must apply:

- The telecommunications cable must be a continuous cable run with unbroken cable sheath for the entire distance this cable is within the EPR zone,
- Jointing of this cable is not permitted within the EPR zone and where the cable requires repair, the entire length within the zone must be replaced,
- Jointing of cable is only permitted outside of the EPR exclusion zone,
- Any pits within the zone must contain signage declaring that an EPR zone exists and that jointing or re-terminations of the cabling within the pit is prohibited,
- AS/NZS 3835:2006 applies.

Where new HV equipment is to be installed in proximity to existing copper telecommunications cabling, the Contractor installing the new HV equipment must apply to the electricity supply authority and the relevant Telecommunications Carrier to determine the extent of any EPR hazard zone created. The installation must be made to comply with the above requirements.

Telecommunications pits and cabling inside an EPR zone must not be installed within 5 metres of an earth grid system for transformers, switchyards or building/asset lighting protection infrastructure.

8.7.2 EPR Distributors

Distributor Location – EPR Zone

The distributor and its supports must be mounted such that there is a minimum of 1.5 metre clearance from any structure or object.

Where a clearance of 1.5m from any structure or object cannot be achieved, any object that can be physically touched by a person working at the Distributor within a 1.5 metre radius of that distributor, must be considered for its potential as an earthed object, and must be appropriately insulated in accordance with AS/NZS 3835:2006.

Earthed objects may include but are not limited to objects such as pipes, railings, metal conduit, metal conduit clamps holding plastic conduit, any metal bolt or fastener heads, walls, trees and wooden or metal posts.

Where a wall or structure mounted distributor is required, the wall or structure must be insulated 1.5 metres either side of the distributor to a height of at least 2.1 metre in accordance with AS/NZS 3835: 2006.

Where possible the installation location for an EPR distributor should be chosen at least 1.5 metres outside of the declared EPR zone. The requirement for an EPR isolation distributor is based on the location of the CPE socket inside that EPR zone. However, if the distributor can be located 1.5 metres outside the zone, lead-in cable jointing and pit location requirements may be simplified.

Distributor Construction

The distributor must be constructed of non-conductive material in accordance with AS/NZS 3835: 2006. All objects within 1.5 metres of the distributor and its support structure must be insulated with a material of identical insulation performance to the distributor enclosure.

A self-draining concrete landing or similar level hard surface must be provided to allow the use of an appropriate insulated rubber mat by service personnel performing work on the distributor.

Distributor Conduit Entry

The distributor lead-in cable entering the HV Isolation equipment and the Distributor CPE socket cable leaving the HV isolation equipment must not share any common conduit or junction boxes. Separate cable entry and exit conduits/junction boxes must be provided and separated by a minimum of 100mm. All conduits must be a non-conductive continuous and unbroken run directly into the HV Isolation equipment conduit glands.

8.8 Telecommunications Surge Protection

All Distributors must be fitted with surge protection devices (as per section 8.3.5 of this document).

As a minimum, surge suppression devices must comply with AS/NZS 4117 “Surge Protection Devices for Telecommunications Applications” and be installed in accordance with AS/CA S009 Section 20.20 "Earthing of surge suppression devices".

To permit the fitting of surge protection devices, all distributors must be constructed in such a way as to provide 30mm clearance between any termination and the inside face of the front cover or door as per AS/CA S008 Section 5.4.2.4 "Space for surge suppression devices".

Coaxial telecommunication cables such as radio and other similar cabling must be fitted with surge protection in accordance with TS01- Section 11 ‘Lightning and Surge Protection’ sub-section 11.5- ‘Surge protection for Radio/Satellite Communications’.

Where a coaxial surge arrestor cannot be fitted to an antenna lead for RF performance reasons (for example in the case of Satellite based equipment), any serial or Ethernet interface leading from that Wireless device to SWC equipment must be fitted with appropriate surge protection devices.

8.9 Wireless Communications

8.9.1 Cellular Wireless Network compatibility

All antennas and cellular modem equipment/modules must be 4G LTE compatible as a minimum with support for the following selection allows.

Equipment must support following frequency bands:

- 4G 700Mhz (B28)
- 4G 900Mhz (B8)
- 4G 1800Mhz (B3)
- 4G 2100Mhz (B1)
- 4G 2600Mhz (B7)

All installed equipment (either standalone modem or device with internal integrated modem) must be compatible with the above frequencies and networks.

8.9.2 Signal Strength

Available coverage with acceptable signal strength is required to allow cellular wireless equipment to service a Sydney Water asset.

Where the communications device for an asset utilises Cellular Data' via 4G or higher based communications media, the contractor must survey the available signal strength at the asset or proposed asset location using an appropriate 4G/5G test device equipped with a Sim Card from the carrier to be used with that equipment. The results from signal strength testing at each location must be provided to Sydney Water prior to installation approval being granted for each location.

A location must be considered acceptable for telemetry wireless cellular communications if:

- signal strength is measured using a 0dB gain antenna (unity gain) for 4G 700/900/1800/2100/2600Mhz
- signal strength recorded is expressed in dBm or ASU (Arbitrary Strength Units)
- Consistent 4G LTE Band 28 RSRP (Reference Signal Received Power) strength of not lower than -100dBm for 4G (LTE) based communications at the asset location.
- Signal strength measured is from the nominated SWC mobile carrier for that telemetry application.

Signal strength for 4G LTE communications is formally assessed using a combination of the internally modem signal parameters

- RSRP (Received Signal Strength Indicator)
- RSRQ - Reference Signal Received Quality (4G LTE)
- SINR - Signal to Interference-plus-Noise Ratio (4G LTE)

Due to the lower bandwidth/throughput requirements typically used for SCADA & telemetry communications over wireless, for simplicity an RSSI of -100dBm has been found to provide adequate 4G LTE performance and is used as a viability threshold for the purposes of this standard.

Measuring Signal Strength

The signal strength must be measured on the enclosure roof to determine a true signal reading.

Where the asset location has acceptable signal strength, antenna installation on top of the RTU enclosure is acceptable.

Where signal strength is below the minimum acceptable level the assets must be relocated to where sufficient signal exists or Sydney Water must be contacted in writing for guidance and approval of alternative antenna or technology solutions.

Signal strength and antenna location for assets inside pits and chambers

Provided suitable signal strength exists within a pit or chamber, installation of an antenna in that location is acceptable. The signal strength must be measured with the pit or chamber lid closed to determine a true signal reading.

Where signal strength falls below the minimum requirement an antenna may be located:

- externally, either mounted on a nearby asset if in a secure site
- in a small pit located adjacent to the pit or chamber, close to the underside of the plastic lid, connected via a 25 mm conduit, where the asset is located in a public place

Insufficient signal Strength/ Lack of coverage

At Asset locations where signal strength is found below the minimum threshold indicated above the Contractor must approach Sydney Water for advice on whether the location may be used and what alternative antenna installation or equipment type can be implemented to improve the locations viability.

Where useable cellular wireless coverage cannot be implemented for the chosen asset location, the asset must be relocated or a technical implementation using an alternate communications media must be implemented in accordance with instruction from Sydney Water.

8.9.3 Antenna Location

8.9.3.1 Antenna Location – Panel Mount

Internal antennas may provide poor performance when compared with an external antenna and can potentially induce electrical noise into nearby control and telecommunications cabling.

The antenna for any radio equipment must be mounted externally to a panel to avoid inducing electromagnetic interference in copper control and telecommunications cabling within that panel. The use of equipment that uses an integral to the device antenna and cannot be configured to utilise an externally mounted antenna within a panel must be avoided where possible or located separate to any interference sensitive equipment.

Where the panel is manufactured from Glass-fibre Resin Polyester (GRP) or other non-conductive material permission in writing from Sydney Water must be gained before mounting an antenna or device with integral antenna within that panel.

The antenna lead must be secured with a drip-loop in place such that any water ingress via the antenna follows a path to the floor of the cabinet without affecting any other installed equipment or cables within that panel.

Where multiple antennas are required they must be mounted a sufficient distance apart to avoid antenna coupling.

8.9.3.2 Antenna Location - Pits and Chamber

Antennas may require location in below ground or enclosed asset spaces where moisture and occasional immersion may be likely.

Locations where this is required must be:

- Fitted with a suitably IP68 rated antenna (4m depth and 4days duration).
- Fitted with a suitable IP68 lead and connector.
- Fitted with an antenna compatible with the bands listed in section 8.9.1

8.9.3.3 Antenna Pit in public places

An antenna pit located in a public place must be:

- Manufactured of a non-conductive exterior rated durable plastic material (such as Irrigation control valve style pit or equivalent)
- Have a bolt down lid and have a depth of no more than 150mm
- Be mounted flush with ground/pavement level
- The antenna cable conduit must enter the bottom of the antenna pit vertically and the conduit must be sealed

The maximum distance between the antenna pit and valve chamber is dictate by the antennas fixed lead length and the conduit path.

Where an antenna pit is required to be located a greater distance from the valve chamber, an antenna with a longer lead length or an antenna lead extension will need to be obtained.

The signal strength test must be repeated with the equivalent extended lead length in place.

8.9.3.4 Antenna mounted on external enclosures

<u>Low profile style</u>

The following guidelines must be taken into account when installing the antenna:

- The antenna must be a low-profile IP65 stubby, or dome, style of robust construction with a maximum height of 95mm, or 25mm consecutively, when installed atop a panel or cubicle that is publicly accessible.
- Mount the antenna in the centre of the enclosure roof with the antenna entry hole not located above any electrical equipment.
- Antenna cable must be arranged with a drip loop away from equipment inside to the enclosure to reduce the impact of a future leak.
- The mounting surface must be flat and clear of oil, dirt or residual sealant to ensure antennas using an adhesive base mounting system adhere correctly to the enclosure.
- Apply silicone sealant to the outer edge of the antenna to improve sealing, once the antenna has been adhered or mounted to the enclosure.
- Where multiple antennas are required they must be mounted a sufficient distance apart to avoid antenna coupling.

<u>Mast mounted antenna on cubicles in poor signal areas (fenced or non-fenced assets)</u>

- The antenna must be a mast mounted high gain vertical or YAGI style antenna necessitated by insufficient signal strength preventing implementation of low-profile dome style antenna.
- The mast must be mounted to the side of the panel in such a manner that provides for hidden or tamper proof fixing for mast attachment
- Mast and mounting arrangement must not provide any hand or foothold assistance points for persons attempting to climb onto the roof of the cubicle.
- The mast mounting location on the cubicle must be located a sufficient distance from nearby object or equipment to prevent a person from using the mast to climb onto the roof of the panel.

- The antenna entry hole is sealed and not located above any electrical equipment.
- Antenna cable must be run internally to the masting material to protect from physical damage and vandalism.
- Appropriate coaxial surge protection must be fitted between the antenna and the modem.
- Where multiple antennas are required they must be mounted a sufficient distance apart to avoid antenna coupling.

8.9.4 Satellite Communications

Where a lack of cellular coverage dictates use of alternate wireless technology to provide an asset with either primary path of backup path telemetry communications, the use of a Satellite based solution may be required. A Satellite based service must provide:

- A compact & physically hardened Satellite terminal and antenna installation to permit installation at a wide range of assets
- Bandwidth of at least 64kbps
- Round trip latency of less than 2000ms
- Support for use as a WAN device by third party routers or smart modems
- Where appropriate encryption of IP Packet headers and payload where traffic leaves the Australian service providers network.
- An Ethernet interface
- Service provider offering Satellite VPN and Private APN facility
- Remote management ability for satellite terminals
- Ability to be powered from a 24V DC control supply
- Power consumption of below 20W
- Support for surge protection on the coaxial cable from the antenna.
- Support for surge protection on the Ethernet interface to Telemetry device

8.9.5 TRT Satellite Antennas

The TRT Satellite Inmarsat L-band antenna must be mounted in according to the following requirements:

- Mounting location is within a 10 metre pre-terminated cable run of the active satellite CPE to allow use of the pre-terminated antenna cable supplied
- Mounted with clear view of the sky north facing at an angle of approximately 22 degrees to horizontal, clear of buildings, vegetation and other nearby and northward “clutter”
- Other antennas must be located a minimum of 1m horizontally or vertically away from any other antenna from the rear and sides of the Satellite antenna viewpoint. This includes the TRT 4G LTE antenna used by the same TRT service
- Other antennas must not be located closer than 25m due north of the Satellite antenna in a horizontal plane. This includes the TRT 4G LTE antenna used by the same TRT service
- Appropriate non-ionising radiation warming signs must be displayed facing locations of physical approach by the public or site personnel

- Appropriate ACMA compliant Radio Frequency Electromagnetic Radiation (RF EMR) warning documentation using the ARPANSA Radiation Protection Standard as a basis, must be provided and placed with the sites hazard identification documentation.
- The RF EMR documentation must clearly show Radiation emission patterns and define access zones in line with a "general, restricted, prohibited zoning model and must detail the locations persons may inhabit and the safe time period of habitation.

Technical Specification

Sydney WATER

Part 9 – Cables, Cubicle Wiring and Identification

9. Cables, Cubicle Wiring and Identification

9.1 Cable and wiring, general

The Contractor must design, supply, install and terminate all cables necessary to complete the work of the Contract, together with all materials to support and convey the cables supplied and installed by the Contractor. All cable and earthing conductors, cable trays, ducts and conduits must comply with the current version of AS/NZS 3000 and AS 3008. They must also comply with Australian Communications and Media Authority (ACMA) requirements for a control system connected to telecommunications service provider's (carrier's) communications system.

Cables must be installed with appropriate segregation and shielding to ensure electromagnetic interference from other equipment or services does not occur on control, signal or telecommunication cabling.

All cables and/or conduits must be grouped according to cable usage (eg. power, instrumentation, telecommunications) as far as possible and must be continuously rigidly supported throughout their length. Catenary supports are not acceptable. All support brackets, saddles and clips must be spaced to ensure that the runs remain straight and in any case must comply with the current version of AS/NZS 3000.

All cabling, junction boxes, terminal boxes and the like must be arranged so that there is ample access for replacement, modification and maintenance.

All cable entries must be cast, moulded or machine-cut and free of burrs and sharp edges. Cutting of holes by burning methods is not acceptable.

Care must be exercised when laying cables in ducts, cableways, trenches and ladder trays. They must be neatly laid and run parallel. Bunching more than two deep will not be acceptable and crossovers must be confined to cables entering and leaving the medium. Cables not so installed will be rejected by Sydney Water.

All cables must be continuous throughout their route length. No "through joints" (splices) will be permitted. Where route lengths exceed practical supply limits joints may be permitted with the approval of Sydney Water.

Cables must not be pulled or laid in tray with a bend radius of less than 300mm or twelve (12) times their outside diameter whichever figure is the greater.

Cables must be anchored immediately before the start and after the finish of the bend.

Cables must be routed around rather than through areas subject to high electrical interference such as high voltage equipment rooms.

The number of cables in conduits, ducts, cable trays, trenches and the like must comply with the requirements of the current version of AS/NZS3000, AS3008 and their de-rating factors. Cables installed on cable ladder/tray must be fixed with 5 mm minimum width black ultra violet radiation stabilised nylon wire ties at a maximum of one metre intervals for horizontal tray installation and a maximum of 0.3 meter for vertical tray installations.

Cables prior to surge protection equipment must be kept physically segregated from other cables within cubicles by a minimum of 50mm and run in separate ducts. In all other locations, a minimum separation of 150mm must apply.

Any cable, which suffers abrasion or damage to the insulation during installation, must be replaced.

The Contractor must size all cables and determine its de-rating factors in accordance with the current version of AS 3008 and to the requirements of the Supply Authority.

It must be Contractor's responsibility to ensure that all cables used have sufficient current carrying capacity.

Where a cable run is required and information regarding the route type is not indicated in the 'Scopes of Work', it will be the Contractor's responsibility to ensure that any estimates provided have taken into account the cable route type i.e. cable type, cable length, conduit, cable tray, trenching, pits and the like to complete the cable installation from source to destination.

Where individual multi-core control cables are not specifically highlighted in the 'Scopes of Work', they are required if implicit in the general description of the 'Scopes of Work'. Where a number of control (not instrumentation) signals are to use the same route, these should be marshalled and combined into multi-core control cables. This arrangement will ensure that the space available for conduit entry or cable glanding at the respective cubicle is efficiently used. The Contractor must ensure that the correct design and installation practices are observed.

A minimum of 20% spare core capacity or at least two spare cores in a multi-core cable must be provided whichever is the greatest.

9.2 Power cables-230V AC 50 Hz

All power cables are to be sized by the Contractor in accordance with the current version of AS/NZS 3000 and AS 3008. Power cable must be circular section orange PVC/PVC, V90, 0.6/1kV grade to AS/NZS 5000 with cores of multi-stranded copper conductors of minimum stranding diameter of 7/0.67 mm and cross sectional area of 2.5 mm².

Cable core colours, except for cubicle wiring, must be as follows:

Active	-	Red
Neutral	-	Black
Earth	-	Green-yellow (or green where permitted by AS/NZS 3000)

9.3 Earth cables

Single core earth cables must be circular section, green-yellow (or green where permitted by AS/NZS 3000), PVC, V90, 0.6/1 kV grade to AS/NZS 5000 with a core of multi-stranded copper conductors of minimum stranding/diameter of 7/0.67 mm and cross sectional area of 2.5 mm². Larger stranding/diameter and cross sectional area cable must be installed as specified and in compliance with the current version of AS/NZS 3000 and AS/ACFI S009.

9.4 Instrumentation (analogue signal) cables

Multi pair instrumentation cables

Multi pair instrumentation cables must be circular section, black, PVC/Overall Screened/PVC with individually twisted pairs of multi-stranded copper conductors of minimum stranding/diameter of 7/0.30 mm and cross sectional area of 0.5 mm², and with individual and overall aluminium tape with tinned copper drain wire.

Multi pair cable core colours must be black and white and each pair must be individually twisted and sequentially numbered at intervals along the cores of not more than 100mm.

Single pair instrumentation cables

Single pair cable must be twisted pair of multi-stranded copper conductors, black, PVC/Overall Screened/PVC, core colours black and white and cross sectional area of 1.5 mm² with minimum stranding/diameter of 7/0.5 mm, and with aluminium tape and tinned copper drain wire.

9.5 Control and monitoring signal cables (230V AC or 24V DC)

Control and monitoring cables must be circular section, PVC/PVC, V90 0.6/1 kV grade to AS/NZS 5000 with cores, including an earth core, of multi stranded copper conductors of minimum stranding/diameter of 7/0.50 mm and cross-sectional area of 1.5 mm². The external sheath must be orange or black, and be consistent throughout the installation.

Cable cores, other than the earth core, must be coloured white with each core sequentially numbered at intervals along each core of not more than 100 mm. The earth core colour must be green-yellow (or green where permitted by AS/NZS 3000). If screened cable is used with Sydney Water's permission for this application, the screen must be earthed at the RTU/PLC or control cubicle end only.

24 V DC control signals must not share a common sheath with 230V AC control signals.

Treatment plant applications

All installations complying with Treatment Plant SCADA Standards version 2.6 or later should employ black (not orange as previously stated in the first paragraph of this clause) sheathed control and monitoring cable, and all 24V DC cables (instrumentation, control and monitoring) may then be installed on the same tray/rack and maintain 300mm separation from the power cables, reducing a three ladder rack system in most switch rooms to a two ladder rack system, one containing orange cables, the other containing black cables. Black cables will then run to the field start/stop buttons which will serve as an indication to electricians, irrespective of any labelling applied, that these buttons are now 24V DC powered.

9.6 Intrinsically safe circuit cables

Instrument and control cables carrying intrinsically safe circuits must be physically segregated from all other cables and must use light blue coloured sheath to distinguish them from non-intrinsically safe cables.

9.7 Cabling for telecommunications customer equipment

Refer to Part 8 –'Telecommunications' clauses 8.3, 8.4, and 8.5.

9.8 Armoured cables

In addition to the above cable type requirements, cables must be steel wire armoured (SWA) where the cable is required to be installed in hazardous areas as defined in the current version of AS/NZS 60079.10.

9.9 Fibre optic cable

Refer to Part 8 –"Telecommunications", clause 8.3.4.

9.10 Ethernet LAN cable

Refer to Part 8 –"Telecommunications", clause 8.3.3.

9.11 Serial communications cable

Refer to Part 16 – "Modbus communications".

9.12 Existing cables

In cases where the 'Scopes of Work' indicate that existing cables are to be reused, the Contractor must fully test the cable and cores, after ensuring that the cable is safe to be worked on, to ensure that the cable is suitable for the particular application.

Prior to commencing work (testing) on existing cables the Contractor must notify Sydney Water.

In the event that existing cables fail the Contractor's tests, Sydney Water must be notified in writing with an accompanying test certificate and all work must cease on the cable(s). Any further work on the cable(s) must be carried out at Sydney Water's specific instructions.

9.13 Cable glands

The Contractor must supply and install all the cable glands necessary to complete the installation of signal, power, earth and telecommunication cables.

Glands must be installed in the base of enclosures. The installation of glands in the top of enclosures must be permitted only with Principal's written instruction.

Glands must be suitable for the cable type and the environment in which they are to be used. PVC glands are acceptable provided that they are shrouded from sunlight and not subject to vandalism. PVC glands must not be installed in hazardous areas. Brass glands must not be used with aluminium or aluminium alloy boxes.

Cables must be supported within 500mm of the cable entry so that no strain is exerted on the gland. All metallic glands must be earthed and must be installed with PVC shrouds, backnuts and bonded earth tags. Each cable must be separately glanded.

The Contractor must be responsible for drilling all gland plates and the like to suit the cable glands being installed. Spare holes must be fitted with threaded metal blind plugs.

9.14 Cable segregation

The segregation spacing between signal cables (control, instrumentation, telecommunication cables) and power cables and intrinsically safe cables must be 300 mm minimum throughout. Telecommunication multi-pair cables and signal cables must be separated from single core HV cables by a minimum distance of 450mm. Instrumentation and control cables must not be run in the same pit or conduit as HV cables. Refer to Table 9-1, 9-2 and 9-3 for details. Refer to section 8.3.5.1 ‘Cable segregation-telecommunication cables’ of this manual for detailed telecommunications cable segregation requirements.

Where a cross over is unavoidable cables must be arranged to cross at right angles to each other. Where a telecommunications cable is to be crossed at right angles refer to section 8.3.5.1 ‘Cable segregation – telecommunication cables’ of this manual.

Other than cross overs, the only other permitted exceptions to the 300mm rule are:

a) when authorised in writing by Sydney Water (eg if 250mm clearance only is available and the power cable will not carry high fault or starting current)

b) when it is necessary to use existing panel wire ducts, or existing wall, floor or ceiling penetrations, or existing cubicle gland plates, or terminate to non-ELV equipment. In such cases, the route, or location of the penetration, will be chosen so as to maintain the maximum possible segregation between the signal cables and the power cables capable of carrying the most current. If the separation is less than 150mm, a permanent rigidly fixed barrier of durable insulating material or metal must be installed.

   Where a separation of 150mm cannot be achieved for a telecommunications cable refer to section 8.3.5.1 ‘Cable Segregation-Telecommunication Cables’ for telecommunication cable specific barrier type and installation details.

c) when it is necessary to use existing cable tray. In such cases, the route will be chosen so as to maintain the maximum possible segregation between the signal cables and the power cables capable of carrying the most current. If the separation is less than 150mm, a permanent rigidly fixed and earthed metal barrier must be installed.

   Where a separation of 150mm cannot be achieved for a telecommunications cable refer to section 8.3.5.1 ‘Cable Segregation-Telecommunication Cables’ for telecommunication cable specific barrier type and installation details.

All cables must be separated from lightning down conductors in accordance with the requirements of the current version of AS/CA S009 clause 9.4. Where a separation distance of nine (9) metres or more cannot be achieved, the minimum separation distance must be determined using the current version of AS 1768.

Cable segregation must be measured between the two closest points of the cable, or the two closest points of the conduit for cables run in conduit, for the entire cable route.

Table 9-1. Segregation requirements between cables and conduits based on cable type in mm.

Segregation requirements between cables and conduits based on cable type in mm.					
	Fibre	Copper telecom.	ELV signal	LV	HV
Fibre	Note 1.	0	300	300	450
Copper telecom.	0	Note 1.	300	300	450
ELV signal	300	300	Note 1.	300	450
LV	300	300	300	Note 2.	Note 2.
HV	450	450	450	Note 2.	Note 2.
Note 1. No segregation is required but capacity requirements must be followed.					
Note 2. Refer to Technical Specification - Electrical for requirements.					
Note 3. These segregation requirements apply to cabling external to proprietary equipment and control panels.					
Note 4. The SCADA fibre network and HV fibre network must use separate fibre cables.					

Table 9-2. Segregation requirements between cables and conduits based on cable type in mm.

Requirement for cables run in the same or separate conduits based on cable type. (Segregation distances between conduits and conduit capacity requirements must also be maintained)					
	Fibre (white)	Telecom. copper (white)	ELV signal (orange)	LV (orange)	HV (orange)
Fibre (white)	Same	Same	Separate	Separate	Separate
Telecom. copper (white)	Same	Same	Separate	Separate	Separate
ELV signal (orange)	Separate	Separate	Same	Separate	Separate
LV (orange)	Separate	Separate	Separate	Note 2.	Note 2.
HV (orange)	Separate	Separate	Separate	Note 2.	Note 2.
Note 2. Refer to Technical Specification - Electrical for requirements.					
Note 5. Conduit colour provided in brackets.					

Table 9-3. Segregation requirements between cables and conduits based on cable type in mm.

Requirement for cables run in the same or Separate pits based on cable type. (Segregation distances between conduits and conduit capacity requirements must also be maintained)					
	Fibre Telecom.	Copper telecom.	ELV signal	LV	HV
Fibre Telecom.	Same	Same	Separate (Note 6.)	Separate	Separate
Copper telecom.	Same	Same	Separate	Separate	Separate
ELV signal	Separate (Note 6.)	Same	Same	Same with segregation	Separate
LV	Separate	Separate	Same with segregation	Note 2.	Note 2.
HV	Separate	Separate	Separate	Note 2.	Note 2.
Note 2. Refer to Technical Specification - Electrical for requirements.					
Note 6. Carrier lead-in and customer cabling must always be run in separate pits. Internal SWC fibre cables may share the same pit as ELV cables provided segregation requirements are maintained.					

Voltage classifications for ELV, LV and HV are as defined in AS3000. For the purpose of this specification ELV monitoring and control cables can be divided into:

- Telecommunications
  - All fibre optic cables (Carrier lead in, customer cabling and internal network cables), and
  - copper ethernet and copper carrier lead in and customer cabling.
  - Underground telecommunications cables are installed in white conduit.
- Signal cables
  - This include all copper digital, analogue and serial control cables (e.g. RS485).
  - Underground signal cables are installed in orange conduit.

9.15 Underground cable-low/extra low voltage cable installation

Additional requirements for underground telecommunication cables are detailed in section 8.5.3 'Underground cable-telecommunication cables'.

The Contractor must install all underground cables in conduits. The size of conduit must be rated to suit the cables being installed and in any case minimum size must be 50mm.

Where new conduits are installed the conduits must be sized for a cross sectional area of at least twice that required installing the minimum required cables to allow for additional future cables to be installed. A draw wire must be provided in addition to the installed cabling to facilitate the installation of future cables.

Any conduit used for underground telecommunications customer cabling must comply with the requirements in the current version of AS/CA S0008 and AS/CA S0009. Conduit installation work must comply with the guidelines in AS/CA S009 Section 18 Table 3 "Conduit curves, bends and distances between access points".

Conduits must comply with:

- the requirements of section 4.1- Pits and Conduits of 'Technical Specification - Electrical' for Treatment plant applications, or
- the requirements of appendix 6.2 'Conduits' of this manual for IICATS applications.

The minimum depth of cover for low/extra low voltage cables must be not less than 500 mm to the top of the conduit as specified in AS3000.

The Contractor must be responsible for all excavation, pumping, drainage, conduit/cable protection, backfill, compacting, surface restoration and installation of surface cable markers. Before proceeding with excavation work, the Contractor must ascertain details of all underground services existing and to be installed in the area of the proposed work.

The Contractor must ensure that adequate safety precautions are observed at all excavations by the provision of safety barriers, warning notices, illumination at night, shoring and any other provisions required by Statutory Authorities having jurisdiction over the work and by Sydney Water.

Where existing concrete or bitumen surfaces are to be disturbed, the surface must be cut in a straight line with a masonry saw to 75 mm minimum depth before excavation is commenced.

Conduits/cables must not be laid in any material likely to cause damage. Turves, topsoil and excavated material must be stored separately and used in the correct order when back-filling.

Following excavation to the required depth, the conduits/cables must be bedded on 50 mm minimum of clean sand and then covered all round with 50 mm minimum of clean sand before back-filling the trench.

In unpaved areas, the trench must be back-filled and consolidated to about 20 mm above the natural ground level. All excess spoil must be removed from the site. In existing grassed areas, the trench must be back-filled and turf re-laid on prepared bed or otherwise re-grassed to approval to about 20 mm above natural ground level.

In existing concrete or brick paved areas, the trench must be back-filled with clean sand to the underside of the reinstated pavement and consolidated by watering and mechanical compaction. Surfaces must be reinstated to the original level. For concrete surfaces previous to excavation incorporating reinforced steel, approved reinforced steel must be used for reinstatement, keyed to the existing and laid to the satisfaction of the Principal to prevent the reinstalled concrete from subsiding and cracking.

In existing bitumen paved areas, the reinstated surfaces must be cambered so that the edges are flush and the centre is 10 mm above the existing pavement. The top 150 mm minimum immediately below the bitumen must consist of finely crushed gravel mechanically compacted into the trench. The existing bitumen edges of the trench must be prime coated with bitumen prior to laying 75 mm minimum of hot 'pre-mix" bitumen to the finished cambered surface. If it can be shown that hot pre-mix is not available, cold pre-mix will be accepted.

Where required by the current version of AS/NZS 3000, mechanical protection for cables must be approved proprietary manufactured, or pre-cast, bricks or covers with the letters "ELECTRIC" permanently indented or marked on them. Covers cast on site must not be accepted.

Where electric bricks or covers are not required over underground conduit/cable installations, a 150 mm wide orange marker tape bearing the words "WARNING" - ELECTRIC CABLE BURIED BELOW" or similar and manufactured in accordance with the current version of AS 2648 and must be laid in the trench 150 mm below ground level for the entire length.

Marker tape is to be provided over conduits and ducts installed underground for future user or for use by others.

Mechanical protection using non-indented or unmarked bricks or covers will be acceptable when installed with marker tape as above.

Cable marker plates must be made of 150 mm x 150 mm x 1 mm thick minimum brass or stainless steel and must be fixed with four brass or stainless steel screws respectively to a 300 mm x 300 mm x 150 mm deep minimum concrete block which must be embedded flush with ground level. Cable marker plates must be engraved with 6 mm high minimum lettering with the wording "Electric Cable" and applicable voltage, and must also have arrows to indicate the direction(s) in which the conduit/cable is laid.

Cable markers must be located at appropriate spacings not exceeding 25 m along each straight run, where runs exceed 25m between pits, and at each change of direction of the run where no pit is used. In addition, for IICATS sites, where a conduit/cable passes under a road or path, a cable marker must be placed at each side of the road or path.

For underground cable pits similar markers with the words "Electricity" must be fixed to the pit lid, where the pit lid does not identify the service type.

Where cables leave trenches they should be protected from damage by encasing them in metal sleeves which extend to a minimum of 300 mm below and 150 mm above ground. The protecting sleeve must be encased in concrete and after installation a suitable sealing compound must be applied to prevent ingress of moisture.

Prior to installing cables in ducts, the routes must be swabbed to ensure freedom from obstruction.

A spare nylon draw cord, anchored at both ends, must be installed with the drawing of cables for SWCs use and in any spare conduits.

Following approval of cable and draw cord installation, ducts must be sealed, using proprietary seals, compound or tape.

Power cables must be run in separate ducts to telecommunication multi-pair or signal cables to reduce interference.

Where pits or access covers are required for electrical or telecommunications services they must be legibly and permanently labelled on the cover to distinguish them from other services. Such pits or access covers must be of heavy-duty construction and must not be placed in a driveway. Duct access cover seals must be renewed as necessary if rendered ineffective following removal. The size of the pits must be selected to enable cable bending radii to be maintained. The finishing level of the pit must be as to prevent the ingress of moisture or soil.

New ducts must be formed using heavy duty UPCV conduit up to 150 mm maximum diameter to AS2053. Draw in and terminal chambers must be provided at intervals not more than 50 m and at every bend. Refer section 4.1- Pits and conduits of 'Technical specification part 3 electrical works'.

9.16 Termination of cable cores and screen

All cable cores must be terminated with approved insulated compression type lugs suitable for use with the size of conductor, type of cable being used and the type of terminal strip employed, as follows:

a) for clip on rail terminals (clamp type) use crimp on compression type pin connectors

b) for stud type terminals use crimp on compression type lugs

c) for tunnel type terminals use crimp on compression type stalk lug or solder type stalk lugs or similar.

Where lugs are to be fitted, each wire must have sufficient length to permit replacement of a lug. For all other cables adequate slack must be provided at each end to allow for at least two (2) re-terminations and connections.

No more than two connections must be made at one terminal.

All spare cable cores must be terminated on terminal strips, earthed at one end only and identified as spare 'SP'.

All terminations of mixed voltages must be segregated from each other with extra large mixed voltage barriers and traffolyte labels must be affixed indicating the appropriate voltage e.g. 24V DC, 32V AC. LV - 230V AC-terminations must be separated from ELV terminations and provided with protective barriers on both sides of the respective group of terminals. Voltages above 32V AC and 50V DC must be labelled with white red white traffolyte engraved labels "Danger", together with the voltage.

All equipment and cable terminals above 32V AC and 50V DC must be touch free (covered and insulated), such that personnel cannot inadvertently touch live parts. The cover must be removable for maintenance purposes and must not prevent air circulation around the equipment and terminals while providing full insulation.

The screens on screened cables must be terminated as outlined below and connected to the instrumentation earth at one end only. Unless otherwise specified the earth must be connected at the control cubicle end. At the field end the drain wire and shield must be totally isolated from earth via a neoprene sleeve.

a) the cable sheath and screen must be left intact to a point which is as near as possible to the termination of the first core. This is to ensure that the length of unscreened cores is kept to a minimum

b) to terminate the screen, first strip back the outer layer of sheathing. Then the screen must be pulled back to this point, the aluminium foil is cut off and the drain wire left undamaged

c) when the end of the cable, where the screen is to be connected to the instrument earth is being terminated, a green-yellow insulated 30/0.25 mm single core cable must be soldered to the drain wire. At the other end of the cable the drain wire is folded back along the sheath and cut off

d) a neoprene sleeve or heat shrink must be placed over the drain wire at the field or sending end of the cable and the drain wire and soldered connection at the terminating end of the cable. This sleeve must be of the tight fitting elastic type, e.g. "Helaprene" neoprene latex sleeves. Insulation tape will not be accepted

e) the free end of the 30/0.25 mm cable must be connected to the instrument earth or the terminal designated for it

f) multi-core or multi-pair cable with individually screened cores must be treated in a similar manner but in this case all the drain wires can be soldered to a common 30/0.25 mm, green-yellow single core cable directly connected to the instrumentation earth terminal designated for this purpose

g) any unused cores in a multicore or multi-pair cable must be terminated, grouped and earthed (to the earth bar) at the cubicle or receiving end. In the field these unused cores should be individually insulated from each other and terminated on a spare terminal.

9.17 Electrical interference in cables

Electrical interference or noise is a result of unwanted voltage/current from external sources. There are five basic types that affect electronic instruments and these may be reduced or eliminated by using the correct techniques detailed below:

a) electrostatic (capacitive) coupling causes a flow of charge in response to a change in charge of an adjacent conductor. An overall screen is used (eg aluminium/polyester laminate) and discharged by earthing at one point only

b) magnetic (inductive) coupling occurs when a conductor is subject to a changing magnetic field. Twisting the signal pair equalises the effect on both conductors

c) common mode interference results from differences in ground potential. Earthing at only one point and equipotential bonding of the earth system should be used to minimise this interference

d) cross-talk results when AC signals are coupled from one pair to another within the same multicore cable. This is eliminated by using only DC signals or if AC is unavoidable (eg voice), use a cable with an irregular lay allowing the relative locations of the twisted pairs to vary, one to another, throughout its length

e) radio frequency interference (RFI) is electromagnetic coupling at very high frequency and is reduced by twisting the conductors and enclosing the conductors inside an overall screen which is suitably earthed.

Earthing of screens and drain wires should always take place at the RTU or PLC Cubicle end unless specifically directed otherwise (eg fast response thermocouples may need to be grounded at the thermocouple end only).

9.18 Cubicle wiring

All electrical connections must be capable of being connected and disconnected from the front and all equipment and wiring must be so arranged that each can be removed and replaced separately from the front without disturbing the remaining equipment and wiring.

Control wiring must be flexible circular section PVC, and must be V90, 0.6/1 kV grade to AS/NZS 5000 with multi-strand copper conductors of minimum stranding/diameter of 32/0.20 mm and cross sectional area of 1.0 mm^2.

230V power wiring, where applicable, must be sized in accordance with the current version of AS3008. Power cables must be a minimum PVC V75, 0.6/1 kV grade to AS/NZS 5000 with multi-strand copper conductors of minimum stranding/diameter of 30/0.25 mm and cross sectional area of 1.5 mm^2.

Instrument wiring must be PVC/Screened/PVC cable, V90 with multi-strand tinned copper conductors of minimum standing/diameter of 7/0.30 mm and cross sectional area of 0.50 mm^2.

All power and control/instrumentation wiring equipment and terminals must be physically segregated from each other. Access to power wiring ducts must not be through control/ instrumentation ducts or vice versa.

Terminal strips must be fitted with barriers between mixed voltages, shrouded, identified with labels indicating applied voltages.

Wiring for instrument signals and the like must be run in separate ducting. Intrinsically safe wiring must be segregated from all other wiring via the use of light blue coloured wiring duct and physical barriers/separation along the entire length of the wiring.

Care must be taken when laying wiring in plastic wiring ducts and the like, they must be neatly grouped, run parallel with crossovers confined to wiring entering and leaving the duct.

The number of wiring in ducts and the like must be such that the space factor requirements of the current version of AS/NZS 3000 and AS3008 are complied with.

Wiring to door mounted equipment must be fixed to hinge side of door and not impede door opening. Spiral type sheathing must be applied to the cables between the fixing at the cubicle and the fixing of the door.

9.19 Identification - cables, cable cores, cubicle wiring

9.19.1 Cables

All cables must be identified at both ends (at each termination) using plastic, or stainless steel, cable marker strips with lettering and numbering in accordance with the specification detailed on the approved Contractor's cable schedules and/or interconnection wiring diagrams. The marker strip type should be suitable for the application and/or environment. Each cable must be identified at the time of glanding off.

For plastic (e.g. PVC, polypropylene or polyethylene) cable markers the label must be machine printed on a yellow background with bold black text. The printing method must be a minimum of thermal transfer print technology. The label must be protected by a clear polyester overlaminate or plastic carrier sleeve. The cable marker and sleeve must be tear, heat, chemical and abrasion resistant. Outdoor cable markers must be designed for outdoor applications and be waterproof and UV resistant. Marker sleeves or overlaminates must be UV stabilised. The label carrier must be secured to the cable at both ends by UV stabilised nylon cable ties.

Where stainless steel cable markers are used they must be grade 316 (e.g. Markfast Steel Mark - Laser Etched Tag, or equivalent). Stainless steel cable markers must be secured to the cable at both ends by grade 316 stainless steel cable ties. The text must be black, machine printed and laser etched. The text must be waterproof, UV, heat, chemical and abrasion resistant.

Cable markers must be installed on cables above the gland plates and must be clearly visible from the access position.

Cable markers must be neatly placed, reading from left to right when horizontal and bottom to top when vertical.

The unique equipment/instrument loop number must be in accordance with SWCs ‘Process and Instrumentation Diagram’ for each specific site.

The letter, denoting the cable duty, must be as follows:

P	-	for power cables (400V AC and 230V AC, 50 Hz) or
		230V AC control cables (if applicable for special cases)
E	-	for earth cables
T	-	for telecommunication cables (copper)
I	-	for instrumentation cables (analogue)
C	-	for control cables (24V DC) or 24V DC power supply to an instrument
D	-	copper data communication cables (LAN, serial)
F	-	fibre optic communication cables

Note 1: ‘P’ should be used as a cable identifier for any cable containing a dangerous voltage.

Note 2: ‘I’ should be used for all signal and 24 V DC power supply cores associated with 3-wire and 4-wire transmitters.

The following system of cable identification must be adopted.

a) Cable identification-waste water/water distribution systems (SPSs, WPSs, monitoring stations):

Cable identification must be a unique equipment/instrument loop three (3) digit numbers followed by a dash (-) and a capital letter denoting the cable duty and a two (2) digit sequential number for each cable of the same cable duty, e.g. 333-P01, 333-P02.

333-P01

333 – Loop no or equipment no

P – Cable duty (P for low voltage power signals) or

230V AC control cables (eg cables connecting to hand stations)

01 – Cable no

b) Cable identification- waste water/water treatment plants (STP, WTP):

Cable identification must be the three (3) letter asset code, a unique equipment/instrument loop four (4) digit numbers (‘1’ digit area code) + (‘1’ digit sub- area code) + (‘2’ digits loop or equipment number) followed by a dash (-) and a capital letter denoting the cable duty and a two (2) digit sequential number for each cable of the same cable duty (eg PMP1233-P01).

PMP1 2 33 – P01 -

PMP – Asset code

1 – Area code

2 – Sub area code

33 – Loop no or equipment no

P – Cable duty (P for Power or 230V AC control cables)

01 – Cable no

9.19.2 Cables cores

a) 230VAC power cable cores and 230V AC control cable cores

All power cable cores must be identified at both ends (at each termination) by the appropriate red, white and blue phase colour, and black for the neutral.

230V AC Control and monitoring cable cores must be identified at both ends (at each termination) by the sequential number on the respective white coloured core and a sleeve type label. 230V AC cable core identification system must consist of the equipment number followed by dash and cable number and two digit sequential core numbers (eg. 5042-P01/01).

b) Earth cable cores

All earth cores must be identified at both ends (at each termination) by the colour green-yellow (or green where permitted by the current version of AS/NZS 3000). Other colours will not be acceptable. Under no circumstances must the colour green or green yellow be used for other than earth core identification.

c) Telecommunication cable cores

<u>Voice grade twisted pair (copper)</u>

All telecommunication cable cores must be identified at both ends (at each termination) by the colour associated with each pair of cores and must be recorded in a ‘Distribution Record Book’ in compliance with the current version of AS/CA S009.

Refer to section 8 for further details.

Fibre optic cables

All fibre optic telecommunication cables must have termination and cable numbering details recorded in a 'Distribution Record Book' in compliance with AS/CA S009.

Refer to section 8 of this manual for further details.

d) Instrumentation (analogue) cable cores

All instrumentation cable/wire core pairs must be identified at both ends (at each termination) by the black and white respective core colour and a sleeve type label.

For wires within a panel the wire core identification system must consist of the loop/equipment number followed by a dash and followed by the wire number for that loop, starting with "1" at the most positive point in the loop (eg. 310-1, 310-2, 310-3, 310-4 etc for loop LI310 for reservoir transmitter for IICATS project).

For cables that run between panels, or from panels to equipment the cable core identification system must consist of the loop/equipment number followed by dash and cable number and two digit sequential pair number followed by the core colour (W for white or B for black). (eg. The cores of the second multipair cable (Cable No: XXX-I02) between Flowmeter 1 (Equipment No: E140) and control cubicle will be numbered as 140-I02-01W, 010-I02-01B, 010-I02-02W, 010-I02-02B etc.)

Multi-pair instrument cables in Treatment Plants:

The cable number of the multi-pair must take pre-fix from the cubicle or equipment it originates from (eg the 4th instrument cable originating from cubicle EP1233 must have cable number EP1233-I04). If the first pair of cores within that cable is for pressure indicating transmitter 1256, the two cores of that pair must be labelled as PIT1256-01 and PIT1256-02, if the second pair is for temperature indicating transmitter 1257, then the cores would be TIT1257-01 and PIT1257-02 etc.

e) Control and Monitoring (Digital) Cable Cores or 24 V DC power supply

All control and monitoring cable cores must be identified at both ends (at each termination) by the sequential number on the respective white coloured core and sleeve type label.

Control and Monitoring Cable Core identification system must consist of the loop/equipment number followed by dash and cable number and two digit sequential core numbers. (eg. The cores of the second multicore cable (Cable No: XXX-C02) between Starter 1 (Equipment No: E010) and control cubicle will be numbered as 010-C02-01, 010-C02-02, 010-C02-03, 010-C02-04 etc.)

IICATS example (SPS applications);

010-C2-03

010- Equipment No (Starter 1 for IICATS SPS projects)

C - Cable Duty (C for Control)

02- Cable No (2nd cable of same cable duty)

03- 3rd core of 010-C02

An example for Water/wastewater Treatment Plants:-

PMP1233-C2-03

PMP – asset code

1233- (area code (1)+sub area code (2)+Equipment code (33))

C - Cable Duty (C for Control)

2- Cable No (2nd cable of same cable duty)

3- 3rd core of 1233-C2

f) Control and Monitoring core and wire labels

Control and monitoring wires and cable cores must be identified at both ends by clear PVC sleeve type label carriers with insertable labels (e.g. Durasleeve, Markfast sleeve and labels or equivalent). The sleeve must be matched to the OD of the cable so that it does not slide on the wire under normal conditions. Labels must be machine printed on a white polypropylene or acrylic label with black text. The printing method must be laser engraved printing or thermal transfer print technology. Laser engraved label trees are preferred. The label must be sized to the sleeve carrier, as supplied by the manufacturer, so that it does not slide out unless deliberately removed. Sleeve type label carriers and labels are only suitable for indoor or internal enclosure applications.

9.19.3 SCADA LAN cable numbering

For all but the smallest Treatment plants the Plant SCADA and control network is configured to comprise a self-healing ring/s.

- The labelling of cables and cable cores must be in accordance with the above sub clauses 9.19.1 and 9.19.2.
- For fibre cables that run between areas:
  - Cable duty is to be identified using prefix "D" for copper data cable and "F" for fibre optic cable.
  - Fibre cable to be numbered using SOURCE AREA – DESTINATION AREA – CABLE NUMBER (XXXX – YYYY - FZZ) e.g. 0001 – 0002 – F03 for the third fibre cable in the ring running from area 0001 to area 0002.
  - The source, destination and cable number is to be determined from the network layout diagram with the cables run in a clockwise direction around the plant;
- For fibre or copper patch leads within an area:
  - Cables are to be identified using a SOURCE-PORT – DESTINATION-PORT convention;
  - Source and destination equipment identification must use the Maximo asset ID, or abbreviation where the Maximo asset ID is not applicable, as per Table 9-4.
  - Both ends of the cable must use the same cable number. Source priority is to be determined using table x. Equipment with the highest priority must be used as the source. For equipment with equal priority the lowest numbered equipment must be used as the source.
  - The port is the port number the cable terminates at. For PLCs the rack/slot/port number is to be used. SCADA workstations do not require a port designation.
  - Examples:
    - For numbering of LAN cables connecting between network switches and PLCs, switches have the higher priority. E.g. TMS1004-P01 – PLC1001-R00S01P02.
    - For numbering of LAN cables between network switches and workstations, switches have the higher priority and workstations do not require a port designation. E.g. TMS1004-P02 – WS04.
    - For numbering LAN cable connecting between switches, the lowest number switch has priority. E.g. TMS1004-P03 – TMS1005-P04.
    - For numbering LAN cables between PLCs and remote I/O drops, the Rack/Slot/Port identification is used and the remote I/O drop is the destinations e.g. PLC1001-R00S01P02 – PLC1001-R04S01P01
    - For numbering of LAN cables connecting between network switches and FOBOTS, switches have the higher priority. E.g. TMS1004-P05 – F04-T1/2.
    - For numbering of LAN cables connecting between network switches and socket outlets, switches have the higher priority. Use the socket outlet label for the destination. E.g. TMS1004-P05 – A.GF.ER.02-RU40.002.
- For patch lead colours to be used for the Plant SCADA and control network refer to D0000724 Treatment Plant SCADA Standards.

Table 9-4. Treatment plant SCADA equipment abbreviations and priorities.

Equipment	Asset ID	Abbreviation/comment	Priority
Switch	TMS		1
PLC	PLC		2
Patch panel		Use the patch panel port label e.g. A.GF.ER.02-RU22.004	3
Firewall	IFD		4
Guard	ITM		5
LAN socket outlet		Use the socket outlet label e.g. A.GF.ER.02-RU40.002	6
Workstation		Use the workstation number – e.g. WS2	7
FOBOT		Use the fibre cable number and terminal number e.g. F03-T1/2	9
Other equipment & instruments	As per Maximo asset ID		10

9.19.4 Identification of cubicle wiring

Labelling

Each end of all wiring conductors must be identified with white thermoplastic interlocking ferrules with machine printed black and red characters. Each wire must be uniquely identified. Ferrules must be sized to fit wiring conductor insulation and installed at every terminal. Ferrules must be oriented towards and visible from cubicle access point.

The wiring identification system within cubicles, electrical enclosures and the like must consist of two (2) components separated by a dash as follows:

The first component must be the line number corresponding to the location of the wire on the circuit drawing.

The second component must be the position number of the wire on the line number referred to by the first component.

For example -

The third (3) wire on drawing line reference seventeen (17) of the circuit diagram would have a wire identifier '17-3'.

Colour coding

Wiring inside cubicles must be colour coded as per Table 9-5.

Table 9-5. Cubicle colour coding.

Cable function	Colour	Notes
230V AC control	Brown	Active- locally isolated
	Orange	Active- remotely isolated
	Black	Neutral
24 V DC other than twisted pair conductors	Light grey	All cores
Intrinsically Safe	Light blue	All cores
Instrumentation twisted pair conductors	White	Positive
	Black	Negative

Technical Specification

Sydney WATER

Part 10 – Earthing and Neutral Connections for Instrumentation and Control

10. Earthing and Neutral Connections for Instrumentation and Control

10.1 General

For sites where an earthing system exists, the system shall be examined, evaluated, and modified as necessary to meet all requirements stated herein and in the current version of AS/NZS 1768 and AS/NZS 3000. Sydney Water DOC0016 Technical Specification – Earthing and Lighting also applies for HV installations. For these sites the impact to, and effect on, the instrumentation and control earthing must be considered as part of the assessment.

All electrical, instrumentation and communication equipment and exposed metal on which such equipment is mounted including steel conduits, cable ladder tray, metal cable glands, gland plates, cable armouring and screening shall be earthed in accordance with the requirements of the current version of AS/NZS 3000 and those of the Electricity Supply Authority and the Australian Communications Authority.

Notwithstanding some provisions of AS/NZS 3000 regarding the use of constructional bolts or studs for earthing or earthing terminals, all metal to be earthed shall be connected from an approved earth terminal directly to the earth bar or link with an electrically continuous copper conductor.

Metallic pipes used for other services, such as gas, water and the like, shall be considered as unavoidably in contact with metallic enclosures of electrical equipment and shall be effectively bonded to the power supply earthing system (the main earth bar).

Bare earth conductors shall not be used unless otherwise detailed.

Screened cables shall have their screens connected to earth at the signal destination end (control cubicle earth bar) unless specified otherwise, and isolated from earth at the signal source and for the full length of the cable run to ensure that cable screens are earthed at one common point only.

The negative of instrument loop signals shall be earthed only at the DC voltage source. For a common DC voltage source, the negative of the source voltage only shall be earthed via control cubicle earth bar.

For power supply earthing systems, a separate MEN system for each building or outdoor enclosure shall be used except where an earthing conductor is run with the submain to that building or outdoor enclosure.

The effects of Earth Potential Rise (EPR) shall be a major consideration during design and installation and shall comply with all the recommendations as set in the current version of AS/CA S009 and relevant codes.

The earthing of telecommunications multi pair cable shall comply with section 8 'Telecommunications', clause 8.7 'Plant Communications Earthing and Surge Protection'.

The earthing of lightning/surge protection units shall comply with section 11 'Lightning and surge protection', clause 11.9 'Earthing of protection units'.

10.2 Earth electrodes

Earth electrodes shall consist of copper plated stainless steel rods not less than 16 mm diameter driven to a depth of not less than 1800 mm to reach the permanent moisture level.

Where the ground permits the electrodes shall be of the extendible type to enable improvement in the earth resistance by extending the electrodes and driving them deeper.

The connection at the top of all earth electrodes shall be installed in spigotted pipes or approved pits with hot dipped galvanised checker plate covers flush with the top of the pipe or pit.

All earth electrodes shall be provided with an accessible removable type connection or link or other prior approved means to enable resistance tests to be carried out. The earth resistance provided by the electrode (or electrodes) shall comply with the requirements of the current version of AS/NZS 3000 and of the Electricity Supply Authority. After completion, tests in accordance with AS/NZS 3000 and Supply authority's requirements shall be carried out on the earth electrode to verify that it complies with the requirements of the Standards and that is suitable for the use intended. The records of measurement and verification shall be supplied to Sydney Water.

10.3 Earth bars and links

All earth bars and connections shall be of high conductivity copper sized for the application.

Earth bars shall be fitted in all cubicles and panels and shall incorporate terminals of the appropriate size to allow for the termination, where applicable, of the following:

a) main earth cable (earthing conductor) of minimum size 6 mm^2 between cubicle earth bar (instrument earth) and power supply system earth (main earth bar/link)

b) instrumentation and control cables screens

c) surge protection earthing cabling.

Using soldered joints and unsupported in-line connectors to terminate earth conductors and screens is not acceptable. Earth bars shall have terminations to accommodate all circuits and 25% spares for future connection.

10.4 Earthing and neutral connections

a) Earthing connections

All metal cases of instruments, selector switches, and the like either mounted on the hinged doors or front covers shall be directly connected by an electrically continuous flexible multi-stranded earth cable (of minimum size 2.5 mm^2) to the cubicle earth bar.

All electrical equipment and exposed metal on which electrical equipment is mounted shall be earthed in accordance with the requirements of the current version of AS/NZS 3000 and of the Electricity Supply Authority. Earthing connections shall be such that removal of one component or its earthing conductor shall not affect continuity of the earthing conductor associated with any other component.

Cable gland plates shall be fitted with a M9 brass earth stud, which shall be connected by an appropriately sized earthing conductor to the earth bar.

Metal frames of fuse switches and circuit breakers shall be connected to the earth bar, the earthing cable shall be of a size suitable to the particular switch or circuit breaker.

One secondary of all current transformers shall be connected to the earth bar. Earth cables shall be sized to comply with the requirements of the current version of AS/NZS 3000 and of the Electricity Supply Authority.

Earthing of components by means of mounting fastening is not acceptable.

If electrical equipment is mounted on hinged cubicle components such as doors, partitions or chassis assemblies, cubicle components shall be separately earthed by means of a flexible earth link across the hinge.

b) neutral connections

All neutral conductors from circuit components shall be connected to the neutral terminal for each circuit; the circuit neutral terminal shall be connected directly to the neutral bar. No "looped" neutral connections will be permitted.

10.5 Equipotential bonding

The purpose of equipotential bonding is to eliminate earth loops and potential differences (refer to SSD/08 - Preferred Earth and Bonding Arrangements).

A site may have several service earths installed. The different service earths may comprise structural steelwork, electricity supply, telephone communications, metallic process pipelines and lightning protection earths. When potential differences occur between any of these service earths, equipment damage is imminent.

It is of vital importance that all service earths be bonded together. The bonding conductors and associated bonding conductor termination points (eg earth bars and electrodes) shall form an earth grid, which is collectively referred to as the site earth or system earth. All bonds should follow the most direct lowest impendence path possible. The following equipotential bonding shall be carried out:

- the electricity supply earth (main earth bar) is to be bonded to the lightning protection earth. The bonding cable shall be at least 6 mm^2 as per requirements of the standard. The applicable Supply Authority regulations are to be adhered to
- the communication earth is to be bonded to the lightning protection or electricity supply earth. The bonding cable shall be at least 6mm^2. ACMA regulations are to be adhered to
- all cubicle/panel earth bars including the control cubicle earth bar (instrument earth) shall be bonded to the electricity supply earth (main earth bar/link). The bonding cable shall be at least 6 mm^2
- metallic process pipelines shall be bonded to the lightning protection earth. The bonding cable shall be at least 16 mm^2
- the structural steelwork and all other service earths as stated above shall be bonded to the lightning protection earth. The dimension of the bonding cable shall not be less than 16 mm^2
- the earth link from lightning protection earth to the electricity supply earth (the main earth bar/link) shall be limited to a maximum of 15 m and run via the most direct route. In case the distance to the site earth is more than 15 m, a separate electrode shall be installed and bonded to the electricity supply earth (main earth bar)

10.6 Resistance of the earthing system

The resistance of the earthing system shall comply with the current version of AS/NZS 3000 earthing requirements. The resistance of the main earthing conductor (the conductor between main earth bar and earth electrode) or any equipotential bonding conductor shall be no more than 0.5 ohm. The resistance from any point on the installation required to be earthed to the point where the main earthing conductor is connected to the neutral conductor of the supply system (ie main earth bar/link) shall be low enough to permit the passage of current necessary to operate the circuit protective devices.

The resistance of the earth cable (minimum 6mm^2 diameter) between the point of connection to the electricity supply earth (the main earth bar) and the instrument earth (control cubicle earth bar) shall not exceed 1 ohm.

The impedance between the site earth system and the general mass of earth shall not exceed 10 ohms except with written approval of the Superintendent.

On completion of the installation or modifications to the site earthing system, the resistance to earth of the whole installation and or each earth termination shall be measured and continuity of all conductors, bonds and joints and their mechanical condition verified. The records of measurement and verification shall be supplied to the Superintendent's Representative.

Technical Specification

Part 11 - Lightning and Surge Protection for Instrumentation and Control

11. Lightning and Surge Protection for Instrumentation and Control

11.1 General

Any length of instrument signal, telecommunication or power supply cable is a potential aerial for surges due to lightning.

The most common damage to systems occurs when lightning discharges to the ground within close proximity to the cable run (within a kilometre). The rapid rise in ground potential, which can be as high as 2000 volts per metre, produces large earth currents in cables due to potential differences in the network.

Lightning may also strike installations as a near or direct strike to cables or by inducing surges in cables from cloud to cloud discharges.

The current version of NZS/AS 1768 for lightning protection details the design requirements of complete lightning protection systems to protect the building or structure from direct lightning strikes or induced surges entering via mains, communication lines or building services. Effective protection against high energy transients and induced transient (capacitive and inductive) can be achieved by applying direct strike solutions for protection of facilities, structures and people, and transient and surge solutions for protection of equipment, operations and service.

'Direct strike lightning protection' for a site is not in the scope of this I&C Manual. If required in the scope of Work, such a system must be provided in accordance with the requirements of the current version of NZS/AS 1768. Point of entry protection-'Surge diverters for incoming power lines'- is not in the scope of this I&C Manual, and must be provided in accordance with relevant clauses of the current version of SWC document Technical Specification – Electrical.

Lightning/Surge Protection Device (SPDs) must be used for the protection of equipment and personnel from lightning and other surge effects on all sites.

Transient and surge protection for the equipment and signal lines must be provided at the possible entry points for lightning impulses and other surges. The possible entry points for lightning impulses and other surges include, but are not necessarily limited to the following:

external structure or roof top protrusion (air termination, antenna, satellite dishes, etc)

- the electricity supply (overhead lines or underground cables)
- telecommunication cables (overhead lines or underground cables)
- control and instrumentation cables (overhead lines or underground cables)
- water or gas pipelines
- earthing systems (power earth, communication earth, lightning protection earth, water pipe earth); and
- building lighting protection system (if provided).

The following clauses describe the design and installation requirements and guidelines to choose suitable lightning/surge protection units for different applications.

11.2 Transient and lightning protection for mains powered equipment (230V AC, 50Hz)

Three mode, or all mode, surge diverters (refer to SWC document 'Technical Specification - Electrical'.) installed on each incoming supply as primary protection are used to clamp the voltage when it exceeds a certain limit but may not provide adequate protection for control and instrumentation equipment. Therefore an additional protection unit specifically designed for process control applications to protect the switched mode power supply units must be provided at the entry point of the 240 volt AC, 50 Hz power supply unless the equipment is supplied from a UPS installed within the same building as the equipment. Upstream primary SPDs should include spark gap technology to improve coordination with downstream devices.

The protection units must be provided at the entry point of 230V AC supply to the following:

- 24V DC power supply units

- four (4) wire transmitters
- cubicles (RTU, water quality monitoring, pressure monitoring, etc)
- PLCs, RTUs
- communications equipment (modems and routers)
- UPS units.

Transient and surge protection units for mains powered equipment must be designed to ensure the voltage protection level (Up) is sufficiently reduced to prevent equipment damage. It must comply with the following minimum requirements:

- supply voltage: 230V AC, 50Hz
- maximum continuous operating voltage ≥260V rms
- surge rating In 20 kA (L-N, L-PE) and 10kA (N-PE) (Using an In test as defined by IEC61643-11 8/20μs waveform) or above
- 3 protection modes: L-N, L-G, N-G
- Let through voltage Up <1500 V at In and < 700 V L-N at 3kA (8/20μs) and N-PE at 1kV/μs
- efficient filtering to protect equipment from large dv/dt and di/dt transients
- easy installation- DIN rail mounting
- standard models available for different loads (5 A to 20A range)
- Failsafe monitoring circuit for connection to a RTU/PLC digital input
- For hybrid SPDs designed to provide both primary and secondary protection, one stage should be a spark gap
- Should have an RCM mark indicating compliance, through independent testing, to EMC, and other applicable, standards

11.3 Surge protection for instrument signal lines

Surge protection devices for applications on long lines (i.e. all cables over 5 m in length and external to a cubicle/ building), high exposure lines and lines susceptible to induction must be used. SPDs must provide at least 2 stages of protection, one of which must be a gas discharge tube.

The clamping voltage must be selected based on open circuit driving voltage, ie for a 24V DC loop a continuous operating voltage of ≥ 29V DC must be used. The SPD must have a total discharge current (I_{total}) ≥ 10KA, (8/20μs waveform as per IEC test conditions), a nominal discharge current (I_n) of >= 5kA line-line and line-earth (defined as the nominated surge current for an IEC C2 test), and a pulse discharge current (I_{imp}) of >= 0.5kA (defined as IEC D1 rating point). Refer to Table 11-1 to 11-4 for all rating requirements.

Instrument SPDs must have an end-to-end resistance not greater than 3 ohms, a maximum continuous operating current ≥ 250 mA and a leakage current less than 10 μA. A high current version ≥ 2A must also be available in the range.

SPDs for instrument signal lines must have a positive clamping mechanism to earth to the instrument surge DIN rail. The SPD must have options for an earthed and floating shield in the range. The floating option must provide a GDT path to earth in the event of a surge.

Table 11-1. Line-line minimum SPD ratings.

Category	Open circuit voltage	Short circuit current	Up
C1 (x300)	1kV (1.2/50)	0.5kA (8/20)	≤ 200V
C2 (x10)	10kV (1.2/50)	5kA (8/20)	≤ 320V
C3 (x300)	1kV/μs	25A (10/1000) 100A (10/1000)	≤ 50V ≤ 55V
D1 (x2)	≥ 1kV	0.5 kA	Pass

Table 11-2. Line-earth, or line to PE, minimum instrument SPD ratings.

Category	Open circuit voltage	Short circuit current	Up
C1 (x300)	1kV (1.2/50)	0.5kA (8/20)	≤ 750V
C2 (x10)	10kV (1.2/50)	5kA (8/20)	≤ 750V
C3 (x300)	1kV/μs	25A (10/1000) 100A (10/1000)	≤ 700V ≤ 750V
D1 (x2)	≥ 1kV	0.5 kA	Pass

Table 11-3. Static line-line minimum instrument SPD ratings.

Category	Open circuit voltage	Short circuit current	Up
C1 (x300)	1kV (1.2/50)	0.5kA (8/20)	≤ 50V
C2 (x10)	10kV (1.2/50)	5kA (8/20)	≤ 120V

Table 11-4. Static line-earth, or line to PE, minimum instrument SPD ratings.

Category	Open circuit voltage	Short circuit current	Up
C1 (x300)	1kV (1.2/50)	0.5kA (8/20)	≤ 750V
C2 (x10)	10kV (1.2/50)	5kA (8/20)	≤ 750V

11.4 Surge protection for telecommunications and data circuits

For telecommunications lines, primary protection utilising the three pole module (A-side BD) gas arrester or discharge tube must be used at the network carrier's termination.

In circumstances where the potential for induced transients or over voltage is high (eg overhead cables), multi-stage protectors, utilising the gas arrester or discharge tube as primary protection, metal oxide varistors to clamp the over voltage as second stage protection, and decoupled semi-conductor high speed diodes for both transverse and common mode attenuation as final stage protection, must be used.

The SPD for telecommunication cables that make electrical connection with a communication service provider must comply with ACMA requirements.

11.5 Surge protection for radio/satellite communications

Coaxial surge protectors must be used to protect radio equipment against lightning and other induced disturbances. Coaxial surge protectors must be suitable for use on MF, HF, VHF and UHF and microwave frequency cables.

The coaxial surge protection must be used between the antenna and communications device and must be fitted with an appropriate earth integrated with the site earthing system.

Where a radio/satellite communication device possesses an integral antenna and communication device, to be mounted externally on a mast or structure, protection devices and appropriate earthing must be provided on all cabling entering the device at both terminating ends of each cable.

Any mast or structure supporting radio communications antennas or equipment must be fitted with an appropriate earth and integrated with the site earthing system.

Appropriate earthing of radio communications equipment, masts, structures and coaxial lightning protection units must comply with the current version of AS/NZS 1768 and AS/NZS 3000.

Where the earthing of radio communications equipment is to be installed in proximity to a building lightning protection system or a Dynasphere type lightning protection system, the antenna or coaxial earthing system must have a separation distance that meets the requirements of the current version of AS1768.

Coaxial surge protectors must comply with the ACMA requirements.

11.6 Performance Specification – General

On an industrial or commercial site there will typically be two or three types of zones, each requiring differing forms of protection.

Zone 1 – the entry point to a site should be protected primarily by a surge diverter.

Zone 2 – is at the main switch or distribution board. The protection device here must be a surge filter that can both divert the surge and control the amount of current to the equipment downstream.

Zone 3 – in this zone, the surge device must be suitable for the protection of power supplies, instruments, data, communications and radio equipment, etc. and their cables.

a) environmental conditions

The lightning and surge protection unit must suffer negligible degradation of performance for environmental changes within the standard requirements operational limits. Unit must operate within the defined specification over the following range of environmental conditions:

- ambient temperature:
  - indoors –10 deg C to + 55 deg C;
  - outdoors or chambers –25 deg C to + 70 deg C
- relative humidity: 5 % to 95 % non condensing

b) protection

The lightning and surge protection unit must have a speed of response sufficient to ensure that a surge of 40 kA pulse on incoming mains supply or 5 kA pulse on any other externally connected circuit, 8/20 micro seconds waveform, line-to-line or line-to-earth, is accommodated and consequently protection is maintained in all situations other than overload resulting from a “direct strike”.

c) auto reset

The unit must auto reset. The unit must provide protection over multiple strikes.

d) compliance

All lightning and surge protection units must comply with the requirements of the current version of AS1768 and relevant regulatory authority requirements and must be certified as tested to IEC 61643 latest version. Test certificates and results must be available to indicate testing to the latest version, that the device was independently tested, Up was measured at the Up peak, a hybrid surge generator was used (generator produced a voltage surge with a follow on current surge) and the surge was imposed on the max operating current. All lightning and surge protection units must be matched to the risk zone to which they are being applied.

e) Failed indication

SPDs must provide a visual indication of a failed protective component and provide a means of remote monitoring. This must be a failsafe circuit. The circuit should open circuit if a device has failed. The design must allow all surge protection to be monitored by a single digital input to the RTU or PLC.

f) Stages of protection

SPDs for instrument and signal lines must provide at least 2 stages of protection, one of which must be a gas discharge tube.

g) Failsafe operation

The surge protection should be designed such that susceptible components fail open circuit. Components that typical fail to earth via a short circuit, such as MOVs and diodes, should provide a means for thermal disconnect when they reach end of life.

h) Design

SPDs for instrument and signal lines must use a base and plug design. The replaceable plug is to replace the protective components (e.g. GDT and diodes) without the need to remove wiring from the base terminals.

i) HART compatible

SPDs for instrument and signal lines must be HART compatible.

j) Electrical characteristics

SPDs for instrument and signal lines must have a series resistance per path, or per line, of ≤ two (2) ohms and response time ≤ five (5) ns.

11.7 Physical specification- general

The housing of the lightning protection units located outdoors must be an IP65 rated enclosure. This must be suitably sized to provide adequate space for protection of all the cable cores of the multi-core cable entering the enclosure such that, in the future, if additional circuits are needed, they may be protected by new SPDs located in this enclosure.

The SPD must be suitable for DIN rail mounting within an enclosure or junction box. Slimline type SPDs, with width ≤ seven (7) mm, should be used for signal and instruments.

11.8 Installation specifications

The installation of surge protection must follow the guidelines in the current version of AS/NZS 3000, the manufacturer's recommendations, and this Standard.

The application of surge protection must be as follows:

(i) cable run is outside the building AND remote equipment is non-electronic (e.g. buoyancy switch);

- provide surge protection at the marshalling cubicle only.

(ii) cable run is outside the building AND remote equipment is electronic (e.g. field located flow meter, level transmitter, pressure indicating transmitter);

- provide surge protection at both ends, one at or preferably incorporated in the field instrument and one at the Marshalling Cubicle.
- where surge protection cannot be incorporated into the field instrument external surge protection must be provided as close to the instrument as reasonably possible, or as the cable enters the remote cubicle, for instruments located in remote panels.

(iii) telecommunication lead in cable;

- at all sites provide surge protection at the network boundary MDF
- where the site includes multiple distributors, additional surge protection must be installed on each line at each distributor that provides direct connection of a copper communication service for that RTU/PLC.

(iv) network cabling;

Ethernet cable must be fitted with surge protection acting on all cable cores where;

- the cable leaves a cubicle to connect to another cubicle within a structure

- leaves a structure to connect to a device in an adjacent structure
- connects to a Telstra TRT modem Ethernet port from outside the panel the Telstra modem is housed in.
- connects a security system with field sensor wiring to the Ethernet interface on the Telstra modem Ethernet port.

(v) copper data cabling;

Copper data cabling carrying serial or similar signals such as RS/485/RS422/RS232 must be fitted with surge protection acting on all cable cores where;

- the cable leaves a cubicle to connect to another cubicle within a structure
- leaves a structure to connect to a device in an adjacent structure
- connects to a Telstra modem serial port from outside the panel the modem is housed in.

The above provisions comprise the SWC standard approach to surge protection. The basis of the approach is that all cables that connect equipment located within or upon the building or structure, with equipment forming part of another building or structure, or with equipment mounted directly in the ground, must have surge protection. The AS1768 Risk Assessment spread sheet is not concerned with the remote equipment and consequently refers to these cables under the category “Surge Protection at Point of Entry”. Surge protection at point of entry must be provided at all SWC buildings or structures. The AS1768 Risk Assessment spread sheet also refers to a category “Surge Protection on All Equipment”. Surge protection on all equipment must not be provided at any SWC buildings or structures unless specifically authorised in writing by SWC. Should the AS1768 Risk Assessment spread sheet indicate that surge protection should be provided on all equipment in order to achieve an acceptable risk, then this matter must be drawn to the attention of SWC in writing in order that SWC may determine the most appropriate course of action in order to achieve an acceptable risk.

11.9 Earthing of SPDs

The earthing must comply with the requirements of the current version of AS/NZS 3000 and of NZS/AS 1768 and manufacturers’ guidelines. A low impedance earth is to be provided to facilitate the dissipation of the lightning energy into the general mass of earth as quickly as possible. A maximum resistance level of 10 ohms is permitted for the whole of the interconnected lightning protection system (measured from the system earth to the general mass of earth as per Appendix B of AS1768). This cable must be direct to earth, as short as possible, and to manufacturers’ guidelines and applicable standards.

The earth cable connection between the SPD common earthing point and the site earth (system earth) must have an impedance less than 0.01 ohm.

Where a remote instrument is to be protected and no system earth exists, then a suitable earth must be provided locally in the form of an earth rod (electrode).

Also, where the site earth is over 15m from the cubicle earth bar, then a new earth electrode must be located as close as possible to the earth bar and an equipotential bonding connection must be made from the electrode to the site earth in accordance with subclause 11.10 below.

The electrode must achieve a low resistance or have a low resistance. For simple applications where the ground water level is high, single rod earthing is satisfactory. For medium soil resistivity, multiple rod or radial earthing is required. In dry areas where ground water is very low or the terrain is rocky, deep drill earthing is required.

The electrode must be suitable for long-life and type of environment without chemical deterioration.

The electrode must be able to dissipate the maximum current capable of being carried by the attached earth cable.

All joints must be constructed to pass the maximum current capable of being carried by the conductor and whether underground or housed in earth pits, must be sealed to guard against the ingress of moisture. There must be no joints except at the main earth bar. Joints at the earth rod must be exothermic.

The connection to the earth grid at the injection point must be accessible, marked and installed to permit future maintenance inspection.

At sites with an Electricity Authority supply, the surge equipment must be connected directly to the main earth. However, at sites where an Electricity Authority supply does not exist an earth rod (electrode) must be installed.

Earthing associated with communication equipment, e.g. MDF or other Communication Distributor must comply with Section 8 of this manual.

For installation of new earth cables, particularly where the installation of a new earth rod (electrode) is required, the design and installation must ensure that earthing loops are not created within the site earthing system.

11.10 Installation of SPDs and earthing system

Installation of Surge Protection Devices (SPDs) and earthing system must be as follows:

(i) SPDs must be connected to a low impedance earth

(ii) the installation of SPDs must comply with AS3000 wiring rules, AS1768 and all relevant national electrical and safety codes

(iii) ensure that the SPD is of the correct voltage, current, phasing and frequency and suitable for the purpose

(iv) follow the manufacturer's instructions for correct mounting and connection

(v) earth cables for mains SPDs must be ≤ 1m. Ideally they should be ≤ 500mm and be a straight as possible

(vi) keep cables and equipment a suitable distance from the SPD as per manufacturer's instruction

(vii) a minimum of 50 mm clearance between surge protected and non-surge protected cables must be maintained

(viii) equipotential bonding for the earthing must be used

(ix) adhere to AS1768 in order to minimise earth impedance

(x) surge protection must be installed at the entry point of a panel located in the field and at the entry point of a panel after entry to a building.

11.10.1 Earthing for instrument and signal SPDs

All instrument SPDs must be secured to a dedicated instrument surge DIN rail. SPDs must be earthed to the DIN rail. This DIN rail must not be used for any other components other than SPDs and associated earthing terminals. Failure of a single SPD earth connection must not cause failure of any other SPD earth. A clamping ground terminal block must be secured to the DIN rail and a $16mm^2$ multistrand flexible copper earth cable, with ferules, must be installed between the earth terminal block and control panel earth bar. After installation the earth from each SPU to control panel earth bar must be low impedance (<0.01 Ohms).

Instrument and signal SPDs must have the shield earthed at the RTU/PLC panel end only. The field end of the cable must use a floating shield that diverts to earth in the event of a surge event.

For 3 wire Modbus SPDs (HF) the signal ground must be left floating at the RTU end, as this is already grounded at the originating device. An additional earth terminal block must be installed for the shield.

11.11 IICATS SPD numbering

SPD numbering at IICATS sites must use the IICATS preassigned loop numbers. Where the SPD is connected to a cable with a multiloop cable number, 510 to 519, the SPD must be numbered using the original equipment loop number, not the multiloop cable number.

Technical Specification

Part 12 - Process Impulse Line Connections

12. Process Impulse Line Connections

12.1 General

Impulse lines convey the process pressure to the relevant instrumentation. Tube or piping from the process tapping to the instrument must be of approved quality and size for the particular service.

Tubing is the definition used in this manual for naming the process impulse line connections with compressed type fittings.

Piping is the definition used in this manual for naming the process impulse line connections with screwed fittings.

The instrument must generally be installed as close to the process as practical and the impulse lines must be kept as short as possible and must be made from tubing with compression fittings.

When the instrument is mounted in a panel, the impulse line is generally much longer. Steel piping must be used to ensure mechanical strength and allow greater distance between supports. The pipe must be suitably sized to provide freedom from blockage. Line length must be designed for the required speed of response and consider the possibility of blockage and mechanical damage.

Double isolation facilities together with an easy connection and discharge must be provided for all normal maintenance routines.

Except for very light instruments, eg locally mounted pressure gauges, the instruments must not be supported from the impulse lines.

Special provisions may be required in impulse lines such as:

- filling valves on low points when the line is filled with seal fluid
- vent plugs or valves on high points in liquid filled lines
- drain plugs or valves on low points in gas or vapour filled lines
- flushing and neutralising connections for lines and instruments in toxic and/or noxious applications
- straight pipe lengths only with plugged crosses at each corner for rodding
- all spare, or unused, connection points must be plugged.

12.2 Pipe and Screwed Fittings

The minimum size of pipe used must be 1/2 inch N.B. (15 mm).

A larger pipe is required for instrument impulse lines where:

- long pipe runs are necessary or
- dirty gas or highly viscous fluids are measured or
- fluids containing entrained solids are measured.

Material for piping and fittings must be stainless steel except where corrosive conditions require other materials such as monel etc. Piping with suitable lining is required for applications for where no suitable metallic material is available. Threaded fittings must use compatible mating thread forms and when required the correct sealant must be used, - PTFE tape is the preferred method.

12.3 Tubing and Compression Fittings

The minimum size of tube used must be 1/2 inch O.D. (12mm). Wall thickness and fittings must be selected for working pressure and be compatible with process conditions. The wall thickness must not be less than 0.035 inches (0.89 mm).

Tubing must not be used to carry the weight of pressure gauges, seal pots, etc. These items must be supported by steel piping, nipples and fittings.

Stainless steel tube must be used for all clean and dirty water process fluids. Other materials may be considered where stainless steel is not suitable for the process conditions. must

For applications which are subject to high vibrations, compression fittings having an additional o-ring of suitable material must be used.

12.4 Pipe and Tube Connections

All joints in impulse lines must be kept to a minimum.

The method of attachment of isolating valves, vent/test valves and valve manifolds to instruments, must make it possible to disconnect the instrument from the impulse line without having to disconnect or drain the impulse line.

Transducer connections, screwed plugs or caps and any other threaded union must be arranged to release the pressure before final disconnection.

The impulse line layout must allow for easy disconnection of instruments for repair.

12.5 Fall of Impulse Lines

The run of pipes and tubes containing liquids must be arranged such that their slope allows entrained air or gas bubbles to rise to vent points, and liquids or solid deposits to fall to settling chambers or blowdown points. There should be a continuous rise, or fall, of the impulse line between the instrument and process. In pipe runs where obstructions have to be avoided the pipes may be run in a series of slopes providing that gas vents are fitted at high points and settling chambers or blowdowns at low points. These points should be arranged in positions suitable for ease of operation.

Service	Minimum fall
water	1 in 20
lubricating Oil	1 in 20
gas	1 in 80
air	1 in 80

Generally the fall of pipes containing more viscous fluids should be increased over the slopes indicated.

12.6 Thermal effects

12.6.1 Thermal Expansion of Pipes and Tubes

Provision must be made for the expansion and contraction of the pipework system. Anchors must be used where it is necessary to ensure fixed points for pipe loops or bends to absorb the thrust caused by thermal expansion or contraction. The detailed method to be used must be subject to approval.

12.6.2 Lagging

Thermal lagging must be used for cold locations, or where nominated, to protect the liquid, or gas, being measured from freezing.

A cold location is considered a location above 500m elevation and where the median monthly lowest temperature is less than 0^{O}C. Data must be sourced from the Australian Bureau of Meteorology monthly lowest temperature climate data records.

Lagging must also be used on process piping where the liquid, or gas, being measured is at a temperature that creates a safety risk to people, or requires it to reduce the thermal effect of the external environment on the process. Refer to Sydney Water Technical Specification – Mechanical for typical applications that require lagging.

The lagging used must be appropriately rated for the installation environment and process fluid being transported, as recommended by the manufacturer, and any relevant Australian Standards or WHS requirements to protect people, and the process, from any thermal risks. Lagging must meet the requirements of Sydney Water Technical Specification – Mechanical section M37.9.5 Pipe lagging. In additions, for process pipe lagging, weather resistance must include protection against UV exposure for outdoor applications.

12.7 Bends

Smooth tube bends must be used in preference to elbows wherever possible. Bending must use correct tube bending apparatus and must be free from kinks or flats. Tube ends must be cleared of sharp edges and the pipe rodded (before bending) and blown out prior to installation.

The minimum bending radius must be three (3) times the tubing O.D. and fittings must be at least three tubing diameter away from the bend.

12.8 Supports

Pipes must be supported from hangers or laid in the open on pipe clamps or brackets connected to the support beams or structure.

Tubes must be run flush with the wall, floor or ceiling or must be continuously supported either in trays or using appropriately spaced pipe clamps or brackets.

Instruments must not be supported by impulse lines except for pressure gauges mounted directly on the plant by means of threaded valves and nipples.

Impulse lines and supports must be kept free from vibrating structures, and structures to which pipe and tube supports are attached must be suitable for carrying the required loading. The layout of the impulse lines must not obstruct traffic through the process, nor interfere with accessibility to service and overhaul the process equipment (pumps, motors, etc). They should be routed away from hot, mechanically abusive or corrosive environments.

Supports must be provided at positions of concentrated loads, positions where the pipe or tube changes direction and near to pipe or tube joints.

Impulse lines must enter panels or racks by means of a bulkhead fitting so that when the site run pipework is connected there are no forces exerted on the instrument or associated valves.

A minimum number of two supports must be provided on all pipework runs and for straight runs of pipework the recommended maximum span between supports must be as shown in the table below:

Material	Maximum span between supports
stainless steel	0.3 metres
other materials	0.3 metres

12.9 Tapping Point Location

Each instrument must be provided with its own tapping point. The following locations for all pressure tapping points in straight cylindrical main service piping are recommended.

For horizontal main service piping containing gas or air, tappings must be in the vertical meridian plane upwards.

For horizontal main service piping containing liquids, tappings must be at an angle not greater than 45^{o} above or below the horizontal meridian plane. For horizontal main service piping containing steam or vacuum conditions tappings must be in the horizontal meridian plane.

For vertical main service piping tappings can be in any radial position, for any process fluid, provided that condensation occurring in the process line connected to the measuring device can re-enter, or drain back into, the main service pipe work. If doubt exists with regard to the system location of the tapping point then the tapping point must be in the horizontal meridian plane.

12.10 Differential Pressure Measurement

The two pressure pipes must be run close together to avoid errors which may arise from a difference in temperature. Where there is a possibility of heating or cooling occurring in the two pressure pipes they must be lagged together.

Bores of the pipes must be the same throughout the run from the tapping point to the pressure measuring device.

12.11 Snubbers or Pulsation Dampers

In general snubbers and pulsation dampeners must be not used, however, where conditions for steady instrument readings are unobtainable due to low frequency pulsations, or where instrument inaccuracy or failure is attributed to high frequency pulsations, a snubber or pulsation damper must be provided in the impulse line, unless otherwise incorporated in the instrument.

The snubber or damper must be positioned after the instrument isolating valve so that it can be removed or its effect modified without having to drain lines.

12.12 Seal Pots or Separating Chambers

Where instruments are used for the measurement of fluids which are corrosive, very viscous, likely to congeal, or likely to form deposits in the line or instrument, seal pots must be provided in the impulse line between the main pipework and the instrument.

They must be located as near to the primary isolating valve as is practicable and at the level of the tapping point.

The capacity of the seal pots should be larger than the volumetric displacement of the instrument and suitable venting and filling connections must be provided.

Where seal pots or separating chambers are used the sealing fluid should not mix or react with the main service line fluid and should differ in density by an amount which will ensure a stable interface. Where the physical and chemical characteristics of the main service line fluid are such that a suitable sealing fluid cannot be found then seal pots with partitions must be used.

12.13 Settling Chambers

The use of settling chambers is necessary in lines containing liquid with considerable amounts of entrained solids which may block even if these lines are run in accordance with the recommendations contained herein. The settling chamber should be located at the lowest point in the run and have a volumetric capacity as large as the needs of the system demand. They must be provided with blowdown valves and venting facilities. All applications must be subject to the approval of Sydney Water.

12.14 Identification of Impulse Lines

Each pipe must be identified in accordance with the Contractor's design drawings and P&ID diagrams. Transition joints must be suitably identified. All labels must be fitted during installation of the pipe work.

12.15 Instrument and process line valves

All instrument and process line valves must comply with Sydney Water Technical Specification – Mechanical section M9 Valves unless stated otherwise here.

Instrument and process line valves must have a pressure rating suitable for the process being measured and a PN at least equivalent to the designed pipe or tubing system or be rated PN16.

Two isolating valves must be provided on each connecting line between the tapping point and instrument, and a single valve on each branch line provided for test measurement, drain, vent or blowdown purposes.

Valves will be minimum size 1/2 inch BSP threaded full bore ball valves.

The use of gate valves must be approved by Sydney Water in writing.

Valves DN65 and smaller must close in a clockwise direction. The direction of rotation to close the valve together with the word 'CLOSE' or 'SHUT' must be clearly marked. Refer to Sydney Water Technical Specification – Mechanical section M9 Valves for additional requirements. The arrangement of pipe work and connections must be such that the temperature of the instrument isolating valve or instrument valve or instrument valve manifold does not exceed 30^{o}C.

All valves must be installed so that they are accessible for in-situ maintenance from a floor or permanent structure level.

The following valve duties are covered by this specification:

- primary isolating valves - must be located at the tapping point. Ball valves are preferred. These valves must <u>not</u> be of the stop-cock or non-return type as these types retain the maximum pressure in the impulse line
- instrument isolating valves - must be located on the connecting pipe at the instrument end of the line. These valves must be as near to the instrument as is practicable. The valve may form part of a valve manifold or be an individual valve
- venting and test valves - must be supplied on all measuring devices where there is a possibility of entrained air or gas bubbles collecting at the measuring device end of the line and where there is a need to carry out calibration and other tests without disconnecting the measuring device from the pipework. These valves must be orientated to discharge vertically downwards and must be fitted with a hexagonal headed screwed plug. Venting and test valves may form part of an instrument valve manifold together with the instrument isolating valve. In all applications, venting and test valves must be located as close to the instrument as possible such that the maximum amount of entrained air can be vented from the pipe work and a minimum pipe work volume is achieved for testing. Where the instrument is located in a panel or rack, the venting and test valve must be routed external to the panel or rack via a bulk head coupling with a 1/2 inch BSP threaded hexagonal headed plug on the external side
- equalising valves - must be provided with all differential pressure measuring devices with the exception of those services which use seal pots without partitions. The equalising valve must be positioned as close to the measuring device as possible and may form part of an instrument valve manifold. Where sealing chambers without partitions are used, the equalising valve must be positioned between the two primary isolating valves connections to the sealing chambers, such that it is impossible for the main service line fluid to flow through the instrument pipe work system. Also it must not be possible for the sealing fluid to flow into the main service line, due to the isolating valve leaking or if it is inadvertently left open because of the difference in pressure between the tapings

- blowdown/drain connections - must never discharge within panels and local equipment housings. Blowdown/drain lines must use a bulkhead connection to reach an approved drainage location or hinged lid tundish external to the panel. The blowdown pipe work connection must be made at a point as close to the instrument as practicable and preferably at the lowest point in the system

12.16 Local Gauges

Individually mounted local gauges must be adequately protected from damage by falling objects, water, steam, scaffolding, lagging, etc to the approval of Sydney Water.

Direct reading pressure gauges, vacuum gauges, compound gauges and gauges used in conjunction with pneumatic signals from transmitters must be protected from damage due to vacuum conditions occurring.

The Contractor must supply technical details and drawings of each type of gauge proposed.

12.16.1 Local reservoir and tank gauges

Reservoir and tank pressure gauges must be mechanically calibrated and referenced to the minimum operating level (MOL). The range must be from MOL to overflow level in metres water (mH_2O). The MOL must be shown as 0m. Pressures outside this range must be blank and not shown on the scale except for a mark at true zero. The true pressure at MOL and overflow must be written on the gauge. The gauge display must be provided by the manufacturer and be scaled to provide 80% deflection. A Bourdon tube 160mm 270deg deflection mechanical indicating pressure gauge must be used. Refer to SSD130 Local pressure gauge detail drawing.

All IICATS reservoirs and water tanks require a pressure gauge. The gauge must be mounted on a pressure board, refer to SSD081 Reservoir pressure board layout drawing for details.

12.16.2 Suction, discharge and local pump gauges

Pump gauges must be mechanically calibrated and referenced to the pump centreline. The pump centreline must be 0m. The range of the suction gauge must be from 0m to maximum suction head. The discharge gauge must be ranged from 0m to maximum discharge pressure. Suction and discharge pressure gauges must be referenced to the pump centreline. The gauge display must be provided by the manufacturer and be scaled to provide 80% deflection. Individual pump pressure boards gauges and station suction or delivery pressure board gauges must be in metres water (mH2O). A Bourdon tube 150mm 270deg deflection mechanical indicating pressure gauge must be used. Refer to SSD130 Local pressure gauge detail drawing.

All IICATS water pump stations require stations suction, discharge and local pump gauges. The gauges must be on a pressure boards, refer to SSD131 Pump differential pressure board and SSD132 Suction of delivery pressure board for details.

12.16.3 Suction and discharge gauges at booster pump stations

At booster type water pumping stations the suction and discharge pressure gauges must be mounted directly on the top of respective manifold. The suction and discharge pressure transmitters must be mounted on top of the respective manifold and include a block and bleed. All Gauge and transmitter diaphragms must be mechanically calibrated and at the same height. The height above the manifold must be kept as short as reasonably practical considering the tapping point, isolation valve, fittings and block and bleed.

The range of the suction gauge must be from 0m to maximum suction head. The discharge gauge must be ranged from 0m to maximum discharge pressure. The gauge display must be provided by the manufacturer and be scaled to provide 80% deflection. The suction and delivery pressure gauges must be in metres water (mH2O).

A Bourdon tube 150mm 270deg deflection mechanical indicating pressure gauge must be used.

Part 13 - Installation in Hazardous Area

13. Installation in Hazardous Area

13.1 General

Installation within hazardous areas must be in accordance with Sydney Water Technical Specification – Electrical section E2.5 Hazardous areas.

Technical Specification

Sydney WATER

Part 14 - Testing and Commissioning of Instrumentation and Control Systems

14. Testing and Commissioning of Instrumentation and Control Systems

The majority of the requirements in this section are not applicable to treatment plants. Refer to Section 8- SCADA Test and Commissioning of 'Treatment Plant SCADA Standards" for treatment plant projects. The only applicable clauses to treatment plants are 'sub-clause 14.3.4- Instrument tests' and 'sub-clause 14.3.5- Cubicles'.

14.1 Introduction

This section describes the tests and procedures that must be completed and acceptable to Sydney Water for testing and commissioning of all the electrical and instrumentation systems, equipment and installation work carried under the contract.

This section addresses the general requirements that shall apply for the testing of the system at the Contractor's premises and subsequent testing of the system and its component elements at SWC sites.

This section does not constitute a test specification for any particular part of the system, however, it identifies the stages at which test shall be required together with the subject, location and purpose of each stage of testing.

The stages of testing and commissioning of all electrical and instrumentation systems, equipment and installation work are:

- factory inspection and acceptance test
- site acceptance testing and commissioning
- acceptance and takeover
- warranty period.

14.2 General Requirements

14.2.1 Test Plan

The Contractor shall prepare and submit a test plan for review and approval by Sydney Water and shall clearly indicate how each system element from source to destination including all instruments, cabling, earthing and termination should be tested and the criteria, which are to be used to assess the passing or failure of the individual tests by Sydney Water.

The test plan shall specify the nature of and program for access to and use of Sydney Water's facilities.

14.2.2 Performance and Acceptance Criteria

The Contractor shall prepare a performance and acceptance criteria document to be used as the basis for acceptance of all electrical and instrumentation systems, equipment and installation work carried out under the Contract.

SWC's "Instrumentation and Control Standards" shall form the basic specification criteria for the performance and acceptance criteria document.

14.2.3 Test Specification

The Contractor shall produce a test specification for each test, which shall be submitted for review and approval by Sydney Water and which shall be issued at least four (4) weeks prior to the commencement of the tests.

The Contractor shall not commence testing until such approval has been granted.

Each specification shall include as a minimum:

a) test objectives

b) test conditions and test configuration including support facilities

c) program of tests to be performed, including test sequence and duration of tests

d) step by step instructions and expected results, including the interpretation of test data for tests to be performed

e) acceptance criteria

f) method of recording results for evaluation and certification

g) test timetable

h) type and model of test equipment to be used with calibration certificates of accuracy

i) a listing of relevant Australian and/or International Standards

14.2.4 Test Equipment

- the Contractor shall make available all labour, materials, test equipment and the like required for the factory tests, site tests and commissioning
- all test equipment used for factory test, site tests and commissioning shall have a valid certificate of calibration prior to the test commencing. All test instruments shall be subject to approval by Sydney Water's representative
- the Contractor shall be responsible for the safe operation of any equipment used in the tests
- during factory acceptance test or site acceptance test any equipment damage due to the Contractor's negligence shall be replaced by the Contractor at the Contractor's own expense.
- all control circuit fuses damaged as a result of faulty wiring or equipment shall be replaced by the Contractor at the Contractor's expense
- during factory acceptance test or site acceptance test equipment subjected to considerable wear and tear must be replaced by equipment of the same specification at the Contractor's expense
- Sydney Water may reject any equipment without a proper 'Material Conformity Certificate" and test certificates.

14.2.5 Notice and Witnessing of Tests

The Contractor shall provide a plan showing the scheduled dates of testing and shall provide updates to this plan regularly and when changes occur.

For IICATS sites an IACS Commissioning Engineer or IACS Project Engineer is the only person authorised to act as Sydney Water's representative in accepting the instrumentation, automation and control component of any work.

Sydney Water's representative shall have the right to defer the scheduled dates of testing if the Contractor is not deemed well prepared for the tests.

The Contractor shall advise Sydney Water's representative, in writing, of the date of commencement of individual stages of testing at least two (2) weeks in advance. However a complete and detailed program shall be issued along with the test plan.

Sydney Water's representative shall have the right to witness any tests. Such inspection shall not relieve the Contractor of the responsibility for compliance with the requirements and satisfactory operation of the equipment.

Sydney Water's representative shall have the right to access to all original documents, calculations and drawings.

14.2.6 Test Report

Subsequent to the completion of each test, the Contractor shall prepare a test and inspection report, which shall be a complete record of the actual tests carried out, conditions under which the tests were carried out, any assumptions or allowances made, the results obtained, lists of any reservations noted during the tests and the manner in which they were corrected and retested.

Test and inspection report formats must be approved by Sydney Water's representative.

The summary report and acceptance certificate shall be submitted to Sydney Water's representative. The full report shall be submitted for those tests, where Sydney Water's representative requires it.

Records of every test, whether witnessed or not, shall be submitted to Sydney Water's representative within two weeks. Such submission shall occur before acceptance of the equipment under test can be considered.

14.3 Factory Acceptance Test

14.3.1 General Requirements

- before delivery of the equipment to the site, the Contractor shall carry out such tests as are necessary to confirm the guaranteed performance as set out in the specification, at the Contractor's own premises and shall supply details of such tests
- the Contractors test premises shall be located within the Sydney metropolitan area unless agreed in writing by Sydney Water prior to Contract award
- the Contractor shall plan, specify, schedule, conduct and record results of all factory tests
- the time period between delivery of the factory test specification and the commencement of the factory acceptance test (FAT) shall not be less than four (4) weeks
- an updated set of Contractor's assembly and wiring drawings shall be made available prior to commencement of tests
- all equipment shall be subject to factory inspection by Sydney Water at any stage of manufacture and assembly
- the FAT shall be carried out at the Contractor's premises and shall be at the cost of the Contractor. The Contractor shall be responsible for correcting any sequences, omissions or defects to ensure that the system is fully functional and ready to be delivered to site
- facilities shall be provided for Sydney Water's representative at the Contractor's or any Sub-Contractor's premises where any test is to be witnesses. These facilities shall include desk and chair for two staff, lockable storage for documents, use of telephone in privacy and reasonable access to catering facilities
- where possible the full system shall be set up for factory acceptance test. If the system is to be installed in stages, then the full system of the stage to be installed shall be set up for the test. In the latter case, the full system integration shall be tested on site.
- the FAT shall only be commenced when:
    a) the system or sub-system is fully assembled, developed and verified by the Contractor
    b) ready for shipment to site
    c) all calibration sheets, installation, operation and maintenance documentation are complete

Prior to inviting the Principle to attend FAT, the Contractor shall carry out a pre-FAT to ensure compliance with the specification. Records of pre-FAT, including all defects raised shall be made available to the Principle at least 5 days in advance of FAT.

14.3.2 Inspection

Prior to commencement of the tests the equipment shall be inspected to ensure:

- correct standards of workmanship and quality (visual inspection only)
- correct identification labels, cabling, tagging, housing and mounting, etc
- adequate accessibility (visual inspection only)
- compliance with the system's operational requirements and approved drawings embodied in the design contract document(s) prepared for each design project
- model numbers, quantities of items, serial Nos. etc. against the Contractor's design to be verified and to be entered on assembly and wiring sheets
- compliance with the SWC Corporation's Instrumentation and Control Standards.

14.3.3 Test Conditions

The following conditions shall apply to the factory acceptance test (FAT):

- unit tests shall have been successfully completed; including certification or environmental testing to demonstrate compliance with the requirements of section 6.2 of this Standard
- all necessary set up and adjustments shall be carried out before commencement of the test so that the tests can continue uninterrupted by routine operations
- the equipment shall be complete at the start of the tests and no interchange of modules or equipment shall be allowed
- no repairs or adjustments shall be carried out during the test period unless agreed by both parties.

14.3.4 Instrument Tests

Instrument tests shall include but not be limited to the following:

a) instruments general

Each instrument shall be separately tested to prove the calibration, accuracy, repeatability, and where appropriate, the control response. Instruments shall be tested at 0, 25, 50, 75 and 100% FSD with both rising and falling signals.

b) flowmeter tests

The manufacturers of a flow-tube shall provide a type test and calibration certificate for each instrument, verified by a NATA approved testing authority. The procedures for certification shall be based on items (i), (ii) and (iii) below:

i. the primary measuring device, before acceptance, shall be tested by the manufacturer to an internal hydrostatic pressure of twice the design pressure. The pressure shall be applied to the assembly for a period of 30 minutes. There should be no evidence of any leakage

ii. the manufacturer shall carry out a water test under simulated working conditions. The primary device shall be installed in a pipeline. The velocities passing through the primary device shall be comparable to those envisaged in the actual service. During this test, the actual instrumentation as supplied under this Contract shall be connected to the primary device. The readings obtained shall be compared with an independently certified flowmeter provided by the manufacturer. The correctness of the latter shall be certified by an authority acceptable to Sydney Water.

iii. The meter full scale deflection (FSD) shall be set on the capacity of the flow rig and tested at 0%, 10%, 25%, 50%, 75% and 100% levels of this flow.

The meter FSD shall then be set on the specified flow range and tested at a minimum of three points as follows:

- 10% of the specified maximum flow
- 100% of the specified maximum flow, or if the capacity of the flow test rig will not permit this, the maximum flow-rate of the test rig
- A point midway between the two previous flow- rates (55%).

c) acceptance

Delivery will not be accepted until Sydney Water's representative is satisfied that the instrumentation is in accordance with the Specification.

14.3.5 Cubicles

The word "cubicles" shall include cubicles, enclosures, switchboard, starters, panels, back plates and installed components and the like, and shall also include alterations and additions to existing equipment carried out under the work of the Contract.

Cubicle tests shall include but not be limited to the following:

a) complete circuit component, continuity and termination checks against all relevant Contractor's drawings. The Contractor shall mark up the drawings such that errors are corrected, omissions and modifications added and shall redraw and submit all such drawings as detailed under the terms of this specification

b) insulation tests, using a 1000 V insulation tester, of all cables and equipment. Such tests shall include the following:

   i. phase and neutral to earth

   ii. phase to neutral

c) check and/or test to verify fuse link ratings, and the setting of overload and under voltage protection equipment shall be proven by injection test

d) tests shall be carried out on power supply equipment to:

   i. verify satisfactory operation of equipment

   ii. check supply and output voltage tolerance

   iii. prove operation and alarming on power and hardware failure.

e) functional tests shall be performed on all cubicles to prove satisfactory operation of the equipment as a whole, and to verify compliance with the requirements of the specification.

On completion of all checks and tests, the Contractor shall ensure that equipment that may have been disconnected and/or removed prior to testing to enable such a test have been reconnected back to the original position again. For example, verify that all links have been closed and tightened, all fuses replaced, all covers and the like replaced.

14.3.6 Factory Inspection and Test Results Record Sheet

A sample of the factory inspection and test results record sheet for the electrical and instrumentation systems and equipment is attached at the end of this section. This is only a typical sample and detailed procedures and recording forms are to be prepared by the Contractor. Other functional test results may be recorded in similar format.

14.3.7 Completion of Factory Acceptance Test

- Sydney Water's representative shall witness the factory acceptance test (FAT)
- four (4) copies of the factory inspection and test results record sheets signed and commented shall be submitted to Sydney Water, for approval within seven (7) days from the conclusion of the particular factory test
- Sydney Water will advise the Contractor of the acceptance or otherwise of the factory test results
- the Contractor shall not deliver or install any part of the system until such approval has been granted by Sydney Water in writing
- In the event of parts of the test, including achievement of performance criteria, not being passed, the Contractor shall modify and re-test the system at his/her expense until the test is satisfactorily passed. Test will be re-witnessed by Sydney Water's representative unless agreed otherwise
- delivery of the system to site with known test deviations or failures will be at the discretion of Sydney Water.

14.4 Site Acceptance Test (SAT)

14.4.1 General Requirements

- the SAT shall follow the successful completion of factory acceptance test (FAT) and delivery and installation of all equipment to site.
- Sydney Water shall verify that correct equipment (model nos., serial nos. etc.) which were subjected to factory acceptance test, has been received
- the SAT shall demonstrate that the overall system, as installed and tested, can perform its intended functions under actual operating conditions using live data with uninterrupted operation
- the SAT shall be carried out by the Contractor to the satisfaction of Sydney Water. If any test is unsuccessful, the equipment shall be repaired or replaced and re-erected as appropriate and shall be retested until successful at the Contractor's expense
- in advance of commencement of formal SAT, the Contractor shall carry out functional tests to verify that the system components have been installed correctly. These tests shall be carried out initially with the drives isolated from the process (dry test)
- all WAE drawings, calibration certificates, P&IDs, I/O schedules and dry run-SAT test records shall be submitted to Sydney Water for approval at least 5 days prior to the commencement of formal SAT
- after the dry tests have been proven, the wet tests shall be carried out on the actual process (wet test). All tests carried out in this phase shall be in coordination with the plant operator
- four (4) copies of site acceptance test sheets signed and commented shall be submitted to Sydney Water for approval
- same format of factory acceptance test/inspection results record sheets shall be used for site acceptance test results record sheets.

14.4.2 Tests

Site testing and commissioning shall include but not be limited to the following:

a) routine operational and sequence checks and tests

b) functional tests on all control, protection and metering equipment. Functional tests shall be performed at all cubicles to prove satisfactory operation of the equipment as a whole, and to verify compliance with the requirements of the specification

c) all tests required by the Electricity Supply Authority

d) complete circuit component, continuity and termination checks against all relevant Contractor's drawings. The Contractor shall mark up the drawings such that errors are corrected, omissions and modifications added and shall redraw and submit all such drawings as detailed under the terms of this specification

e) insulation tests using a 1000 V insulation tester of all interconnecting cables. Such tests shall include the following;

    i. phase and neutral to earth

    ii. phase to neutral.

f) check and/or test to verify fuse link ratings and the setting of overload and under voltage protection equipment

g) tests shall be carried out on power supply equipment to:

    iii. verify satisfactory operation of smoothing equipment

    iv. check supply voltage tolerance

    v. prove operation and alarming on power and hardware failure.

h) check all relays, contactors, selector switches, pushbuttons and indicating lights for operation, installation, adjustment, rating and labelling

i) all fuses and circuit breakers type and rating shall be checked against the Contractor's drawings

j) cable installations shall be inspected and sizes shall be checked against the Contractor's drawings

k) cabling shall be checked and tested against the Contractor's interconnection wiring diagrams. If the circuit is interlocked with other drives or equipment the logic of these interlocks shall be demonstrated

l) check that all safety devices and auxiliary equipment are installed, connected and set for correct operation

m) check tightness of cable terminations, correct labelling of all cables, cable cores and termination strips

n) with control circuits only energised, verify that each field device and associated relays operate correctly and repeat for each circuit

o) instrument loop checks shall include:

    i. calibration and testing procedures shall be carried out for each instrument loop and all interconnected control equipment in accordance with the Contractor's information and details as submitted in accordance with this specification and as approved by Sydney Water.

ii. such tests shall verify the guaranteed accuracy, repeatability and drift of the equipment as specified for the particular instrument and/or instrument loop, and shall verify the specified functional requirements of the overall systems

iii. for all interfaced components of the instrumentation system, complete continuity checks shall be carried out to establish the correct physical interconnection of the various individual components and their isolation from one another and earth.

iv. all signal voltage shall be checked to verify that their magnitude and type is compatible with the interconnected components.

p) any additional tests deemed necessary by Sydney Water during the commissioning period.

On completion of all checks and tests, the Contractor shall ensure that equipment that may have been disconnected and/or removed prior to testing to enable such a test have been reconnected back to the original position again. For example, the Contractor shall verify that all links have been closed and tightened, all fuses replaced, all terminations made and tightened, components replaced and/or reconnected, and all covers and the like replaced.

All equipment and installation failing to meet the requirements of the Specification shall be made good or replaced at the Contractor's cost prior to the issue of the certificate of practical completion.

14.4.3 Completion of Site Acceptance Test

- The site acceptance test shall be deemed complete based on site acceptance test results record sheets and certificates completion and sign off by Sydney Water.
- after this test is satisfactorily completed, the system development is practically complete and can be handed over to plant operation for the next phase of the tests (system reliability and availability tests). The warranty period starts at this point of time
- Practical completion and warranty period commencement shall be subject to satisfactory resolution of Principal's comments noted during the factory acceptance test and site acceptance test stages

14.5 System take-over

The criteria for take-over of the system (practical completion) shall be:

- all discrepancies found during the factory test or site testing rectified by the Contractor. When rectified correct operation shall be verified by Sydney Water
- submission of final operation and maintenance manuals
- submission by the Contractor and approval of work-as-executed drawings
- issue of all relevant test and calibration certificates
- successful completion of site acceptance test and issue of site acceptance test certificate
- completion of operator training.

Following satisfaction of all the above, Sydney Water shall issue the 'Certificate of Practical Completion'.

14.6 Post Commissioning Support (Warranty Period)

- the post practical completion support shall include first 5 days of on-site support followed by off-site on-call support. The hours and response time of support is negotiable. The Contractor shall rectify free of charge all defects found during the warranty period
- defect rectification shall include but not limited to the following failures:
    a) failure to meet technical requirements during the warranty period (eg significant equipment deterioration)
    b) abnormal conditions resulting in process or safety concerns eg multiple failures of equipment causing undesired results
- the defect liability period shall be extended by 12 months for the repaired equipment.

Note: Refer to the next page to find a sample of ‘Test Results Record Sheet’.

TEST RESULTS RECORD SHEET

Site Name: / **Site ID:**	**Test result:** ☐ PASS ☐ FAIL ☐ TO BE RETESTED / **NCR NO:**
☐ **Inspection** ☐ **FAT** ☐ **SAT**	**Principal:** Name: signature: date:
Test Topic:	**Contractor:** Name: signature: date:
Test set up:	**Performance Criteria:**
Method of testing:	**Acceptance Criteria:**

Test steps:	**Expected result:**	**Observed result:**	**Pass/fail**	**Comments**(assumptions, condition of test, etc.)	**Date:**	**Signature:**

Technical Specification

Part 15 – Documentation and Quality Control

15. Documentation and Quality Control

The requirements in this section are not applicable to treatment plants. Refer to Section 7- 'Documentation' of 'Treatment Plant SCADA Standards" for treatment plant projects.

This section of the manual is only applicable where the Contract document does NOT require compliance with the following Sydney Water documentations:

- *D0001440 Commissioning – transitioning assets into operation,*
- *MEFA0001 Maintenance Related Clauses for Capital and Operational Projects, and*
- *CAD Standard and templates*

15.1 Quality Assurance

15.1.1 General

The Contractor is required to control the quality of all equipment within his scope of supply in such a documented manner as to give a high degree of assurance of product quality.

In addition to covering the manufacture of equipment, this control must encompass hardware and software design activities and site installation and commissioning.

For the required level of quality assurance to be achieved, the Contractor will be required to possess a functional, documented quality management system formulated to satisfy the requirements of AS9001 or AS9002.

15.1.2 Quality Plans

The quality plans must include, but not be limited to, design, installation, site testing and commissioning. Flow charts supplemented with brief explanatory text are the preferred method of presenting information as to when the various control stages will be applied. Due allowance of time must be made in these documents for approval by Sydney Water. The plan must include activities to allow witness testing or inspection at the end of each stage.

15.1.3 Product Audit

Correct functioning of the equipment and the Contractor/Subcontractor's quality system will be verified by the application of product audits during and upon completion of manufacture of major items of equipment.

These audits will encompass functional testing, physical condition of the equipment and a review of quality records for the various stages in the production process, in order to gain assurance that equipment is of the required level of quality.

The frequency and depth of ongoing surveillance activities by Sydney Water will be dependent upon the results of initial product audits. Should major deficiencies be found in either the product or in the methods for the control of quality, then due notice will be given to the Contractor that urgent remedial or corrective action is required.

All costs associated with additional surveillance activities by Sydney Water required as a result of major deficiencies within the Contractor's control must be borne by the Contractor.

15.1.4 Quality Records

In order to maintain control over the quality of all equipment during design and manufacture, a system of quality record sheets must operate, which will normally require one copy of each document for each piece of equipment. Furthermore, it may be necessary for all major items and assemblies to have unique serial numbers. All quality records must refer to these numbers, wherever possible. Records generated to substantiate the attainment of performance and design standards must be retained for at least 5 years and should be filed in such a manner that retrospective review by Sydney Water can readily be affected.

Each major item of equipment must have a unique certificate of inspection and testing, detailing results of inspections and test. However, batch-produced items may be covered by a batch certificate, providing all serial numbers of equipment are shown and an appendix to the certificate details the acceptance parameter bands within which the controlled parameters have been found to conform.

15.1.5 Sub-Contractors

Where items are purchased from a sub-contractor, the Contractor must take responsibility for such items. If the sub-contractor has a suitable quality assurance scheme to AS9001 or AS9002, then inspection of records will normally be sufficient to establish compliance. Otherwise, the Contractor must be responsible for inspecting and testing the items upon receipt and ensuring their fitness for purpose.

Sub-contractors must not be used except by prior written approval by Sydney Water.

15.2 Contractor's drawings and information

15.2.1 General

This specification covers the Contractor's drawings and information to be supplied by the Contractor.

Work must not precede, or the order of, or manufacture or supply of equipment, components or structures until the relevant drawings have been submitted to and accepted by Sydney Water, and returned to the Contractor as an accepted drawing.

The Contractor must be fully responsible for the correctness of all Contractor's drawings which are necessary for the manufacture, installation, operation and maintenance of the equipment. The accuracy of all drawings must be checked and countersigned by a responsible representative of the Contractor before submission of the drawings.

Should any work carried out by the Principal be unsuitable through errors in information supplied by the Contractor, then the cost of rectifying such errors must be borne by the Contractor.

15.2.2 Design Documentary Summary

The following design documentation must be supplied for all projects.

a) drawing register
b) instrument schedules
c) equipment installation documents
d) instrument specification sheets
e) schematic wiring diagrams
f) loop drawings
g) process connection drawings
h) panel layout drawings
i) terminal layout drawings
j) site/building layout drawings
k) block cable diagrams
l) cubicle drawings
m) cable schedules
n) cable calculations
o) instrument calculations

p) hazardous area certification

q) transmittal register

r) alarm/trip setting schedules

s) process and instrumentation diagrams

t) programmable instrument parameter setting schedules

15.2.3 Content of Design Documentation

a) drawing register

The drawing register must list drawings to be submitted by the Contractor, showing the scheduled date of first submission and expected date of final issue.

b) instrument schedules

These must show all instruments, panels and associated items of equipment in loop number sequence.

All instruments, electrical equipment, panels etc., to be supplied and/or installed by the Contractor are to be listed on these schedules. The schedules must be completed in sequence and by site i.e the numbering sequence begins at the first loop or tag number for each site. It is not required to dedicate any one sheet(s) to a measured parameter, i.e. on small sites where only one level, one pressure and one flow measurement is made, the equipment may all appear on one schedule sheet. Items on any one schedule sheet must all belong to the same site. There must be at least three blank lines between each tag or loop number.

c) equipment installation documents

These must list all installation materials and accessories such that, together with instrument schedules, all items supplied (except spare and consumables) are listed:

i. item description
ii. quantity
iii. order number and manufacturer
iv. data sheet or reference drawing as relevant
v. instrument specification sheets reference
vi. diagrammatic representation showing how each piece is installed

d) instrument specification sheets

Instrument specification sheets must include the following:

i. process and operation conditions
ii. material specification and connection data
iii. manufacturer and model number
iv. calibration
v. hazardous area details

Every item of equipment supplied by the contractor must have a unique specification sheet. An exception will be where quantities of identical items are specified. In this case one specification sheet will be required with an additional sheet showing relevant tag numbers and locations.

e) schematic wiring diagrams

These must define the full wiring details for each particular system or application (eg motor starter). Full terminal and cable references etc., will be given to facilitate commissioning and maintenance. Where possible, each complete system must be shown on one sheet including outline details of associated items sufficient to give full understanding of the operation and minimise the need to cross refer to other drawings. Power supply, fusing and other associated details must also be shown.

f) loop drawings

These must show details of instrumentation loops and all items of equipment supplied by the Contractor, or free issued to the Contractor, together with existing equipment and all components of loops and systems connected to telemetry equipment. In addition they will cross refer to the associated process connection diagram.

There will be only one loop or system per loop drawing sheet.

g) process connection drawings

Process connection drawings must show the impulse piping arrangements required to connect the instruments to the process. They will define all necessary installation materials.

All equipment must be installed in accordance with relevant sections of this specification. The Contractor is to provide a drawing showing the tag numbers and location of equipment to be installed.

h) panel layout drawings:

i. general arrangement showing front and back of panel layout of equipment. It must also indicate general gland plate/bulkhead locations and cabling routes

ii. cut-out data - detailed drawing

iii. label schedule

iv. any special power distribution or system inter-connection drawings as necessary

v. terminal layout drawings

These must identify the layout and circuit identification for the connected cores to all terminals.

The I/O identification layout on the RTU backplate drawings in Appendix 1 is fixed and must not be altered.

i) Site and building layout drawings

i. site layout - These must identify the access to and location of buildings and installations on the site, detailing the orientation of each item to grid north.

ii. building layout - These must identify the location of access to and location of major plant items, main power supply boards, telephone access points and telemetry equipment.

j) block cable diagrams

These are single line drawings of, signals and power supplied from instruments to panels, showing all associated marmusting details.

k) cubicle drawings

As appropriate these will show sizes, terminal referencing and wiring details for all cubicles, including Marmusting Cubicles, Interface Boxes, Main Distribution Frames and the like.

l) cable schedules

These give point-to-point connection data for all cables associated with instruments and equipment. They also tabulate:

i. location of items being connected

ii. reference of cable/conduit/tray and associated glands

iii. cable/conduit/tray identity

iv. route take and length run

v. cable type/size/cores

m) cable calculations

All cables are to be sized by the Contractor in accordance with AS3000 and AS3008. Calculations are required by the Sydney Water for all three phase power cables and for all single phase power cables.

n) instrument calculations

A specific calculation (on a standard format) is required for all instruments, eg. flow meters, tank contents measurements and control valves (including actuators) supplied by the Contractor.

o) hazardous area certification

Two copies of all systems and apparatus certificates of approval of equipment to be supplied by the Contractor for use in hazardous areas are required.

p) transmittal register

These must list all documents, date of transmittal, originator's name, receiver's data and a comments section, as a minimum

q) alarm/ trip setting schedule

These schedules must list each and every alarm/trip initiator, function, location reference, tag number, range, alarm setting value, date and revision columns, as a minimum.

r) process and instrumentation diagrams

These must show all the loops on the site. Symbols must be in accordance with SWC DTC P & I Diagram Legend (DTC 7018 to 7020) and, if available, any Networks template P&ID drawings or DTCs. Asset numbering must align with ACP0055 Asset numbering standard operating procedure.

s) programmable instrument parameter setting schedules

These schedules are in addition to the Instrument Specification Sheets and apply to programmable instruments only. For each programmable instrument a schedule must be produced which uniquely identifies the instrument by duty and tag number and lists all the programmable parameters and the value assigned to each parameter.

15.2.4 Document Review

(a) design documentation

The Contract program must allow for a maximum period of 21 days for the issue (by Sydney Water) of comments on submitted drawings and information, calculated from the date of receipt.

After review by Sydney Water the Contractor will be informed of the category into which each such drawing is placed according to the following:

(a)	category I	-	no exceptions taken
(b)	category II	-	make corrections noted
(c)	category III	-	amend - resubmit
(d)	category IV	-	rejected - resubmit

Category I must mean that the Contractor may proceed with the relevant part of the works.

Category II must mean that the drawing or document must be first modified to the extent noted by Sydney Water and then the Contractor may proceed with the relevant part of the Works subject to the modification noted by Sydney Water.

Category III must mean that the Contractor must revise the drawing or document and re-submit it to Sydney Water to reach Category I or II. The Contractor may not proceed with the relevant part of the Works.

Category IV must mean that the submission is fundamentally flawed and as a consequence, a review has not taken place. The Contractor may not proceed with the relevant parts of the Works.

Any revisions to drawing or document submittals directed by Sydney Water must be revised and re-submitted to Sydney Water within 14 days, calculated from the date of receipt of Sydney Water's comments. All revisions to drawings or documents by the Contractor must be plainly marked on the drawings or documents together with the date when the changes were made.

Sydney Water must have the right to request the Contractor to make any changes to the drawings or documents which are necessary to ensure that the equipment conforms to the requirements of the Contract, without additional cost to the Principal.

Submitted drawings and information must not be modified or departed from without advising Sydney Water.

15.2.5 Drawing Format

a) production

All required drawings to be submitted by the Contractor must be produced using a Computer Aided Drafting system (CAD) in accordance with the Sydney Water's 'CAD Standard and Specification' and drawing templates. Drawing sizes must be either A1 or A3, depending on the subject details, printed in monochrome black on paper. Drawing file naming convention is specified in the above standard.

All drawings, including manufacturer's standard drawings must clearly define the name of the Contract together with other relevant details on the title block of the drawing.

Drawing numbers must be obtained from Sydney Water's'Plan Management' area.

Each electronic copy must be submitted in two separate formats (i) AutoCAD format (ii) PDF format. The PDF version must be created from CAD version and not scanned unless a signed statement such as a certification is involved. Where the plotted drawing uses coloured line work, the colours selected for the line work must be such that the work depicted is clearly legible when drawing is printed or copied on monochrome (black and white) printer or copier.

b) title block

Title blocks must comply with Sydney Water's standards and requirements. The standards and requirements to be used by the Contractor must be submitted to the Contractor by Sydney Water.

c) size

Drawings and documents must be submitted on the following standard drawing paper sizes: -

Drawing/Document Type	Drawing/Document Size
Drawing Register	A4
Instrument Schedule	A3
Instrument Installation Drawings	A3
Instrument Specification Sheets	A4
Schematic Wiring diagrams	A3
Loop Drawings	A3
Process Connection Drawings	A3
Panel Layout Drawing	A3 or A1

Terminal Layout Drawings	A3 or A1
Site/Building Layout Drawings	A3 or A1
Block Cable Diagrams	A3 or A1
Cubicle Drawings	A3 or A1
Cable Schedules	A3 or A1
Cable Calculations	A4
Instrument Calculations	A4
Hazardous Area Certificate	As received
Process and Instrumentation Diagrams	A3

d) layout

The layout of drawings and documents must comply with Sydney Water's standards and requirements. The standards and requirements to be used by the Contractor must be submitted to the Contractor by Sydney Water.

e) numbering

The numbering of all Contractor's drawings/documentation must comply with the numbering system nominated by Sydney Water. The numbering system to be used by the Contractor must be submitted to the Contractor by Sydney Water.

15.3 Operations and maintenance manuals

15.3.1 General

This specification covers the site operation and maintenance (O&M) manuals to be supplied by the Contractor. The manuals must incorporate both operation and maintenance instructions, detailing all necessary information for the efficient operation and maintenance for each piece of the particular items of equipment and all systems installed or modified, to the satisfaction of Sydney Water.

Failure to supply the manuals may be sufficient cause for the withholding of a Certificate of Practical Completion.

15.3.2 Submission and approval

The Contractor must submit to Sydney Water two (2) unbound draft copies of the manuals. Sydney Water must review these copies and will supply the Contractor with his comments within one (1) month of the receipt of the draft copies. The Contractor must incorporate all submittal review comments and resubmit two (2) unbound draft copies of all manuals not receiving "No Exceptions Taken" or "Make Corrections Noted" review categories. After receiving "No Exceptions Taken" or "Make Corrections Noted" review comments the Contractor must supply six (6) bound completed sets to Sydney Water, incorporating all the changes. One of the sets must contain all originals and must be so marked.

The Contractor must also supply an electronic copy of the manual on CD-R/DVD/USB using MS Word (preferred) or PDF format. When a combination of different software is used ore where are several components/pages of PDF documents forming one O&M manual, the document must be consolidated into one PDF file, with bookmarks for each section in the contents page.

15.3.3 Format

Each copy of the manual must be bound in a three-ring, hard-cover binder with the equipment description, site name, site number and asset numbers permanently marked on the outside cover. The page format must be A4, and printed in a clear typeface with a 35mm margin for binding. Alternative methods of binding and page size format can be submitted, but acceptance of these would be subject to approval by Sydney Water.

Documents which are larger than A4 must be folded to fit within the A4 binder so that their title block is readable when folded. Oversize documents must be folded such that they can be unfolded without removal from the binder, or alternatively be contained within a transparent A4 envelope which is held in place by the binder posts.

All text and references and drawings, parts schedules and the like must be written in the English language

15.3.4 Contents

The manuals must fully describe the particular items of equipment and systems installed and their inter-relationship with existing equipment or systems. Manufacturer's documentation may be included but any information not relevant to the particular equipment, installation or application must be omitted or crossed out.

The contents must be presented as follows (alternative compilation would be subject to the approval of Sydney Water):

Title Sheet for each manual - containing:

a) name, site number and asset numbers for that site
b) contract details.

Title sheet for each equipment/system containing:

a) name of suppliers
b) addresses and telephone numbers for service calls:
   1) manufacturer's representative
   2) manufacturer's spare parts warehouse
   3) stocking supplier of spare parts

Table of contents - listed as follows:

Chapter 1 :	Overview
Chapter 2 :	Description
Chapter 3 :	Principles of operation
Chapter 4 :	Operating instructions
Chapter 5 :	Installation and commissioning instructions
Chapter 6 :	Routine maintenance
Chapter 7 :	Periodic maintenance
Chapter 8 :	Repair, overhauling and dismantling
Chapter 9 :	Test data and troubleshooting
Chapter 10 :	Spare parts and tools list
Chapter 11 :	Drawings
Chapter 12 :	Software documentation
Chapter 13 :	Standard manufacturer's manuals
Chapter 14 :	Additional documentation

The documents contained within each set of O&M manuals must be grouped into tabbed sections as listed below. Each section must have tabbed dividers marked with the chapter number.

Manufacturer's standard O&M manuals may be substituted for the documents to be contained within chapters 2 through 10. If the manufacturer's standard O&M manuals do not contain all the required information, the missing information must be provided in supplementing documents and drawings inserted into the appropriate chapter.

Manufacturer's standard documents must be neatly marked to indicate the specific information which is applicable to the system supplied. Only complete manufacturer's documents will be accepted.

The information to be supplied in each chapter must be as follows (where applicable):

Chapter 1 : Overview - a description of the site operation with detailed descriptions of modified operation modes, changeover strategies and operation and new operation modes.

Chapter 2: Description - a full description of the equipment with a tabulation of dimensions and performance ratings.

Chapter 3: Principles of operation - a basic working description, including novel features and any automatic control.

Chapter 4: Operating instructions - a step-by-step procedure organised in sections entitled:

a. check before starting
b. starting
c. continuous operation
d. stopping
e. emergency stopping
f. abnormal operation, as applicable

Chapter 5: Installation and commissioning instructions - details of standards and procedures for transporting and installing the equipment. Including a step by step procedure for mounting or erecting, wiring and lubricating the equipment. Alignment tolerances and check requirements must be stated.

The commissioning instructions must include step by step procedures for checks before the first start, checks after starting and operations tests. They should be coordinated with Chapters 4 and 9 and may refer to both.

Chapter 6: Routine maintenance - step by step procedure for preventive maintenance work carried out at intervals of two weeks or less.

Chapter 7: Periodic maintenance - step by step procedure for fault correction and preventive maintenance carried out at intervals in excess of two weeks, involving replacement of consumables only. A list of any necessary special tools must be included.

Chapter 8: Repair, overhauling and dismantling - step by step procedures to extract, fully dismantle, re-assemble and re-install the equipment.

Chapter 9: Test data and troubleshooting - instructions to qualified tradesmen for assessing the operational performance of the equipment.

Chapter 10: Spare parts list - illustrations and schedules for identification and specifications of all items in the equipment, exploded diagrams are preferred. The recommended spare past stock must be indicated.

Chapter 11: As executed, drawings, which may include but must not be limited to drawings required to be submitted under other clauses of the specification, must include:

a. general arrangements

b. any other drawings necessary for complete understanding of installation, operation and maintenance of the particular item of equipment.

Chapter 12: Software documentation - all application software or configuration data provided by the Supplier's programming and documentation package for software, ladder diagram reports with appropriate labels and comments for PLC programmes, and as appropriate for all other application software or configurations. This information must be provided on CD-R/DVD/USB in a compatible format suitable for use by the Supplier's programming and documentation package.

Chapter 13: Standard Manufacturer's Manuals - all standard manufacturers operation, maintenance, programming, etc. manuals.

Chapter 14: Additional documentation - all additional documentation necessary to completely describe the installed equipment/system operation and maintenance.

Technical Specification

Sydney WATER

Part 16 – Modbus Communications

16. Modbus Communications

This part applies to Modbus communication to an IICATS RTU. This includes IICATS RTUs at Networks sites and the IICATS Treatment Plant interface RTU.

This part does not apply to Treatment Plant SCADA communication networks.

Modbus is not the default standard for monitoring and control of all instruments. It must only be used where it is specifically defined in the scope of work and approved by Sydney Water IACS SCADA Project Engineer. The device configuration and network layout must be approved during the design phase of the project prior to installation.

16.1 Modbus over Serial

Modbus over serial is the preferred serial communication protocol to the RTU. Equipment must comply with the International Modbus Standards Modbus Application Protocol Specification V1.1b3 and be capable of communicating on an RS485 network defined by the International Modbus Standards Modbus Over Serial Line Specification V1.02.

This specification applies to devices that will be connected to the primary Modbus RS485 bus. It does not apply to devices that do not need to connect to this bus.

If existing, or legacy devices, do not comply with this specification notify Sydney Water IACS. An alternative design may be considered. This design must be approved by Sydney Water IACS.

16.2 Field device and instrument requirements

Field devices and instruments must comply with the minimum Modbus requirements outlined in table 16.1.

Application Protocol Layer	Modbus RTU. (Modbus Application Protocol Specification V1.1b3)
Data Link/Physical Layer	Modbus master-slave/RS485 2-Wire (EIA/TIA-485). RTU transmission mode. (Modbus over Serial Line Specification V1.02).
Modbus master	IICATS RTU.
Modbus slave	Instruments/devices will be the Modbus slave.
Slave ID	Configurable across the standard range from 1 – 247.
Baud rate (bps)	19 200 (default) and 9 600. Must be configurable. Should be configurable across the full range of optional baud rates from 1 200 to 115 000.
Data, Parity, Stop bits	8E1 (default). Support for 8N1 is also preferred.
Data type	Standard IEC datatypes. E.g. IEC Real (32-bit) or IEC Integer (16-bit).
Register definition	Discrete input and/or Input register and/or Coil and/or Holding register
Bytes in registers	Big-endian bytes in registers (as per Application Protocol Specification).
Registers (32-bit data)	Big-endian or Little-endian registers. Must be consistent for all registers in the device.
Address reference	Full 1-based 5 digit standard addressing. For each primary table: Modbus protocol data unit addressed from 0 to n. Modbus data model addressed from 1 to n+1.
Function Codes	Support the public function code definition and Modbus exception responses (as per Modbus Application Protocol Specification).
Termination resistor	Devices shall have 120Ω termination resistors that can be easily switched between connected and disconnected.

Table 16.1 Sydney Water specific Modbus device requirements.

Field devices and instruments must comply with the specifications for their primary function as specified elsewhere in this, or other, Sydney Water standards and technical specifications.

Devices should have the capability to configure the Modbus slave ID and baud rate via a Modbus master.

16.3 Serial Network requirements

A serial communications network must be designed and built to comply with the following requirements:

16.3.1 Network topology

The serial network should typically include the following components: Modbus master, RS485 hub, Modbus slave devices, terminals, surge protection, serial bus cables and protocol converters where required.

Devices within the RTU panel must be connected to the primary RS485 bus. An alternative RS232 point to point interconnection may be considered for specific applications.

Where devices external to the RTU control panel are to be connected to the Modbus network an RS485 hub is required. The network must include a connection from the RTU to an RS485 hub/s. All devices external to the RTU panel must be connected to one field bus from the RS485 hub/s.

One separate bus is required for each motor starter cubicle, valve control panel or one bus for all field instruments. This topology has been selected to create redundancy and prevent data loss for a failure of a single device connection causing a multi-device network failure

The Modbus network designs must be approved by Sydney Water IACS at the design phase prior to installation. Refer to SSD drawings:

- SSD120 IICATS Modbus block diagram
- SSD121 IICATS control panel Modbus network
- SSD122 IICATS field device Modbus network

25% spare capacity must be provided in the network design to accommodate future expansion.

16.3.2 Modbus master

The IICATS RTU is the Modbus master. It must be the only Modbus master on the network.

The RTU provides an RS232 DB9 connection or RS485 3 wire connection. This connection must be wired directly to the primary RS485 hub.

For eNet RTUs RS232 must be used. An inline RS232/485 converter must be installed to create the primary RS485 bus.

For Brodersen RTUs RS485 must be used. This is the primary RS485 bus.

The primary RS485 bus must only connect to devices in the RTU control panel. All field devices must be connected to the field side of the primary RS485 hub.

16.3.3 Primary RS485 hub

An industrial grade RS485 hub must be provided.

It must have an RS485 input and at least 4 fully isolated RS485 bus outputs. Where more RS485 buses are required, due to the number of assets, multiple converters must be used.

The primary RS485 hub must be installed in the RTU panel and powered from the RTU 24V DC power supply.

Each field bus must be arranged in a logical order.

The hub must meet the following minimum requirements:

- Provide RS-485 D+, D- and ground terminals
- Support parity options: None, Even, Odd

- Support data bit options: 8bit
- Support stop bit options: 1bit, 2bit
- Support a baud rate: 1200bps~115200bps
- Load capacity: support 32 nodes (customizable to 128 nodes) polling
- Port protection: provide 2KVac isolation protection, level-4 electrostatic protection, level-2 radiated susceptibility
- Transmission distance: RS-485 1200m
- Provide tinned screw terminals or push in connectors
  - Push in connectors must meet the 150kN standard pull out conductor test.
- Indication of
  - PWR: Power indicator
  - TXD: Host computer serial port data sending status indicator
  - RXD: Host computer serial port data receiving status indicator
  - 1~4: Slave computer RS-485 port status indicator
- Be suitable for connection to a nominal 24VDC supply.
  - Load power must be less than 2W at 24VDC
- Mechanical structure
  - Shell: IP2x protection, high-strength metal shell
  - Installation: DIN-rail installation
  - Dimension (LxWxH): Fit within a space 110mm x 100mm x 40mm
- Working environment
  - Working temperature: -20~70℃
  - Humidity: 5%~95% (no condensation)

16.3.4 Physical layer – serial data cables

The physical layer must be a two-wire standard RS485 bus. This standard is alternatively known as the RS485 TIA/EIA standard.

Cables shall be Belden 3106A or equivalent and must be:

- Shielded twisted pair,
- Characteristic impedance of 120Ω,
- Tinned copper,
- Insulation – PVC,
- Number of pairs (2 or 4),
- Conductor size 0.5mm^2 or 0.2mm^2 (24AWG)
- Conductor colours (white/blue), and
- Have an operating temperature range of -20 to 70^{O}C

The provision shall be made to install 120Ω termination resistors at the ends of each bus or daisy chain. This should be provided by a switchable 120Ω resistor in the final field device on the bus. If this is not provided by the last device then terminals must be provided. The termination resistor must be switched off.

16.3.5 Grounding and Shielding guidelines

Grounding and shielding shall be designed for each installation. Site specific allowances may be required and must be determined and tested at the time of installation.

Large potential differences between earths that are separated and at different potentials must be avoided to prevent ground loop currents.

RS485 networks may be operated without a ground wire where there are low levels of EMI. Some installation may require a ground wire to provide a return path for common mode currents.

Where devices share a common ground (e.g. within a pump station) the cable must be grounded to the common earth within each panel.

Due to significant differences in ground potentials that may be present between nodes in some locations, ground should not be used as a reference. In installations where ground is used as a return path 100-120Ω resistors may be used to limit the ground currents flowing due to ground potential differences between devices.

The shield must be grounded at one end and be continuous for the full length of the RS485 bus. Ground loop currents flowing in the shield will induce noise in the communications cable. A capacitor or an RC network may be used between the other end and ground only where required. Connections must be low impedance. Resistance measurements at the time of installation must be provided.

16.3.6 Biasing

Slaves should not provide biasing. Where they have the capability, it must be configurable and switched off by default.

16.3.7 RS232 to RS485 Converter

RS485 compliant devices are preferred. Where a RS232/485 converter is required to connect an RS232 device to the station RS485 bus it must be inline and line, or port, powered.

Line powered, non-configurable converters must meet the following requirements:

- Provide 2500V optical isolation between the RS232 and RS485 networks,
- Be compatible with EIA/TIA RS232 Standard and RS485 Standard
- Working Mode: Asynchronous, Half-duplex, Differential Transmission
- Transmission Media: Twisted Pair or Shielded Twisted Pair
- Transmission Rate: 1200bps -115.2K bps
- Transmission Distance: 1200m(RS485), 5m(RS232)
- Working Environment: -20 to 70^{O}C (Temperature), 5% - 95% (Humidity)
- CE/FCC/RoHS Compliant

Field instruments, or devices must be able to power the in line converter via the RTS/CTS pins. RS232 cables must have these pins connected. Where a primary device cannot support this capability powered converters may be considered. Written approval must be given by Sydney Water.

Where powered RS232/485 converters are required they must:

- Be capable of being powered from a 24V DC nominal supply.
- Have switchable termination resistor fitted,
- Have the ability to apply 0V and 5V bias,
- Support the baud rates defined in the International Modbus Standard. The converter must have the ability to adjust the baud rate or automatically support changes to the baud rate.
- Be DIN rail mountable.
- Provide optical isolation between the RS232 and RS485 networks.

16.3.8 Lightning and surge protection

Surge protection complying with Part 11 – Lightning and surge protection for instrumentation and control must be installed on all cables entering the RTU panel. Surge protection for Modbus serial data must be designed specifically for high frequency applications.

16.4 Modbus over serial slave device ID

Throughout the water and sewerage systems of Sydney Water there are sites which have common asset types and operating functions and as such are classed as standard sites.

Pre-defined Modbus serial device IDs are used to provide consistent device numbering across standard Networks sites. The device ID must be shown on the Modbus Network drawings for a site.

16.4.1 Pre-defined device ID groups

002 to 009 Site general

010 to 019 Pump unit 1

020 to 029 Pump unit 2

030 to 099 Pump unit 3 to 9

140 to 149 Flow monitoring

Note: Slave address 1 must not be used. It is the most common factory default and has been avoided to prevent two devices been placed on the network with the same device ID.

16.4.2 Site general

	Site general
001	Not used
002	RTU power supply unit
003	Site power supply unit
004	MAS801 central unit (mounted in control panel).
005	Site/station power quality monitoring
006	Site/multipump condition monitoring (vibration)
007	
008	
009	

16.4.3 Pump unit starter panel

Pump unit 1

	Pumps - Sewer	Pumps - Water
010	Drive unit	Drive unit
011	MAS relay (combined protection device)	Combined protection device
012	Power monitoring	Power monitoring
013		Temp 1
014		Temp 2
015		Vibration 1
016		Vibration 2
017		Other devices
018		
019		

Pump unit 2 to 9 must use the above device ID respectively. E.g. Pump unit 2 drive unit is 020. Pump unit 3 MAS relay is 031 etc.

16.4.4 Flow monitoring

	Flow monitoring
140	Flowmeter 1
141	
142	Flowmeter 2
143	
144	Flowmeter 3
145	
146	
147	
148	
149	

16.4.5 Non-standard sites

The device ID for each Pump unit should be numbered according to the IICATS asset number. Typically this is the same as the Maximo asset number. At non-standard sites that contain more than 1 RTU set this may not be the case. E.g. WP0005 Ryde. The slave device ID numbering must be considered per RTU and based on the IICATS RTU asset number not the Maximo asset number.

Sydney Water IACS must approve the device ID assignment.

16.5 Modbus over TCP/Ethernet

Modbus over TCP may be used for the Treatment Plant Interface RTU. Modbus over TCP must not be used at Networks sites.

Where Modbus over TCP is used an industrial firewall must be installed between the IICATS RTU and Plant SCADA network. The firewall and configuration will be provided by Sydney Water OTP group.

All Modbus over TCP equipment must meet the International Modbus Association Modbus/TCP specification requirements. All communications equipment including ethernet patch leads must comply with the requirements provided in Part 8 – Telecommunications of this standard.

16.6 Labelling

All devices and cables must be labelled as required by Part 9 – Cables, cubicle wiring and identification of this standard. Serial data cables must use the functional prefix D. e.g. 010-D01-01.

Appendix 1 – Drawings

Appendix 1 Drawings

A1.1 Index 1: Site works drawings

THESE DRAWINGS ARE NOT FOR CONSTRUCTION. THESE ARE, HOWEVER, TO BE USED AS THE BASIS FOR DETAIL DESIGN DRAWINGS.

Drawing	Issue	Title	Notes
SSD01		Not used	
SSD02_1	A	Typical site installation and conduit entry. Sheet 1 of 2	Withdrawn. Refer to SWC template drawings.
SSD02_2	A	Typical site installation and conduit entry Sheet 2 of 2	Withdrawn. Refer to SWC template drawings.
SSD003-SSD005		Not used	
SSD006	A	Typical control cubicle earthing details – unmetered supply	Added 2023.
SSD007	C	Typical control cubicle earthing details – standard RTU panel	
SSD008	E	Preferred earth and bonding arrangements	
SSD009	E	Typical earth stake installation	
SSD010	A	Magnetic flowmeter earthing details	Added 2023.
SSD011-SSD023		Not used	
SSD024	A	Typical interface to existing signals	Withdrawn. Refer to SWC template drawings.
SSD025-SSD032		Not used	
SSD033	C	Telecommunications distribution hierarchical diagram	
SSD034-SSD043		Not used	
SSD044	D	Typical analogue loop diagrams	Withdrawn. Refer to SWC template drawings.
SSD045	D	Typical digital loop diagrams	Withdrawn. Refer to SWC template drawings.

SSD046	A	Dual RTU analogue output changeover circuit typical loop diagram	Added 2023.
SSD047-SSD056		Not used	
SSD057	B	Typical communications earthing schematic	
SSD058C	C	Communication connection sockets and modem cabling for PMS sites	
SSD059	E	Typical RTU primary and secondary communication links diagram	
SSD060-SSD066		Not used	
SSD067		RTU standard I/O signals electric actuated valves.	Refer TS02.
SSD068		RTU standard I/O signals hydraulic actuated valves.	Refer TS02.
SSD069		RTU standard I/O signals IECV and isolating valves (manual).	Refer TS02.
SSD070		Electric actuated open/close valve and control panel.	Refer TS02.
SSD071		Electric actuated valve (digital positioning) & control panel.	Refer TS02.
SSD072		Electric actuated valve (analogue positioning) & control panel.	Refer TS02.
SSD073		Electric actuated valve (open/close) with integral controls.	Refer TS02.
SSD074		Electric actuated valve (digital positioning) with integral controls.	Refer TS02.
SSD075		Electric actuated valve (analogue positioning) with integral controls.	Refer TS02.
SSD076		Hydraulic actuated valve (open/close) single solenoid & control panel.	Refer TS02.
SSD077		Hydraulic actuated valve (open/close) double solenoid & control panel.	Refer TS02.
SSD078		Hydraulic actuated valve (digital positioning) with double solenoid & control panel.	Refer TS02.

SSD079		Hydraulic actuated valve (analogue positioning) & control panel.	Refer TS02.
SSD080		Reservoir parameters.	Refer TS02.
SSD081	C	Reservoir pressure board.	Refer TS02.
SSD082	C	Example control panel layout (Brodersen series RTU)	
SSD083	E	Control cubicle typical RTU terminal blocks and loom arrangements	
SSD084A		Elevated reservoir parameters. Pressure gauge type.	Refer TS02.
SSD084B		Elevated reservoir parameters. Pressure gauge type.	Refer TS02.
SSD085		Pressure board locating drawing.	Refer TS02.
SSD086	C	IICATS RTU I/O and port layouts	
SSD087	C	24V DC linear power supply unit wiring diagram,	
SSD088-SSD089		Not used	
SSD090		Typical outdoor kiosk general arrangement	Withdrawn. Refer to SWC template drawings.
SSD091		Typical outdoor kiosk plan view	Withdrawn. Refer to SWC template drawings.
SSD092		Typical outdoor kiosk weather shield, hinging & door seals	Withdrawn. Refer to SWC template drawings.
SSD100	I	IICATS RTU (32DI standard model) details & TRT XDSL modem connection	Withdrawn. No longer used.
SSD101	C	IICATS RTU I/O loom wiring details & pin orientation guide	
SSD102	C	IICATS RTU and wireless modem connection diagram	
SSD103	B	IICATS RTU (8DI model) details & XDSL modem connection	Withdrawn. Refer to SWC template drawings.
SSD104	B	IICATS RTU (8DI model) details & GPRS modem connection superseded	Withdrawn. Refer to SWC template drawings.
SSD105		Not used	

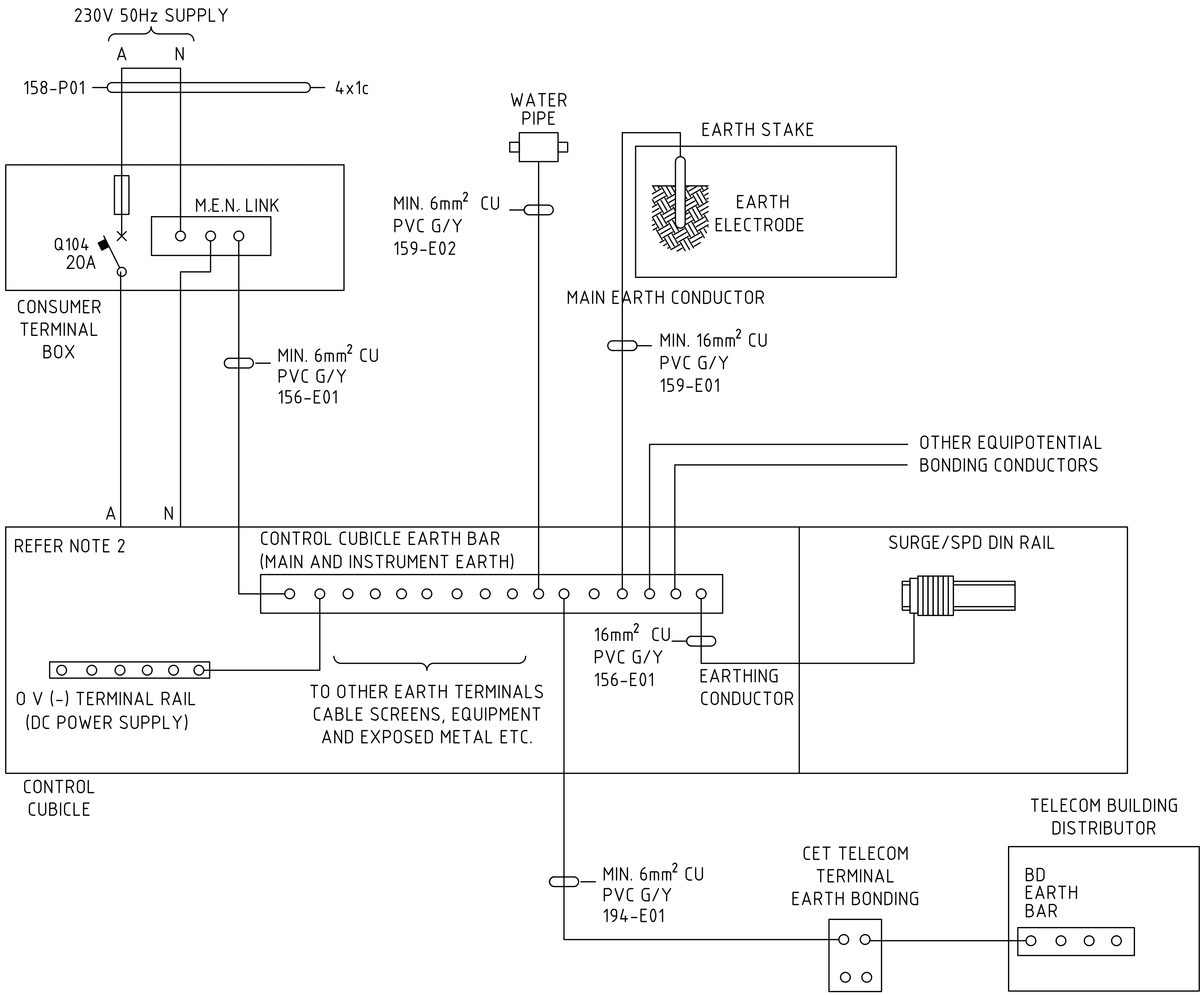
SSD106		RTU cubicle details – SPS sample (32DI standard Serck eNet A model)	Withdrawn. Refer to SWC template drawings.
SSD107		Not used	
SSD108		RTU cubicle details- Treatment plant IICATS interface (STP sample)	Withdrawn. Refer to SWC template drawings.
SSD109		Not used	
SSD110	D	IICATS MDF enclosure general Arrangement	
SSD110A	B	IICATS MDF enclosure copper non-EPR cabinet layout	
SSD110B	-	Not used	
SSD110C	-	Not used	
SSD110D	B	IICATS MDF enclosure optical network terminator MDF layout	
SSD111	E	Lead-in conduit and carrier demarcation general arrangement	
SSD112	B	IICATS copper based MDF connection schematic-non EPR	
SSD112A	-	Not used	
SSD112B	B	IICATS fibre based MDF connection schematic-TRT fibre	
SSD113	C	IICATS RTU and Ultralink modem (UHS UC400T) connection diagram	
SSD114 – SSD119		Not used	
SSD120	A	IICATS Modbus block diagram	
SSD121	B	IICATS control panel Modbus network	
SSD122	A	IICATS field device Modbus network	
SSD123 – SSD129		Not used	
SSD130	A	Local pressure gauge detail	
SSD 131	A	Pump differential pressure board	Refer TS02.
SSD 132	A	Suction or delivery pressure board	Refer TS02.

A1.2 Index 2: Instrument installation drawings

THESE DRAWINGS ARE NOT FOR CONSTRUCTION. THESE ARE, HOWEVER, TO BE USED AS THE BASIS FOR DETAIL DESIGN DRAWINGS.

Drawing	Issue	Title	Notes
SSD201	D	Not used	
SSD202	D	Typical pressure switch/transmitter installation	Withdrawn. Refer to SWC template drawings.
SSD203	D	Typical electromagnetic flow meter installation	Withdrawn. Refer to SWC template drawings.
SSD204	D	Typical electromagnetic flow meter earthing	Withdrawn. Refer to SWC template drawings.
SSD205	D	Typical water quality station equipment panel general arrangement	Withdrawn. Refer to SWC template drawings.
SSD206	D	Typical water quality station equipment interconnection diagram	Withdrawn. Refer to SWC template drawings.
SSD207	G	Typical differential pressure transmitter arrangement	
SSD208	D	Panel mounted Depolox - 3 analyser and buffer pump arrangement	Withdrawn. Refer to SWC template drawings.
SSD209	A	Typical buoyancy Switch installation	Withdrawn. Refer to SWC template drawings.
SSD210	A	Typical hydrostatic level probe stilling tube installation	Withdrawn. Refer to SWC template drawings.
SSD211	C	Typical RF admittance level probe installation	
SSD212	A	Typical ultrasonic and hydrostatic level transmitter installation	Withdrawn. Refer to SWC template drawings.
SSD213	A	Typical ultrasonic flow transmitter installation	Withdrawn. Refer to SWC template drawings.
SSD214	C	Typical open channel flow measurement installation	
SSD215	C	Typical pH/ORP probe installation	
SSD216	C	Typical DO probe installation	
SSD217	C	Typical sludge blanket monitoring probe installation	
SSD218	C	Typical schematic for nutrient analyser sampling system	
SSD219	A	Typical conductivity instrument installation	New

SSD220	A	Typical pH/ORP/Conductivity instrument installation wet rack	New
SSD221	A	Typical free/total chlorine instrument installation amperometric	New
SSD222	A	Typical free/total chlorine instrument installation potentiometric	New
SSD223	A	Typical free/total chlorine instrument installation colorimetric	New
SSD224	A	Typical fluoride instrument installation flow through holder	New
SSD225	A	Typical turbidity instrument installation contact and non-contact	New
SSD226	A	Typical water quality monitoring panel treatment plants	New
SSD227	A	Typical suspended solids sludge density instrument installation microwave	New
SSD228	A	Typical suspended solids sludge density instrument installation optical/light/NIR	New
SSD229	A	Typical dewatered sludge moisture instrument installation conveyor	New
SSD230	A	Typical sludge blanket monitoring probe installation winched infrared	New
SSD231	A	Typical ammonia, NOX and orthophosphate instrument installation in tank	New
SSD232	A	Typical ammonia, NOX and orthophosphate instrument installation under grate	New
SSD233	A	Typical ammonia, NOX and orthophosphate instrument installation	New
SSD234	A	Typical ammonia, NOX and orthophosphate instrument installation	New
SSD235	A	Typical ultraviolet transmittance (UVT) instrument installation	New
SSD236	A	Typical biogas composition instrument installation	New
SSD237	A	Typical gas detection and alarming instrument installation	New



NOTES:

1. THE SIZE OF EARTH CONDUCTOR SHALL BE SUCH THAT IT MEETS THE REQIREMENTS OF AS 3000.
2. REFER TO NSW SERVICE AND INSTALLATION RULES FOR DETAILS.
3. SURGE EARTH BAR TO BE INSTALLED ON INSULATED STAND-OFFS.

DESIGNED S. ROSS SWC 20.09.23					
DRAWN S. ROSS SWC 20.09.23					
VERIFIED S. ROSS SWC 20.09.23					
APPROVED D. FRUCI SWC 20.09.23	A	ISSUED FOR FIRST USE	D.F	20.09.23	
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE	

Sydney WATER

SWC ---

RECOMMENDED 20.09.23 S. ROSS OT STANDARDS ENGINEER SYDNEY WATER

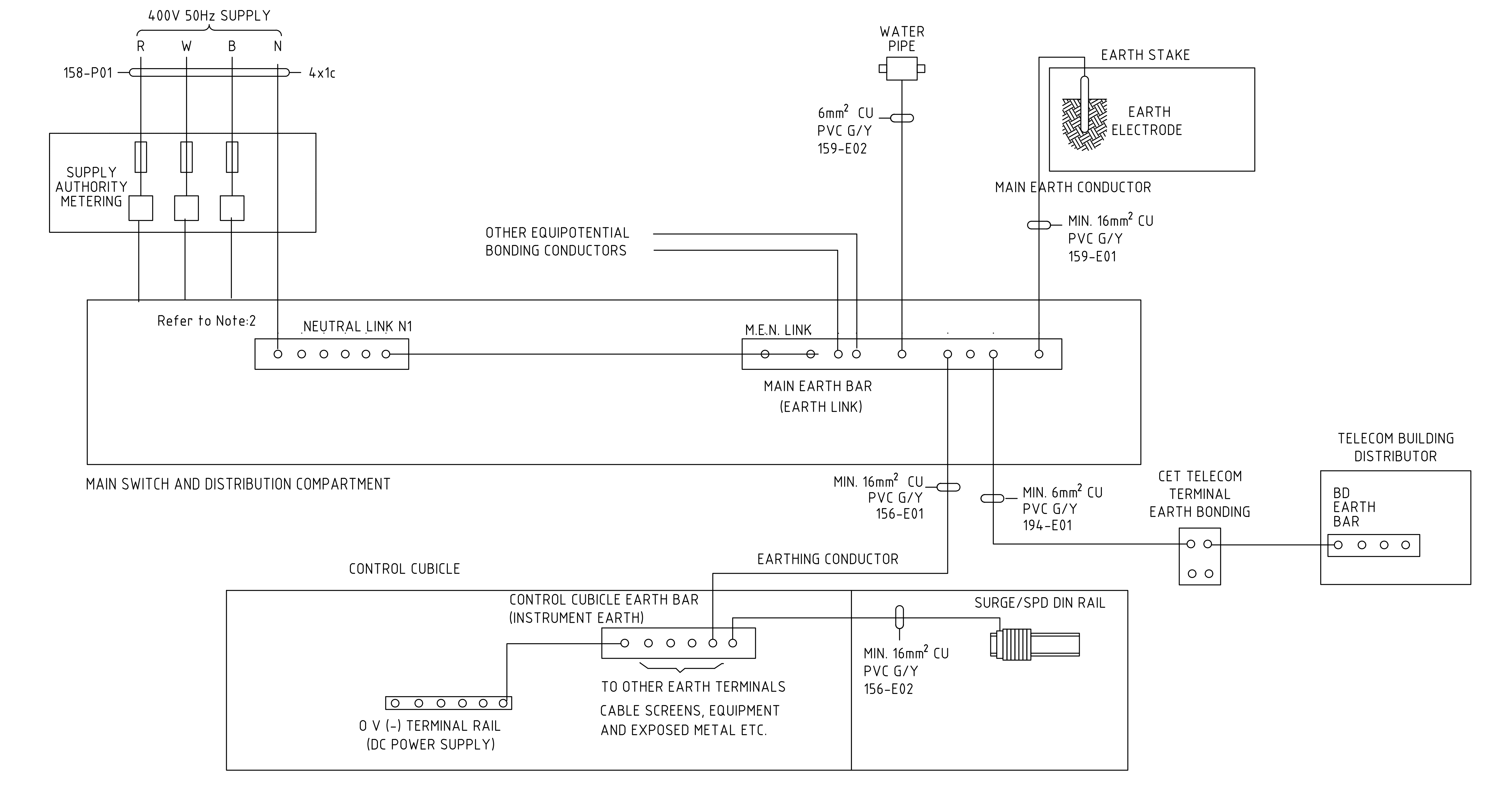
ACCEPTED 20.09.23 D. FRUCI IACS MANAGER SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL CONTROL CUBICLE
EARTHING DETAILS
UNMETERED SUPPLY

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD006

ISSUE A | SHEET No. 1



NOTES:

1. THE SIZE OF EARTH CONDUCTOR SHALL BE SUCH THAT IT MEETS THE REQIREMENTS OF AS 3000.
2. REFER TO NSW SERVICE AND INSTALLATION RULES FOR DETAILS.
3. SURGE EARTH BAR TO BE INSTALLED ON INSULATED STAND-OFFS.

DESIGNED E. DALDAL SWC 10.10.03					
DRAWN E. DALDAL SWC 10.10.03					
VERIFIED S. ROSS SWC 27.11.20	C	UPDATED FOR SPD DIN RAIL DESIGN	D.F	20.09.23	
	B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20	
APPROVED D. FRUCI SWC 27.11.20	A	ISSUED FOR FIRST USE	D.F	08.08.00	
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE	

Sydney WATER

SWC ---

RECOMMENDED S. ROSS OT STANDARDS ENGINEER SYDNEY WATER 20.09.23

ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 20.09.23

INSTRUMENT AND CONTROL STANDARDS
TYPICAL CONTROL CUBICLE
EARTHING DETAILS

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD007

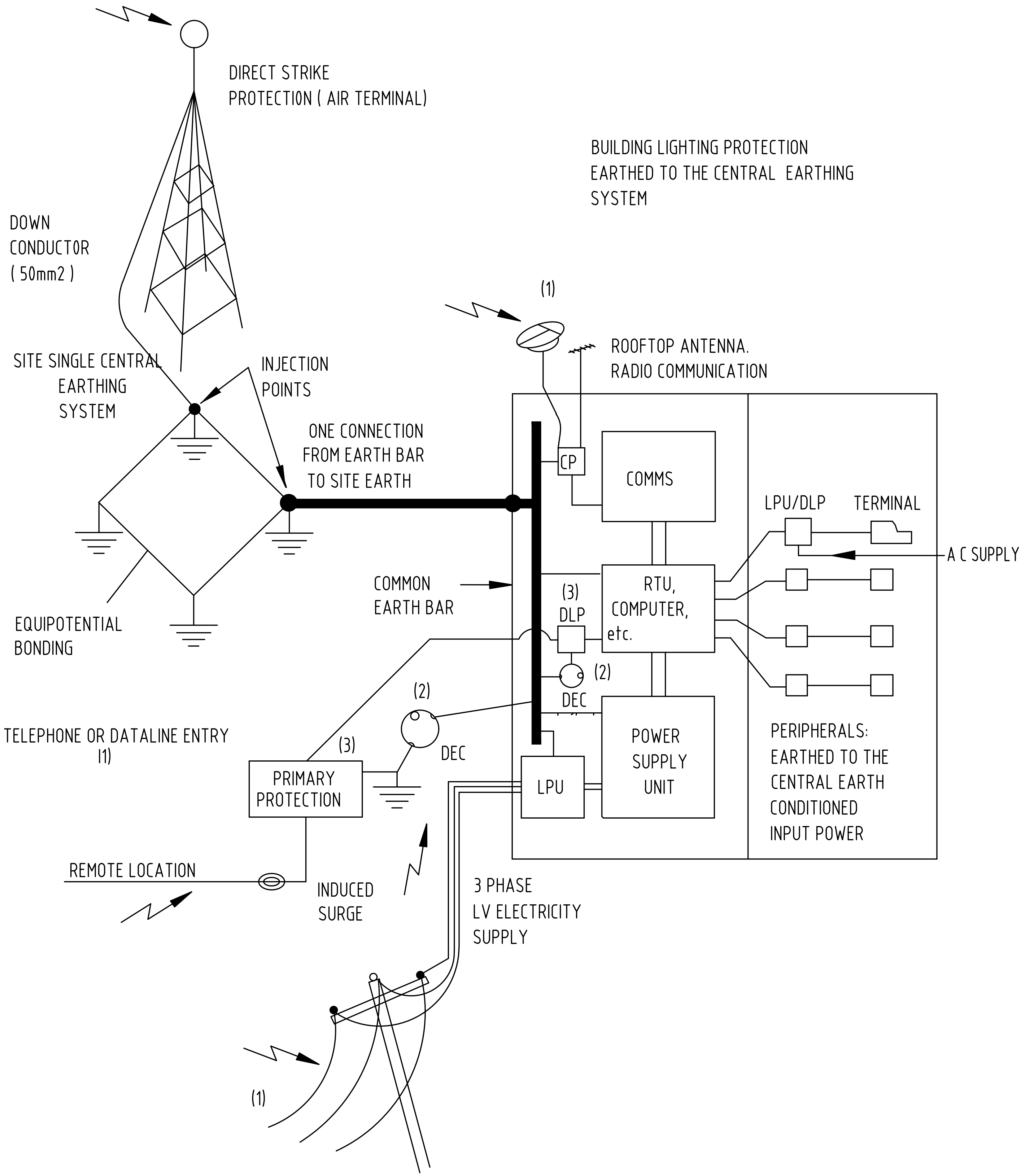
ISSUE C SHEET No. 1

NOTES:

1. ALL RELEVANT POWER AND DATA CABLES THAT ENTER AND LEAVE THE BUILDING SHOULD BE ON THE SAME SIDE (TO AVOID EARTH LOOPS AND CURRENT FLOW THROUGH THE BUILDING).
2. DIFFERENTIAL EARTH CLAMP TO BE PROVIDED (IF NEEDED AS PER SCOPE).
3. THE PRIMARY AND SECONDARY PROTECTION CAN BE COMBINED SUBJECT TO SYDNEY WATER APPROVAL.

PROTECTION EQUIPMENT:

CP - COAXIAL PROTECTORS FOR RF CABLES.
DLP - DATALINE PROTECTORS (SECONDARY PROTECTION).
LPU - LIGHTNING SURGE PROTECTION.
DEC - DIFFERENTIAL EARTH CLAMP.



DESIGNED L. C SWC 01.02.99				
DRAWN L. C SWC 01.02.99				
VERIFIED S. ROSS SWC 27.11.20	E	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
APPROVED D. FRUCI SWC 27.11.20	D	ISSUED FOR USE. PREVIOUS CHANGES NOT RECORDED.	D.F	01.02.99
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

SWC ---

RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 27.11.20

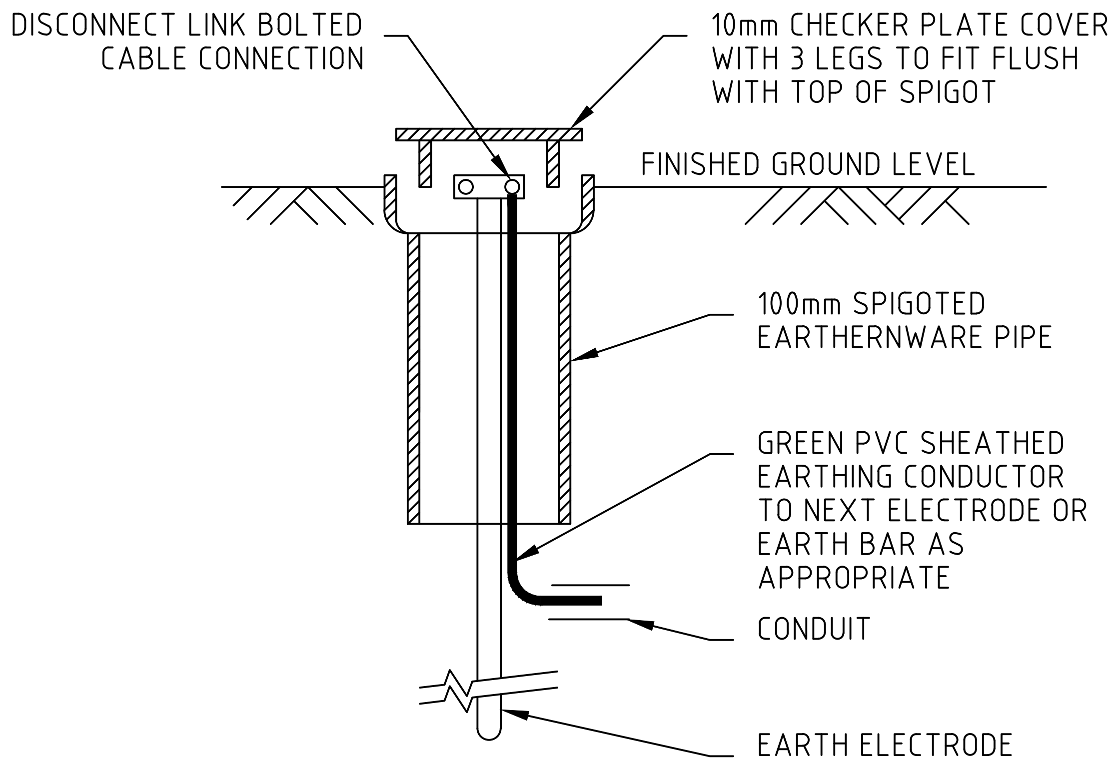
ACCEPTED D. FRUCI I&CS MANAGER SYDNEY WATER 27.11.20

INSTRUMENT AND CONTROL STANDARDS
TYPICAL EARTH AND BONDING ARRANGMENET
BLOCK DIAGRAM

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD008

ISSUE E | SHEET No. ---



TYPICAL EARTH ELECTRODE
INSTALLATION WITH MECHANICAL
PROTECTION AND COVER

DESIGNED E. DALDAL SWC 31.01.99				
DRAWN E. DALDAL SWC 21.01.99				
VERIFIED S. ROSS SWC 27.11.20	E	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
APPROVED D. FRUCI SWC 27.11.20	D	ISSUED FOR USE. PREVIOUS CHANGES NOT RECORDED	D.F	01.02.99
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

SWC ---

RECOMMENDED 27.11.20 S. ROSS PROJECT ENGINEER SYDNEY WATER

ACCEPTED 27.11.20 D. FRUCI IACS MANAGER SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL EARTH STAKE INSTALLATION

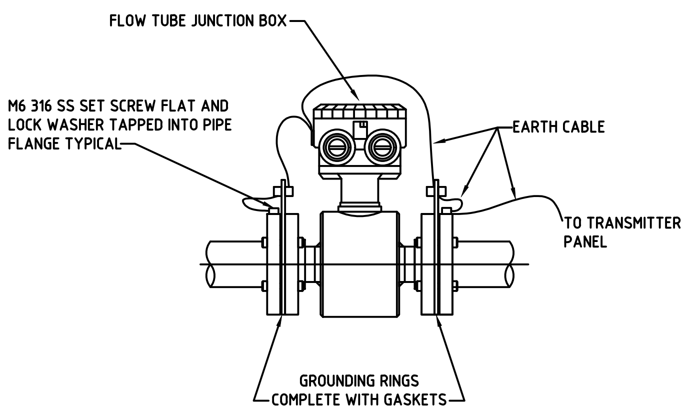
A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

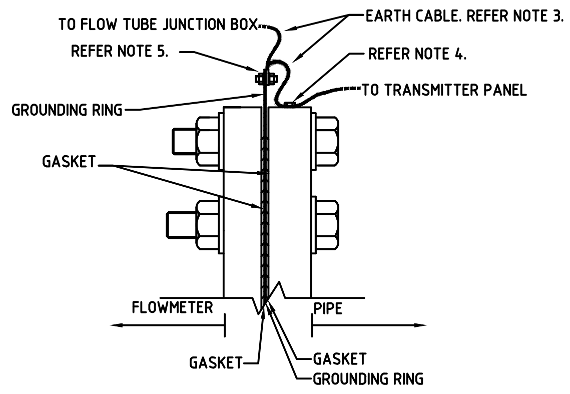
DRAWING No. SSD / SSD009

ISSUE E | SHEET No. ---

SWA1-EXT AUG 2016

TYPE 1 - GROUNDING DETAIL FOR CONDUCTIVE PIPE

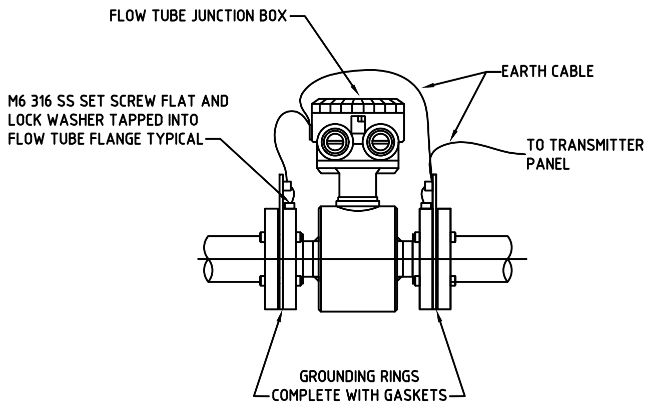


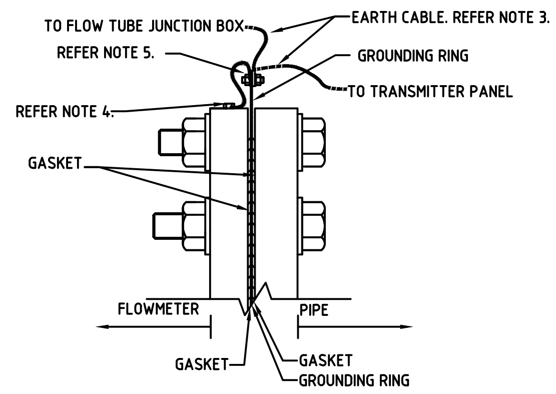


GROUNDING RING INSTALLATION NOTES

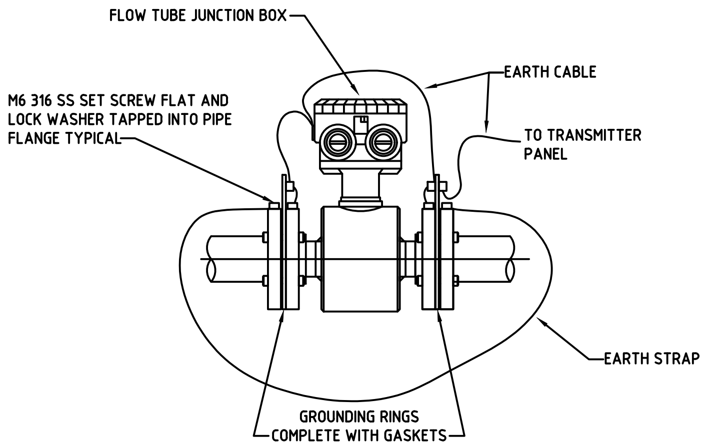
1. GROUND RING CONNECTIONS TO BE SET AT 12 O'CLOCK POSITION.
2. A 6mm² EARTH CABLE IS REQUIRED BETWEEN THE FLANGES, GROUNDING RINGS AND FLOW TUBE JUNCTION BOX.
3. FOR THE EARTH CABLE FROM THE FLOW TUBE TO THE TRANSMITTER/TRANSMITTER PANEL A MINIMUM 6mm² EARTH CABLE IS REQUIRED IF THE CABLE IS < 20m. A MINIMUM 10mm² EARTH CABLE IS REQUIRED IF THE CABLE IS ≥ 20m. THE MEASURED RESISTANCE MUST BE <0.1Ω BETWEEN THE FLOW TUBE AND TRANSMITTER.
4. DRILL AND TAP FLANGE. USE M6 SS316 SET SCREW, FLAT & LOCK WASHER.
5. GROUNDING RING CONNECTION TO USE M6 SS316 SET SCREW, NUT, FLAT AND LOCK WASHER.
6. GROUNDING RINGS TO BE 316 STAINLESS STEEL NOMINALLY 3mm THICK AND SUPPLIED WITH EACH FLOWMETER TO SUIT CONNECTING FLANGES.

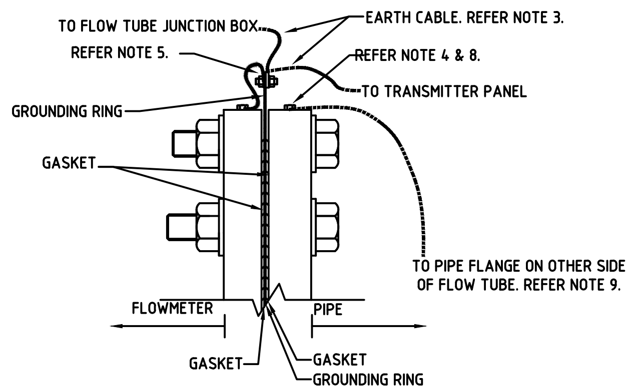
TYPE 2 - GROUNDING DETAIL FOR NON-CONDUCTIVE PIPE





TYPE 3 - GROUNDING DETAIL FOR PIPE WITH CATHODIC PROTECTION





ADDITIONAL NOTES FOR TYPE 3 EARTHING DETAIL PIPES WITH CATHODIC PROTECTION:

7. A BOLT INSULATION KIT IS REQUIRED TO FULLY INSULATE THE FLOW TUBE AND GROUNDING RINGS FROM THE PIPEWORK.
8. SEPARATE TAP AND BOLTS ARE REQUIRED ON PIPEWORK FLANGES WITH NO ELECTRICAL CONDUCTIVITY TO THE FLOW TUBE.
9. PIPEWORK FLANGES TO BE CONNECTED BY A MINIMUM 25mm² EARTH CABLE. THIS CABLE MUST BE OF THE MULTISTRAND FLEXIBLE COPPER CONDUCTOR TYPE CONSTRUCTION (e.g. VERSOLEX OR EQUIVALENT).

EARTHING INSTALLATION DETAILS
SCALE-1:4

GROUNDING RING INSTALLATION DETAILS
SCALE-NTS

DESIGNED IACS SWC	01.07.23			
DRAWN S. ROSS SWC	01.07.23			
VERIFIED L. HARRIS SWC	04.07.23			
APPROVED D. FRUCI SWC	04.07.23	A	ISSUED FOR USE	D.F. 04.07.23
		LETTER	DETAILS OF AMENDMENT	APP'D DATE

RECOMMENDED S. ROSS OT STNADARDS ENGINEER SYDNEY WATER 04.07.23
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 04.07.23

INSTRUMENT AND CONTROL STANDARDS
MAGNETIC FLOWMETER EARTHING DETAILS
TYPICAL INSTALLATION

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

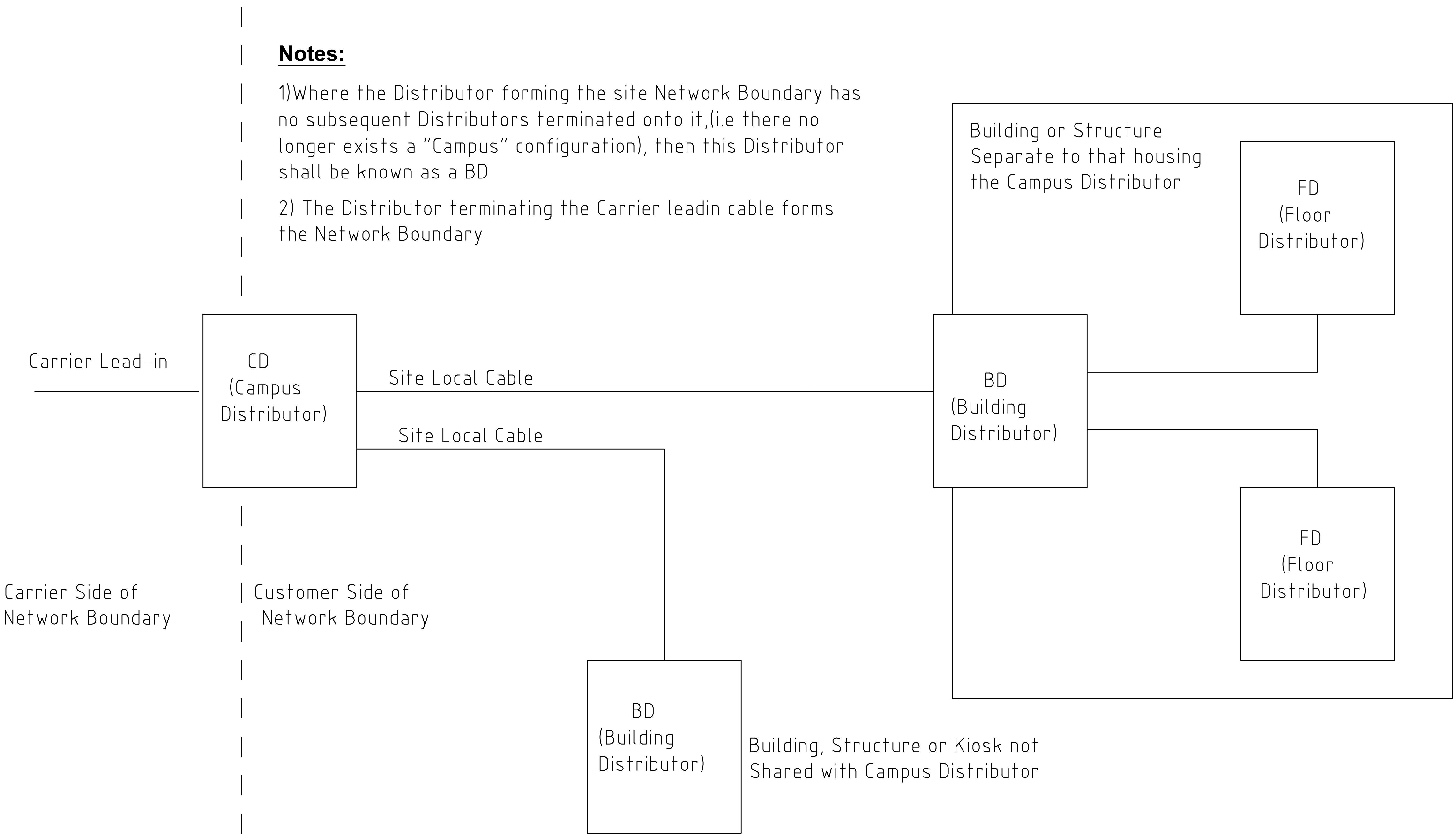
DRAWING No. SSD SSD010
ISSUE A SHEET No. 1

SWA1-EXT AUG 2016

Notes:

1)Where the Distributor forming the site Network Boundary has no subsequent Distributors terminated onto it,(i.e there no longer exists a "Campus" configuration), then this Distributor shall be known as a BD

2) The Distributor terminating the Carrier leadin cable forms the Network Boundary



DESIGNED A. BALUK SWC 03.10.03					
DRAWN A. BALUK SWC 03.10.03					
VERIFIED S. ROSS SWC 27.11.20	B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20	
APPROVED D. FRUCI SWC 27.11.20	A	ISSUED FOR USE	A.B	03.10.03	
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE	

Sydney WATER

SWC ---

RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 27.11.20

ACCEPTED D. FRUCI I&CS MANAGER SYDNEY WATER 27.11.20

INSTRUMENT AND CONTROL STANDARDS
TELECOMMUNICATIONS DISTRIBUTOR
HIERARCHIAL DIAGRAM

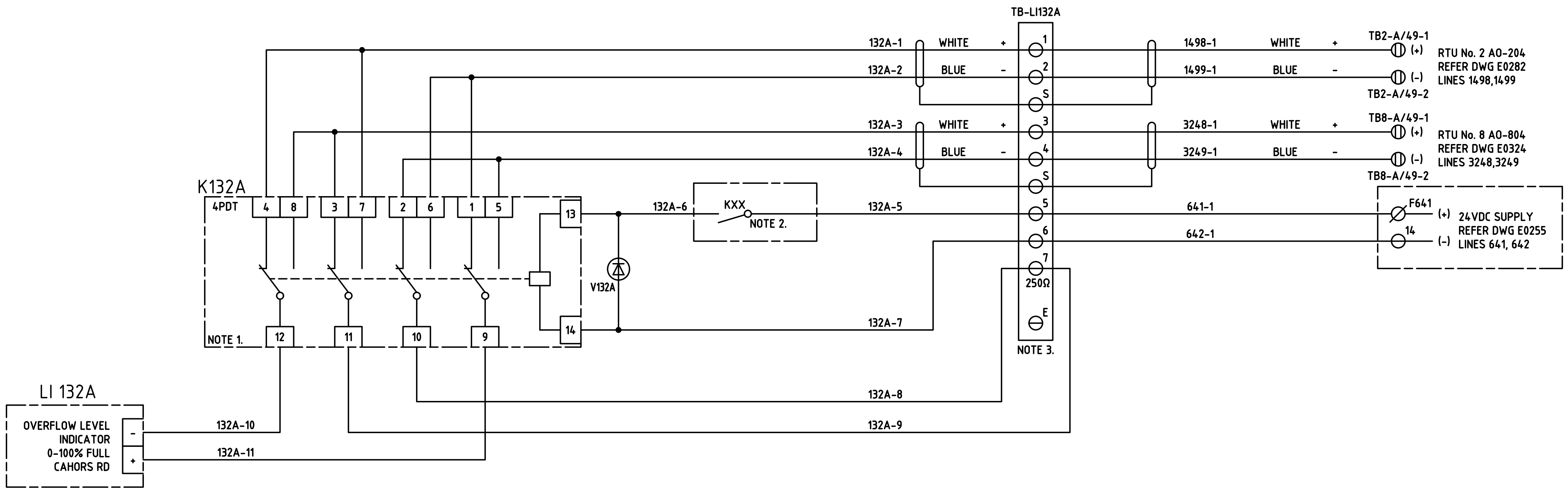
A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD033

ISSUE C SHEET No. ---

SWAI-EXT AUG 2016

RTU CUBICLE



NOTES:

1. RELAY MUST BE 4PDT WITH GOLD PLATED CONTACTS WITH A MINIMUM SWITCHING LOAD RATING SUITABLE FOR 24Vdc, 4mA APPLICATIONS e.g. FINDER 55.34.9.024.5074, WITH CONTACT MATERIAL AgNi + Au AND 50mW/5V/2mA RATING, OR EQUIVALENT.
2. COIL TO BE DRIVEN BY RTUB CONTROLLING DIGITAL OUTPUT RELAY FROM RTU SET B. RELAY NUMBER TO BE UPDATED.
3. TERMINAL 7 TO BE STRAIGHT THROUGH TERMINAL WITH INTERNAL COMPONENT 250Ω RESISTOR TO ENSURE LOAD IS SWITCHED ONTO A RESISTIVE LOAD AND IS NOT OPEN, OR SHORT, CIRCUITED.
4. THIS IS A SAMPLE DRAWING AND IS GENERAL IN NATURE. IT IS INTENDED TO PROVIDE A REFERENCE DESIGN ONLY. THIS DESIGN MUST BE ADAPTED FOR THE SITE SPECIFIC DESIGN.

LEGEND:

- RTU KNIFE TERMINAL (DISCONNECT)
- STARTER TERMINAL
- FUSED TERMINAL (CONTROL)
- RTU UNIT TERMINAL
- EMERGENCY CONTROLLER TERMINAL
- FEED THROUGH TERMINAL

DESIGNED	L.CRAMP SWC	23.08.23	
DRAWN	S.ROSS SWC	30.08.23	
VERIFIED	L.CRAMP SWC	31.08.23	
APPROVED	D.FRUCI SWC	31.08.23	

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
A	ISSUED FOR USE	D.F	31.08.23

Sydney WATER

RECOMMENDED S.ROSS OT STANDADRS ENGINEER SYDNEY WATER 01.09.23

ACCEPTED D.FRUCI IACS MANAGER SYDNEY WATER 01.09.23

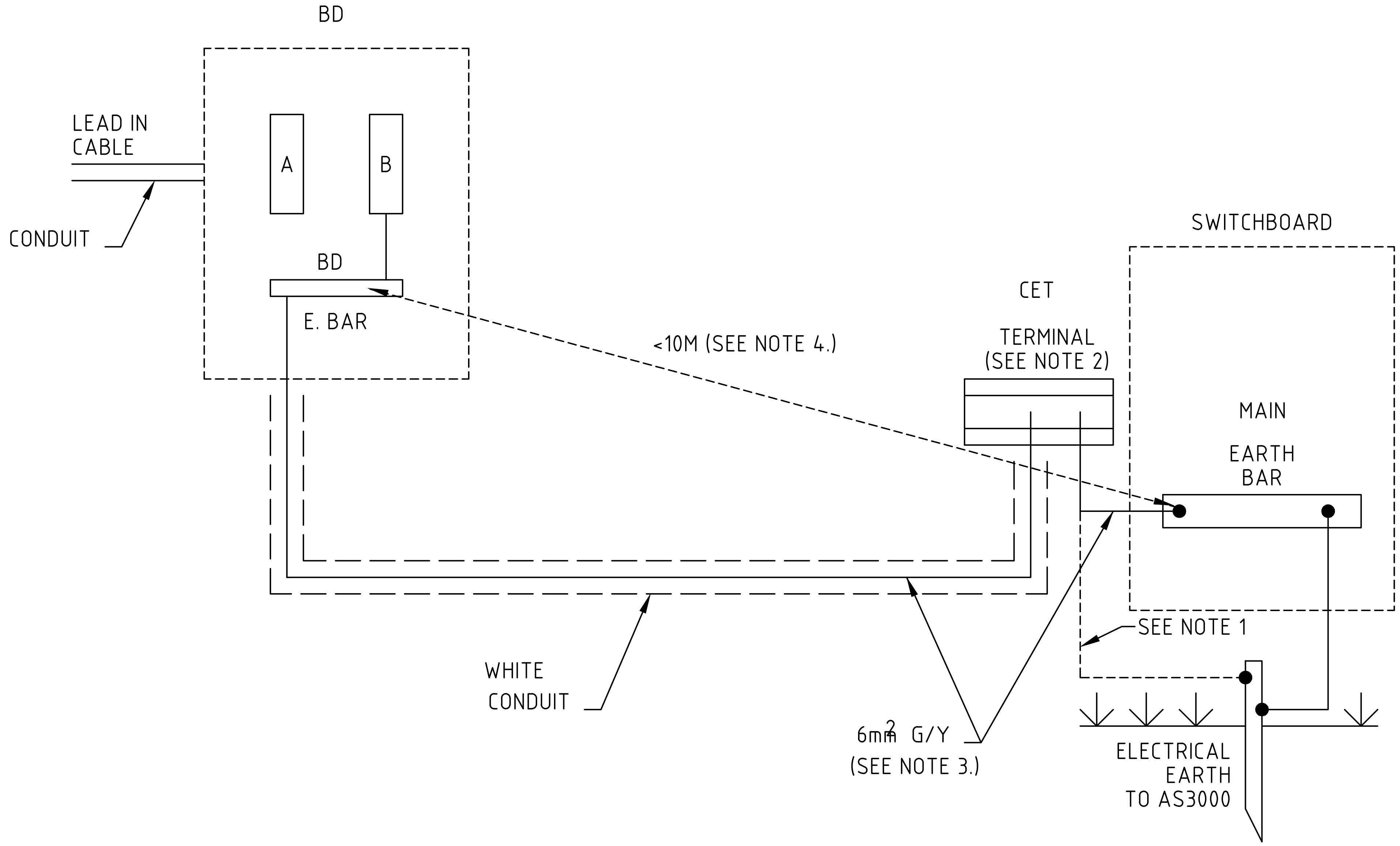
INSTRUMENTATION AND CONTROL STANDARDS
DUAL RTU ANALOGUE OUTPUT
CHANGEOVER CIRCUIT
TYPICAL LOOP DIAGRAM

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD046

ISSUE A | SHEET No. 1

SWA1-EXT AUG 2016



NOTES

1. ON SITES WHICH DO NOT HAVE A SWITCHBOARD, CONNECT DIRECT TO EARTH STAKE
2. COMMUNICATIONS EARTH BONDING TERMINAL HPM CAT.413LA OR APPROVED EQUIVALENT TO BE INSTALLED
3. RESISTENCE OF THE EARTH CABLE BETWEEN POINT OF CONNECTION THE EARTH BAR OF THE PROTECTIVE EARTH (ELECTRICAL EARTH) AND THE EARTH BAR ON THE BD OR RTU SHALL NOT EXCEED 1 OHM
4. ACCORDING TO TS009 THE TOTAL COMMUNICATIONS BONDING CONDUCTOR LENGTH BETWEEN THE BD AND THE POINT OF CONNECTION TO THE PROTECTIVE EARTH SYSTEM SHOULD NOT EXCEED 10 METERS.

DESIGNED SWC
DRAWN SWC
VERIFIED S. ROSS SWC 27.11.20
APPROVED D. FRUCI SWC 27.11.20

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
A	ISSUED FOR USE	UNK	UNK

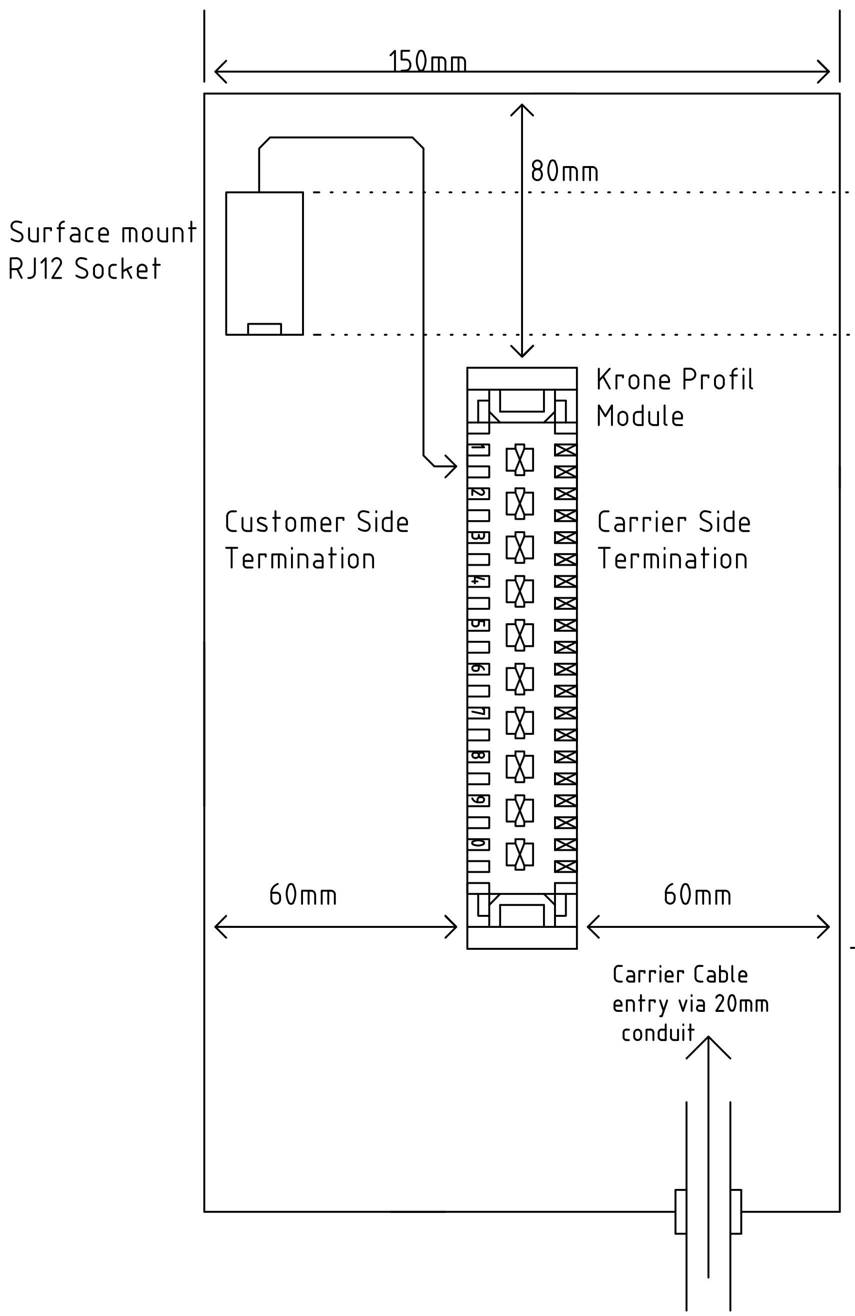
Sydney WATER

SWC ---
RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 27.11.20
ACCEPTED D. FRUCI I&CS MANAGER SYDNEY WATER 27.11.20

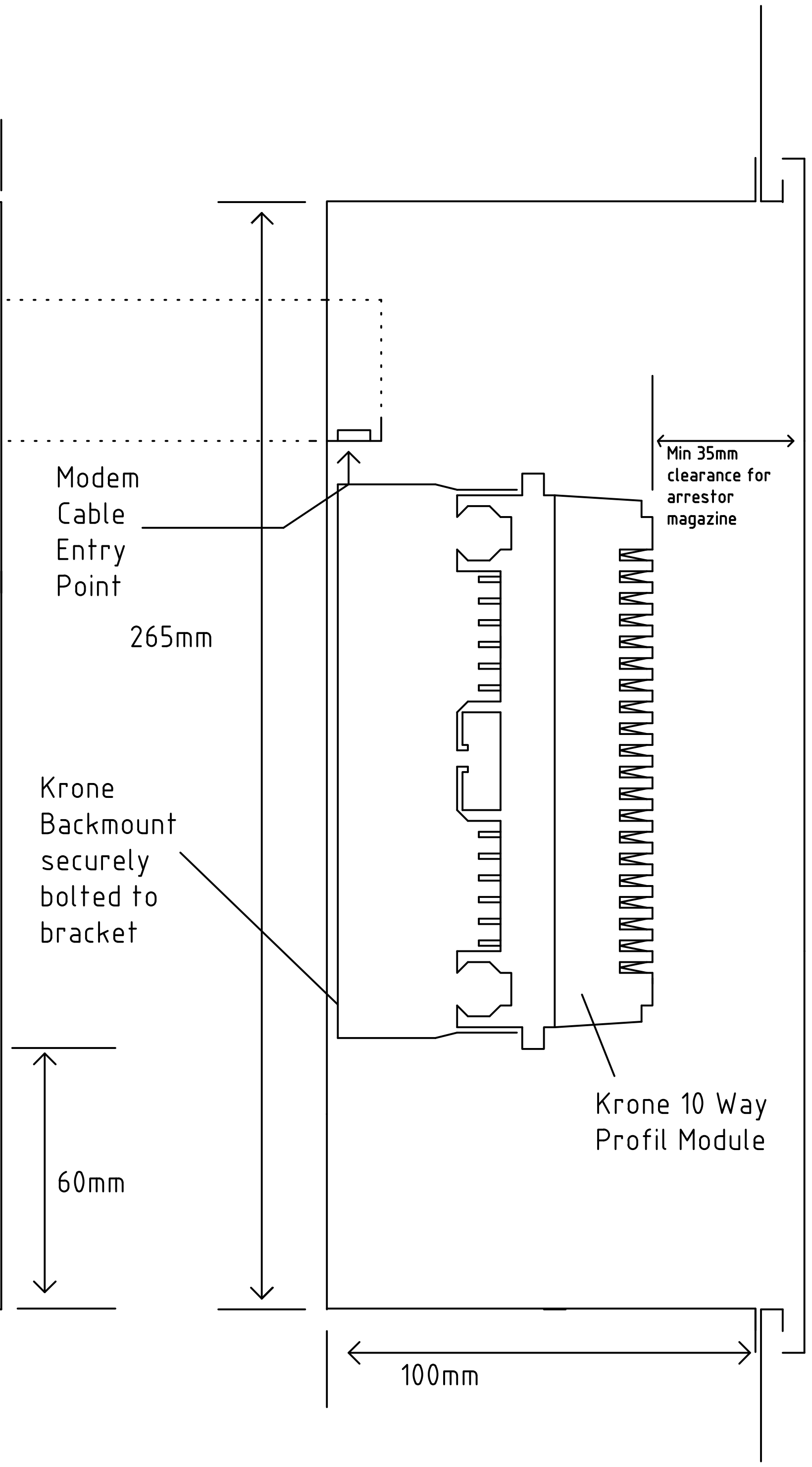
INSTRUMENT AND CONTROL STANDARDS
COMMUNICATIONS EARTHING SCHEMATIC

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

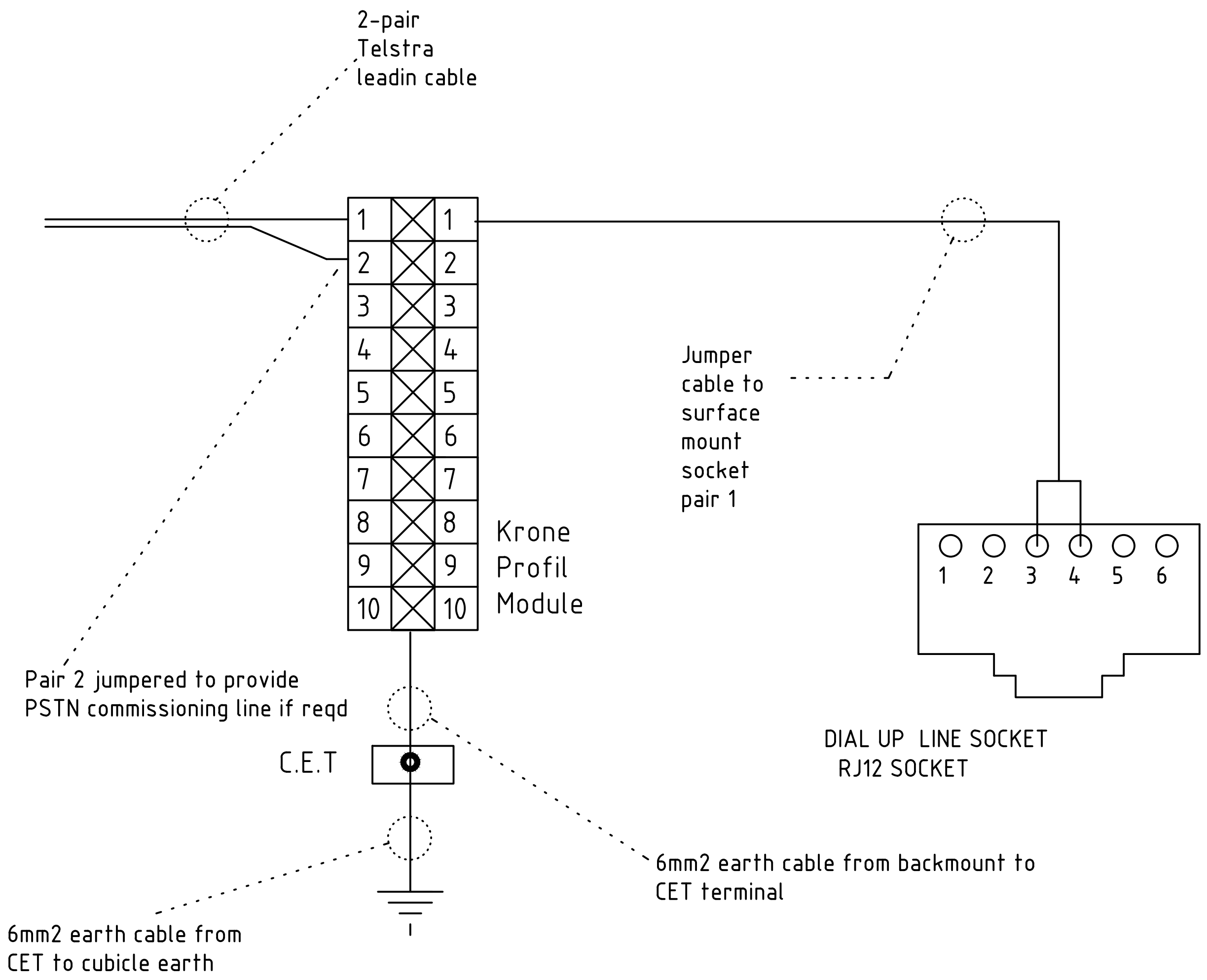
DRAWING No. SSD SSD057
ISSUE B
SHEET No. ---



PMS BD FRONT VIEW



PMS BD SIDE VIEW



PMS BD WIRING ARRANGEMENT

NOTES

1) BD Internal frame consists of vertically mounted U-shaped plate 100mm deep x 260mm High x 150mm Wide made from min 2mm stainless steel welded to inside of cubicle DB aperture/door

2) Bottom of BD to be minimum 375mm above top of the plinth and 450mm above ground level

3) Door to BD to be secured by a single Krone L331 type CAM lock.

4) A Communications Earth Terminal shall be installed in accordance with AS/ACIF S008 and AS/ACIF S009

PARTS LIST

1 off Krone 10 Way Termination strip (Backmount type) 6089-1102-02
1 off Krone Arrestor Magazine (Backmount type) Unloaded) 6089-2023-01
1 off Krone 1 way backmount bracket 6450-3137-00
1 off Krone 230V 3-Pole Gas Arrestor 3YVJ-230JI
1 off Krone 1 Way Surface Mount Keystone outlet box or equivalent
1 off Krone Keystone RJ12 6P6C Socket or equivalent
1 off Communications Earth Terminal HPM Cat No 413LA or equivalent

DESIGNED A. BALUK SWC 24.07.03				
DRAWN A. BALUK SWC 22.03.05				
VERIFIED S. ROSS SWC 27.11.20	C	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
	B	SPECIFIC REFERENCE FOR CET IN MDF EARTHING ADDED	A.B	22.03.05
APPROVED D. FRUCI SWC 27.11.20	A	REVISED IN ACCORDANCE WITH TOG RTR0038	A.B	24.07.03
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

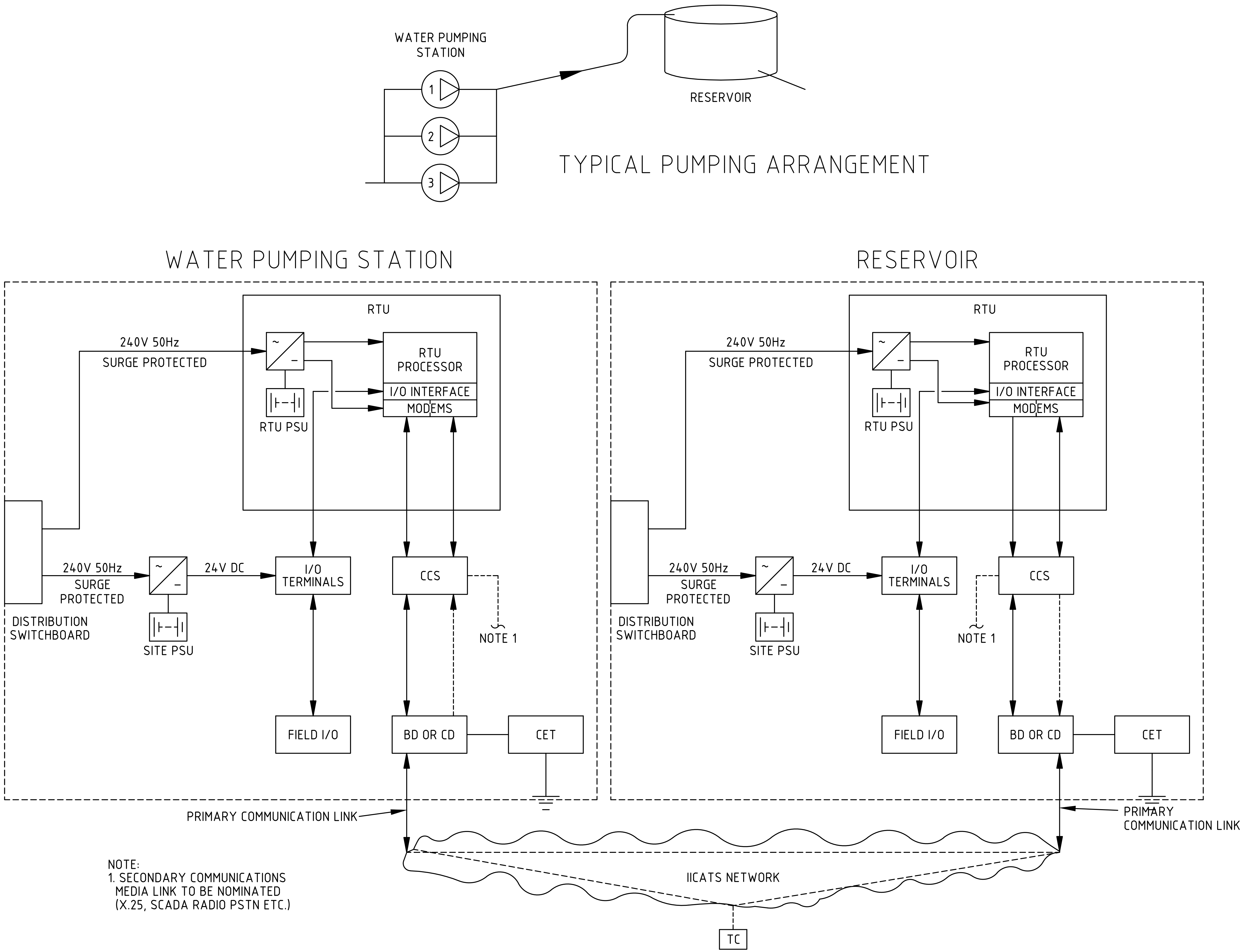
Sydney WATER

SWC ---
RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 27.11.20
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 27.11.20

INSTRUMENT AND CONTROL STANDARDS
COMMUNICATION CONNECTION SOCKETS AND
MODEM CABLING SCHEMATIC DIAGRAM
FOR PRESSURE MONITORING RTU SITES

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD058C
ISSUE C
SHEET No. ---



NOTE:
1. SECONDARY COMMUNICATIONS MEDIA LINK TO BE NOMINATED (X.25, SCADA RADIO PSTN ETC.)

DESIGNED A. BALUK SWC 31.01.99				
DRAWN A. BALUK SWC 31.01.99				
VERIFIED S. ROSS SWC 27.11.20	E	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
APPROVED D. FRUCI SWC 27.11.20	D	ISSUED FOR USE. NO RECORD OF PREVIOUS VERSIONS	E.D	31.01.99
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

SWC ---
RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 27.11.20
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 27.11.20

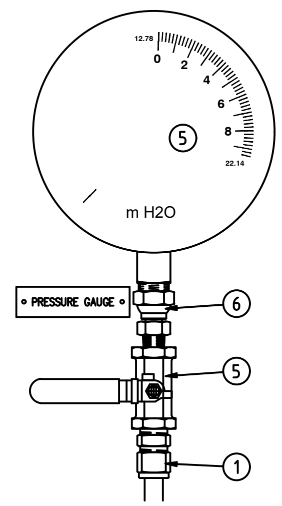
INSTRUMENT AND CONTROL STANDARDS TYPICAL RTU PRIMARY AND SECONDARY COMMUNICATIONS LINK DIAGRAM

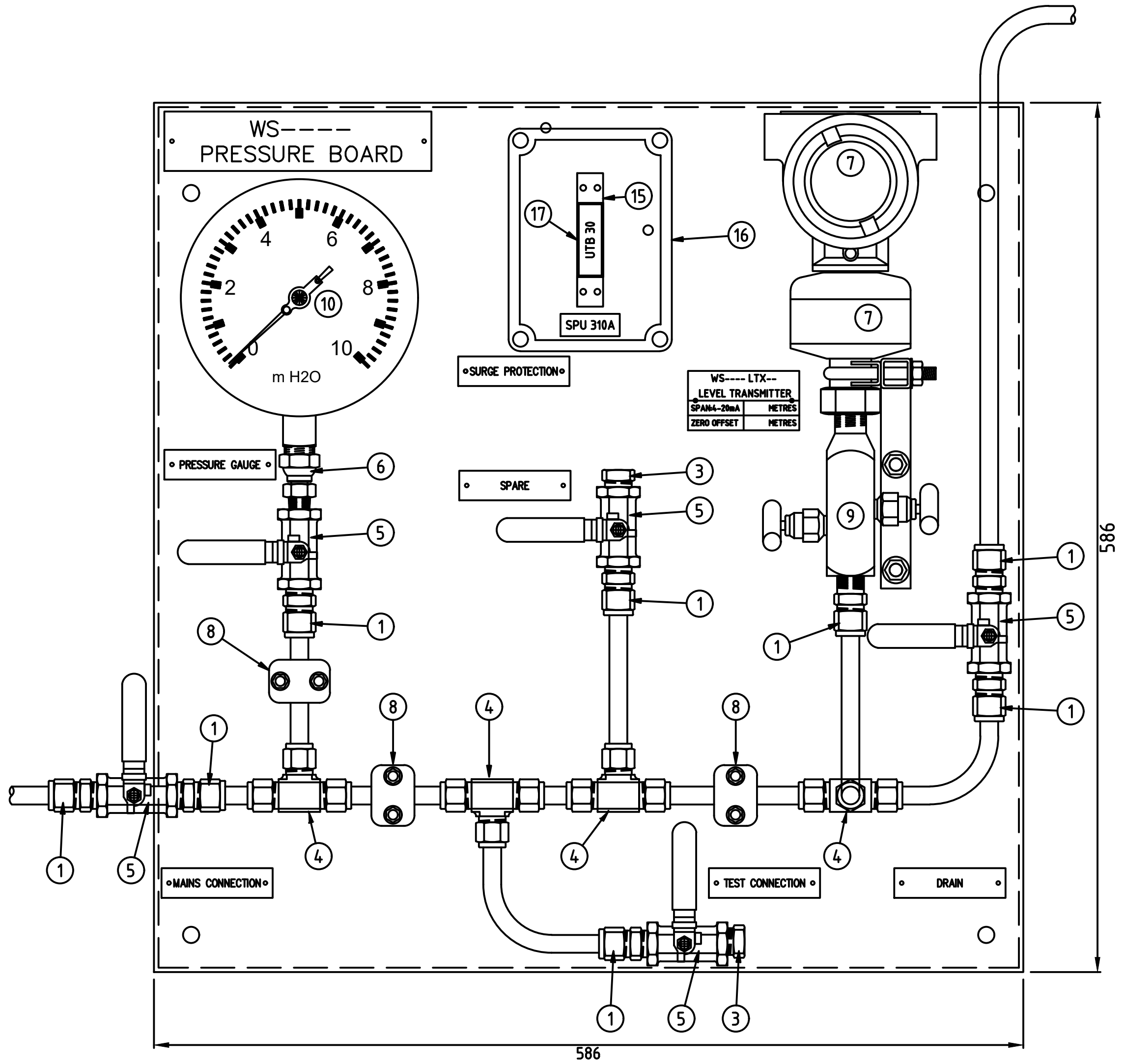
A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD059

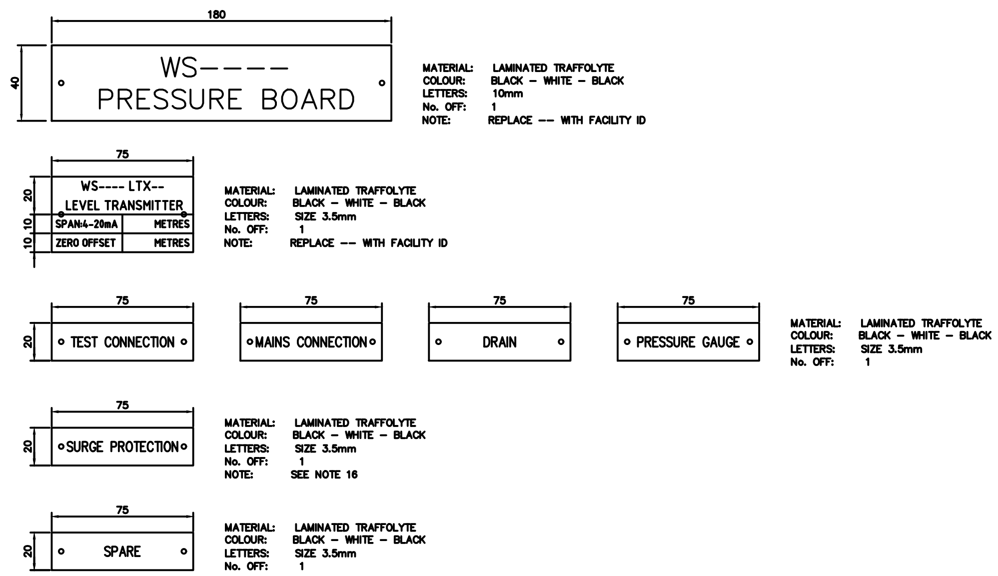
ISSUE E | SHEET No. ---

TYPICAL LOCAL PRESSURE GAUGE
ELEVATED RESERVOIR OR TANK

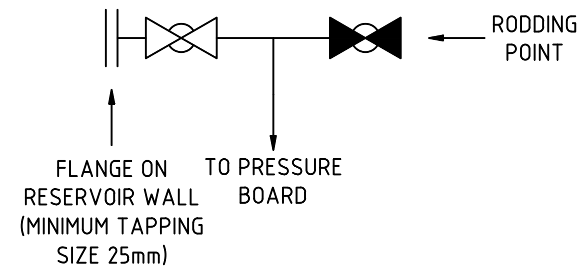




ITEM	DESCRIPTION	MATERIAL / NOTE	QTY
1	12.7mm BSP MALE CONNECTOR	SEE NOTE 1	8
2	12.7mm BSP – 6.35mm BSP MALE CONNECTOR	SEE NOTE 1. FOR INSTRUMENT CONNECTIONS	
3	12.7mm BSP PLUG	SEE NOTE 1	2
4	12.7mm UNION TEE	SEE NOTE 1	4
5	12.7mm BALL VALVE	SEE NOTE 1	5
6	12.7mm SWIVEL GAUGE ADAPTER	SEE NOTE 1	1
7	LEVEL TRANSMITTER	ROSEMOUNT 3051S1TG(3)A2A11A1BB4DM5Q4Q8T1. NOTE 14	1
8	TUBE CLAMPS	SEE NOTE 6 AND NOTE 1	3 SETS
9	2 VALVE MANIFOLD	ROSEMOUNT 0306RT22BA11	1
10	PRESSURE GAUGE	270deg 160mm 316SS 12.7mm BSP GLYCERINE FILLED. NOTE 3, 4 & 5	1
11	STRUT CHANNEL 40mm x 40mm	SEE NOTE 8	1
12	BOARD MOUNTING HARDWARE	HS830S BOLT + E1007S BOLT	4 EA
13	TRANSMITTER MOUNTING HARDWARE	M8x30 SS BOLT + M8 SS NUT + WASHER	2 EA
14	LEVEL SWITCH MOUNTING HARDWARE	M5x40 SS SCREW + M5 SS NUT + WASHER	2 EA
15	SURGE PROTECTION UNIT	CRITEC UTB-30SP – SEE NOTE 16	
16	PVC ENCLOSURE	B&R PJ151115T – SEE NOTE 16	
17	DIN RAIL	TS35 – SEE NOTE 16	
18	12.7mm OD 0.9mm WT SEAMLESS TUBE	SEE NOTE 1	



TYPICAL RESERVOIR TAPPING
WITH RODDING POINT



NOTES:

1. ALL TUBE TO BE 12.7mm OD 316 STAINLESS STEEL 0.9mm WT SEAMLESS. ALL FITTINGS TO BE 12.7mm BSP 316 STAINLESS STEEL. ADAPTERS TO BE SIZED TO INSTRUMENTS.
2. CHARACTER LINE WIDTH IS 1/10 OF THE CHARACTER HEIGHT.
3. PRESSURE GAUGES MUST BE BOURDON TUBE 270 DEGREE DEFLECTION MECHANICAL TYPE. UNITS MUST BE METRES WATER (mH2O). THE GUAGE DISPLAY MUST BE SUPPLIED BY THE MANUFACTURER AND PROVIDE MINIMUM 80% DEFLECTION.
4. PRESSURE GAUGE MUST BE MECHANICALLY CALIBRATED AND REFERENCED TO MINIMUM OPERATING LEVEL (MOL). THE RANGE MUST BE FROM MOL TO OVERFLOW LEVEL (OFL). MOL TO BE SHOWN AS 0m.
5. FOR ELEVATED RESERVOIRS THE SCALE SHOULD BE BLANK BEFORE THE MOL AND AFTER THE OFL. PROVIDE A MARK AT TRUE ZERO. THE TRUE PRESSURE AT MOL AND OFL MUST BE WRITTEN ON THE GAUGE IN NUMBERS.
6. ASSEMBLY TO BE SECURELY FASTENED USING TUBE CLAMPS.
7. PRESSURE BOARD TO BE 3mm STAINLESS STEEL WITH 13mm RETURN ALL AROUND AND WELDED CORNERS.
8. PRESSURE BOARD TO BE MOUNTED ON STANDARD STRUT CHANNEL. EXACT LOCATION TO BE CONFIRMED ON SITE AND APPROVED BY SYDNEY WATER.
9. MAINS CONNECTIONS TO BE SITE RUN TO TAPPING POINTS. RODDING POINT TO BE PROVIDED AT RESERVOIR TAPPING POINT. TAPPING TO BE MINIMUM DIAMETER 25mm.
10. ALL DRAIN/VENT LINE CONNECTIONS TO BE SITE RUN TO NEAREST FLOOR DRAIN.
11. MAIN AND DRAIN CONNECTIONS CAN BE REVERSED AS DETERMINED ON SITE.
12. PENETRATION TO BE MADE WITHIN 100mm OF INSTRUMENT CONNECTION. CABLE BUSH TO BE MOUNTED IN PENETRATION. INSTRUMENT CABLE TO RUN IN CONDUIT TO BACK OF PRESSURE BOARD, PASS THROUGH BUSH, AND TERMINATE THROUGH IP68 CABLE GLAND AT INSTRUMENT.
13. NINTH DIGIT DENOTES PRESSURE CODE. SELECT PRESSURE RANGE OF INSTRUMENT TO SUIT PROCESS.
14. THIS DRAWING IS PROVIDED AS A TYPICAL SAMPLE ONLY. ALL MEASUREMENTS TO BE VERIFIED BY THE DESIGNER PRIOR TO MANUFACTURE. DESIGNER TO PROVIDE INSTALLATION PARTS DETAIL BASED ON EQUIPMENT SELECTION AND OEM RECOMMENDATIONS. PRESSURE GAUGE RANGE IS SHOWN AS AN EXAMPLE ONLY.
15. SURGE PROTECTION UNIT ONLY REQUIRED ON EXTERNAL PRESSURE BOARDS.

DESIGNED IACS SWC 19.08.21				
DRAWN S. ROSS SWC 19.08.21				
VERIFIED L. CRAMP SWC 19.08.21	C	UPDATE FOR TAPPING MINIMUM 25mm	D.F.	18.09.23
	B	UPDATE NOTES AND PART NUMBERS	D.F.	19.08.21
APPROVED D. FRUCI SWC 19.08.21	A	ISSUED FOR USE	E.D.	12.07.18
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

RECOMMENDED 18.09.23 S. ROSS OT STANDARDS ENGINEER SYDNEY WATER
ACCEPTED 18.09.23 D. FRUCI IACS MANAGER SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
RESERVOIR PRESSURE BOARD
TYPICAL GENERAL LAYOUT

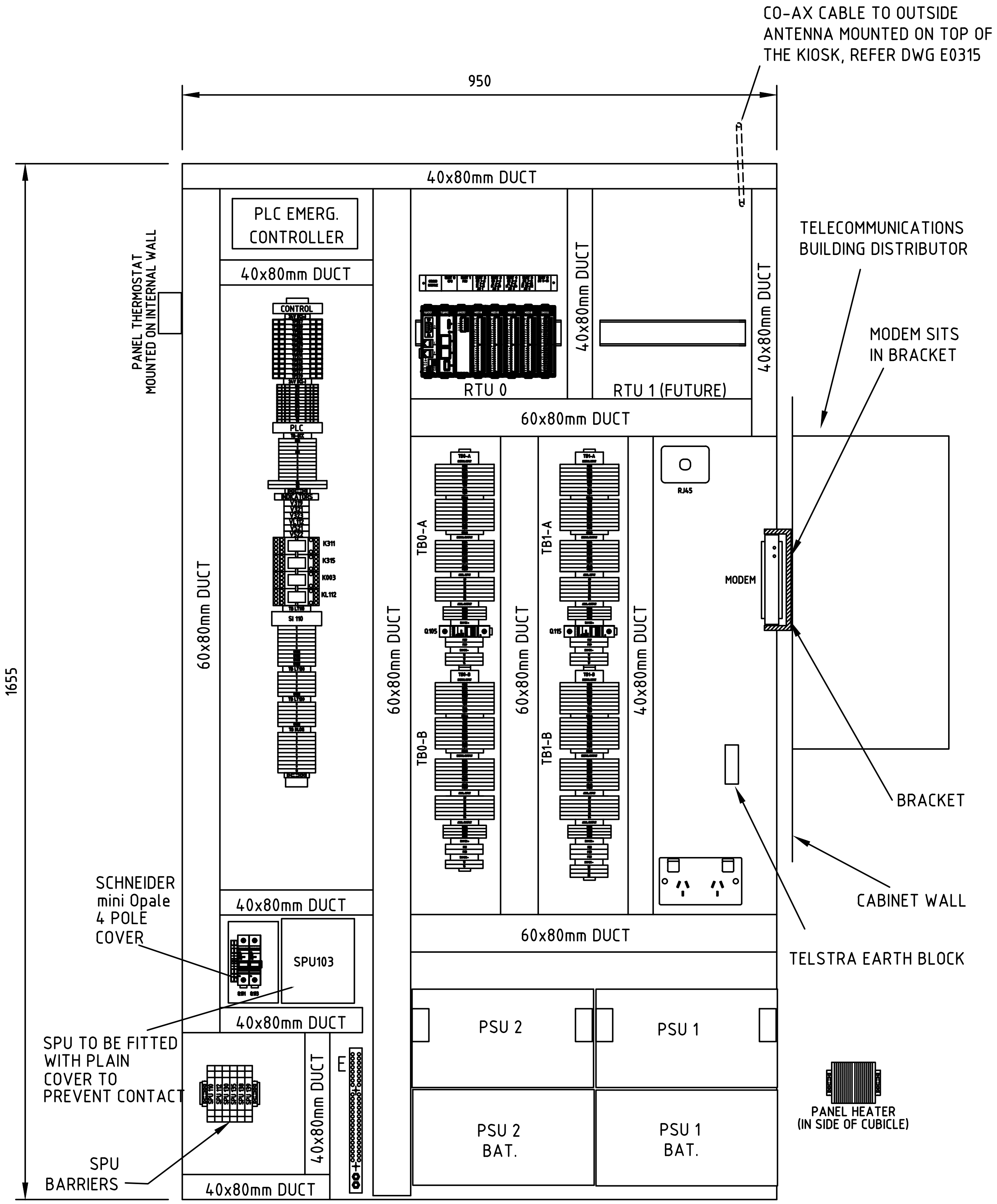
DRAWING No. SSD SSD081
ISSUE C SHEET No. 1

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

SWA1-EXT AUG 2016

NOTES:

1. TERMINALS TO BE KNIFE DISCONNECT TYPE (WITH SOCKET SCREWS TO ACCEPT TEST PLUGS).
2. RTU TERMINALS TO BE PROVIDED FOR THE FOLLOWING I/O: TB0-A- 16DI, 8DO, 6AI, 2AO TB0-8- 16DI, 8DO, 6AI, 2AO. THE FULL SET OF TSO TERMINALS FOR EACH RTU SHALL BE PROVIDED.
3. TERMINAL ASSEMBLIES TO BE MOUNTED ON 63mm TOP HAT BRACKETS, MINIMUM 3 PER ASSEMBLY. RTU TO BE MOUNTED ON 65mm TOP HAT SUPPORT BRACKET. FIT BRACKETS REQUIRED FOR ALL FUTURE EQUIPMENT.
4. MODEM AND RTU TO BE SUPPLIED FROM RTU/MAIN PSU. MODEM MOUNTED ON REAR OF MDF PANEL. MOUNTING BRACKETS TO BE PROVIDED FOR EASY ACCESS/REMOVAL OF THE MODEM.
5. INCOMING TELSTRA CONDUIT TO BE RUN INTO COMMUNICATIONS SOCKET. REFER TO DRAWINGS SSD100 & SSD112 FOR DETAILS. TELECOMMUNICATIONS CABLE BETWEEN BD, COMMS SOCKET AND MODEM SOCKET MUST MEET THE REQUIREMENTS ON DRAWING SSD100 & SSD112 & PART 8 OF THE MANUAL TS01.
6. ALL 230V AC WIRING TO BE COMPLETELY SEGREGATED FROM 24VDC, TELECOMMUNICATIONS CABLING AND SIGNAL CABLING. REFER TO PART 9 OF THE MANUAL TS01.
7. 12 POLE MINI SWITCHBOARD TO CONTAIN EARTH AND NEUTRAL BAR AS WELL AS 230V AC LIGHTNING/SURGE PROTECTION.
8. SURGE PROTECTION UNITS (IN LOAD CENTRE) TO HAVE DEDICATED 16mm^2 EARTH LEAD DIRECT TO SITE EARTH.
9. ALL CUBICLE ENTRIES TO BE VIA CABLE GLANDS & SPLIT GLAND PLATES SO THAT ADDITIONAL GLANDS MAY BE ADDED LATER WITHOUT REMOVING THE EXISTING GLANDS.
10. MAIN 24V DC PSU SHALL ALSO HAVE A 12V DC ADDITIONAL OUTPUT FOR COMMS EQUIPMENT.
11. SEWER PUMPING STATIONS REQUIRE A BACK UP PSU FOR THE PLC. (I.E. 2 (TWO) x 24V DC POWER SUPPLIES).
12. BOTH PSUs MUST HAVE 22 Ah SIZED FOR UP TO 2 (TWO) RTU INSTALLATIONS. CONSULT WITH THE PRINCIPAL FOR OTHER APPLICATIONS.
13. ALL ELECTRICAL WORK MUST COMPLY WITH AS3000 AND WORK HEALTH AND SAFETY REGULATIONS.
14. REFER TO PART 7 OF THIS MANUAL TS01 FOR RTU INFORMATION & SPARE SPACE REQUIREMENTS IN THE RTU PANEL FOR A FUTURE RTU AND ITS ASSOCIATED TB TERMINALS.
15. SEWER PUMPING STATIONS REQUIRE AND EMERGENCY PLC CONTROLLER



EQUIPMENT LAYOUT

DESIGNED G. BAES SWC 16.03.12						
DRAWN E. DALDAL SWC 16.03.12	D	MODIFIED FOR BRODERSEN RTU	D.F	11.09.23		
VERIFIED S. ROSS SWC 11.09.23	C	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20		
	B	LAYOUT & NOTES REVISED	E.D	16.03.12		
APPROVED D. FRUCI SWC 11.09.23	A	ISSUED FOR FIRST USE	G.B	27.11.03		
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE		

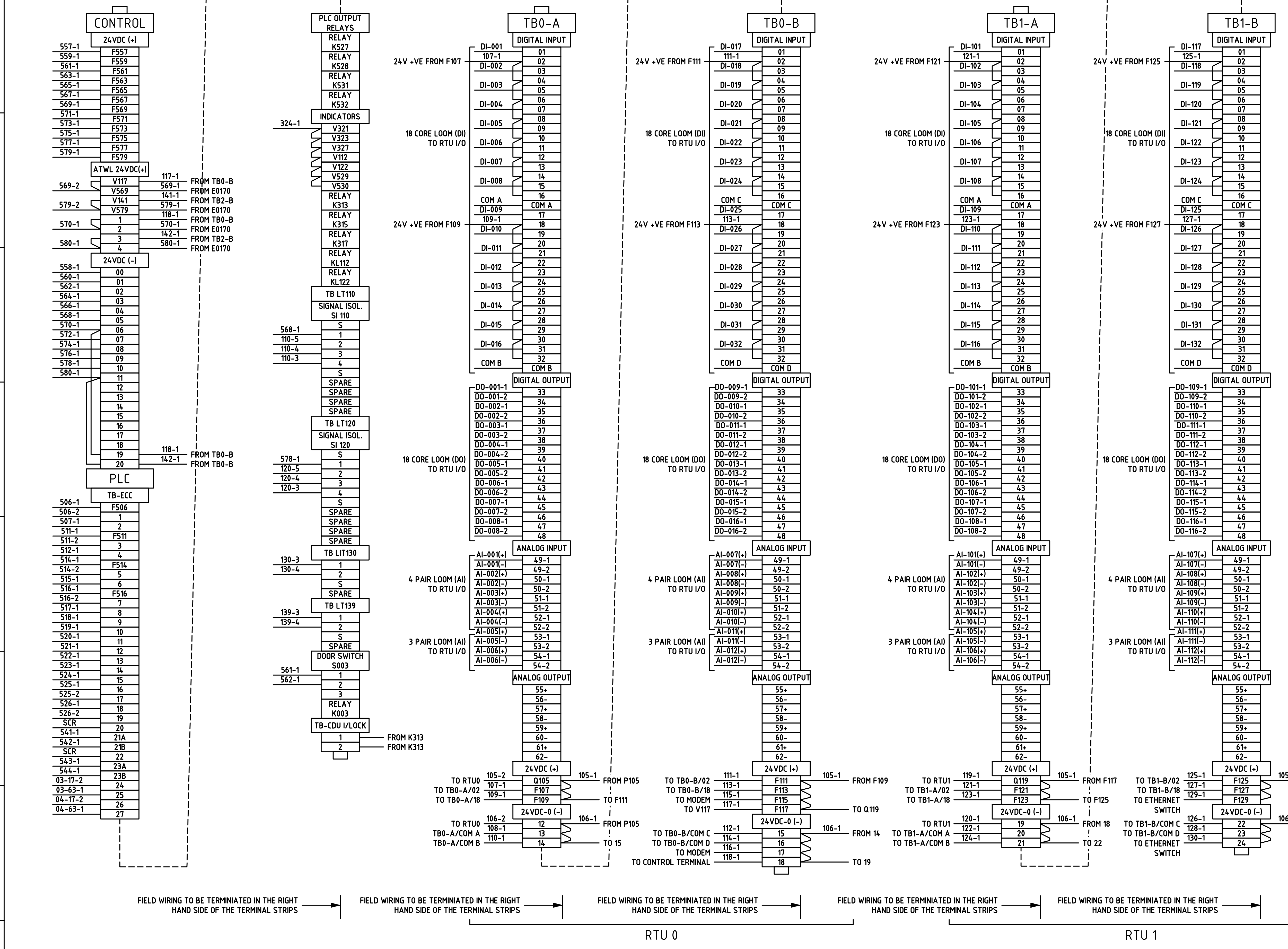
Sydney WATER

SWC ---
RECOMMENDED S. ROSS OT STANDARDS ENGINEER SYDNEY WATER 11.09.23
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 11.09.23

INSTRUMENT AND CONTROL STANDARDS
EXAMPLE CONTROL PANEL LAYOUT
SINGLE RTU INSTALLATION
BRODERSEN SERIES RTU

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

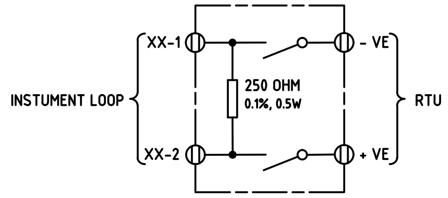
DRAWING No. SSD SSD082
ISSUE D SHEET No. ---

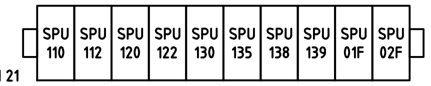


NOTES:

1. GROUP THE TERMINALS IN LOGICAL ORDER. EG. ALL TERMINALS BELONGING TO A PARTICULAR DRIVE ARE TO BE GROUPED TOGETHER.
2. ALL 24 V DC CONTROL WIRING ON FIELD SIDE OF THE IICATS KNIFE TERMINAL IS TO BE 7/0.4MM, 1mm^2, PVC V75, 0.6/1 KV, GREY.
3. ALL CORES TO BE FERRULED.
4. ALL 24V COMMON LINKS TO USE BRIDGING RAIL SUPPLIED BY TERMINAL MANUFACTURER.
5. CONTROL AND INSTRUMENT WIRING SHALL BE SEGREGATED FROM MAINS POWER WIRING WITHIN CUBICLES AND PANELS. CABLES OUTSIDE PANELS SHALL BE SEGREGATED AND RUN IN SEPARATE CONDUITS. TERMINAL STRIPS SHALL HAVE BARRIERS BETWEEN MIXED VOLTAGES, SHROUDED AND IDENTIFIED WITH LABELS INDICATING APPLIED VOLTAGES. THE INSTALLATION SHALL ENSURE THERE IS NO INDUCTION FROM OTHER CABLES TO SIGNAL OR COMMUNICATIONS CABLES.
6. MULTI PAIR INSTRUMENTATION CABLES SHALL BE CIRCULAR SECTION, BLACK, PVC/OVERALL SCREENED/PVC WITH INDIVIDUALLY TWISTED PAIRS OF MULTI-STRANDED COPPER CONDUCTORS OF MINIMUM STRANDING/DIAMETER OF 7/0.30mm AND CROSS SECTIONAL AREA OF 0.5mm^2, AND WITH INDIVIDUAL AND OVERALL ALUMINIUM TAPE WITH COPPER DRAIN WIRE. SINGLE PAIR CABLE SHALL BE TWISTED PAIR OF MULTI-STRANDED COPPER CONDUCTORS, BLACK, PVC/OVERALL SCREENED/PVC, CORE COLOURS BLACK AND WHITE AND CROSS SECTIONAL AREA OF 1.5mm^2, AND WITH ALUMINIUM TAPE AND A TINNED COPPER DRAIN WIRE. THE SHIELD TO BE CONNECTED AT PANEL END ONLY.
7. ALL DIGITAL INPUT SIGNALS INCLUDING COMMONS BETWEEN KNIFE TERMINAL AND RTU TO BE WIRED USING MULTICORE (18 CORE) 16/0.2mm (0.5mm^2) CABLE. ALL DIGITAL INPUT CABLE CORES TO BE NUMBERED AT KNIFE TERMINAL AND THE FIRST CORE ON EACH RTU TERMINAL BLOCK. (REFER SSD101 FOR DETAILS). ALL CORES ALLOCATED FOR COMs (COMA, COMB, COMC, COMD) TO BE NUMBERED AT KNIFE TERMINAL END AND RTU TERMINAL END.
8. ALL DIGITAL OUTPUT SIGNALS BETWEEN KNIFE TERMINAL AND RTU TO BE WIRED USING MULTICORE (18 CORE) 16/0.2mm (0.5mm^2) CABLE. ALL DO CORES (NOs AND VDCs) TO BE NUMBERED AT KNIFE TERMINAL AND ALL INDIVIDUAL VDC CORES AT RTU TERMINAL. (REFER SSD101 FOR DETAILS)
9. WHERE WEIDMULLER TERMINALS ARE USED, THE PART NUMBERS ARE:
   - 7940032217 – FOR THE TERMINAL STRIP.
   - 1635120000 – VQB 1.5/50SWFOR THE TERMINAL WDTR2.5R STRIP "COMB"
   - CABLE LOOMS ARE SUPPLIED BY ELECTRA-LOOM (E.G. CLIRTUIA!1800)

ANALOG TERMINALS TO BE WEIDMULLER WDTR 2.5R – DISCONNECT TERMINAL WITH 250 OHM 0.1% 0.5W. WIRED AS FOLLOWS





TRANSIENT SURGE SUPPRESSORS

DESIGNED E. DALDAL SWC 31.05.11				
DRAWN E. DALDAL SWC 31.05.11	E	CLARIFIED FIELD WIRING TERMINATION TO RHS	D.F	08.09.23
	D	UPDATED FOR CURRENT REQUIREMENTS	D.F	27.11.20
VERIFIED S. ROSS SWC 27.11.20	C	RTU ISOLATORS ADDED	E.D	31.03.12
	B	NOTES UPDATED & TABLES DELETED	E.D	31.05.11
APPROVED D. FRUCI SWC 27.11.20	A	ISSUED FOR FIRST USE	D.F	27.11.03
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

SWC ---

RECOMMENDED S. ROSS OT STANDARDS ENGINEER SYDNEY WATER 08.09.23

ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 08.09.23

INSTRUMENT AND CONTROL STANDARDS TYPICAL DRAWING RTU TERMINAL BLOCKS AND LOOM ARRANGEMENT

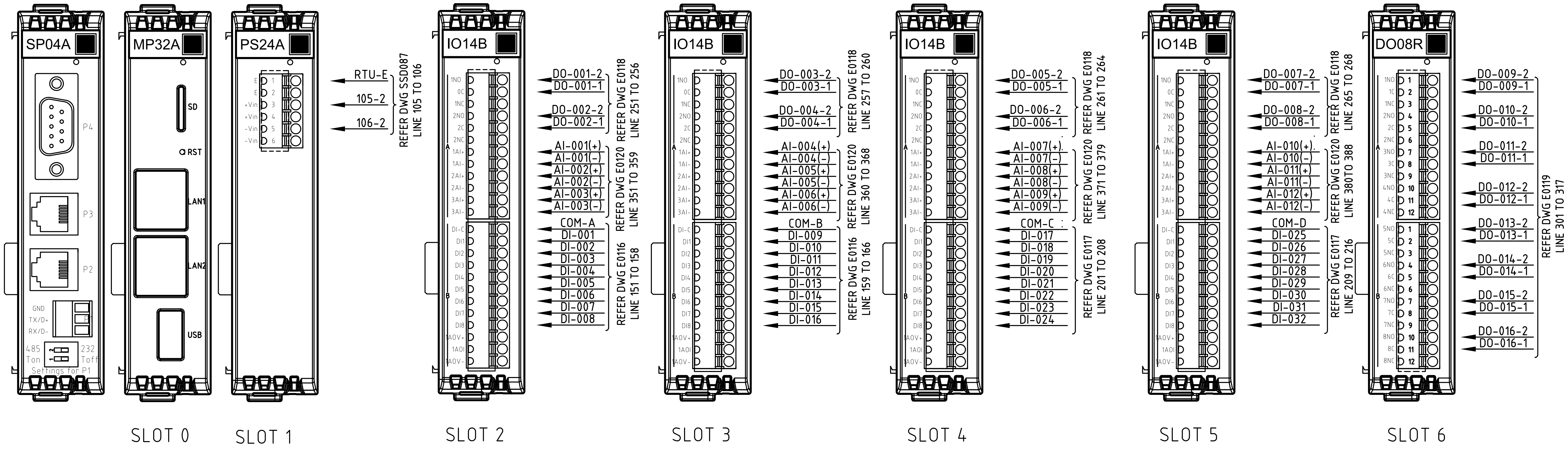
A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD083

ISSUE E SHEET No. ---

NOTES:

1. PORT 1 - 3 WIRE RS485 PORT. DEFAULT COMMS DIP SWITCH SETTINGS FOR PORT A. S1 Ton. S2 485.
2. PORT 2 - RJ12 RS232 PORT. RESERVED FOR LOCAL MODBUS COMMS TO RTU PSU.
3. PORT 3 - RJ12 RS232 PORT. RESERVED FOR LOCAL DIAGNOSTICS SERIAL PPP CONNECTION.
4. PORT 4 - DB9 RS232 PORT.
5. LAN1 - RJ45 ETHERNET PORT. RESERVED FOR MODEM CONNECTION.
6. LAN2 - RJ45 ETHERNET PORT. RESERVED FOR LOCAL DIAGNOSTICS.



LETTER	DETAILS OF AMENDMENT	APP'D	DATE
C	UPDATED FOR BRODERSEN RTU	D.F	11.09.23
B	UPDATED ENET RTU LAYOUT	D.F	27.11.20
A	ISSUED FOR FIRST USE	D.F	08.05.00

DESIGNED	E. DALDAL SWC	08.05.00
DRAWN	S. ROSS SWC	11.09.23
VERIFIED	S. ROSS SWC	11.09.23
APPROVED	D. FRUCI SWC	11.09.23

Sydney WATER

SWC ---

RECOMMENDED S. ROSS OT STANDARDS ENGINEER SYDNEY WATER 11.09.23

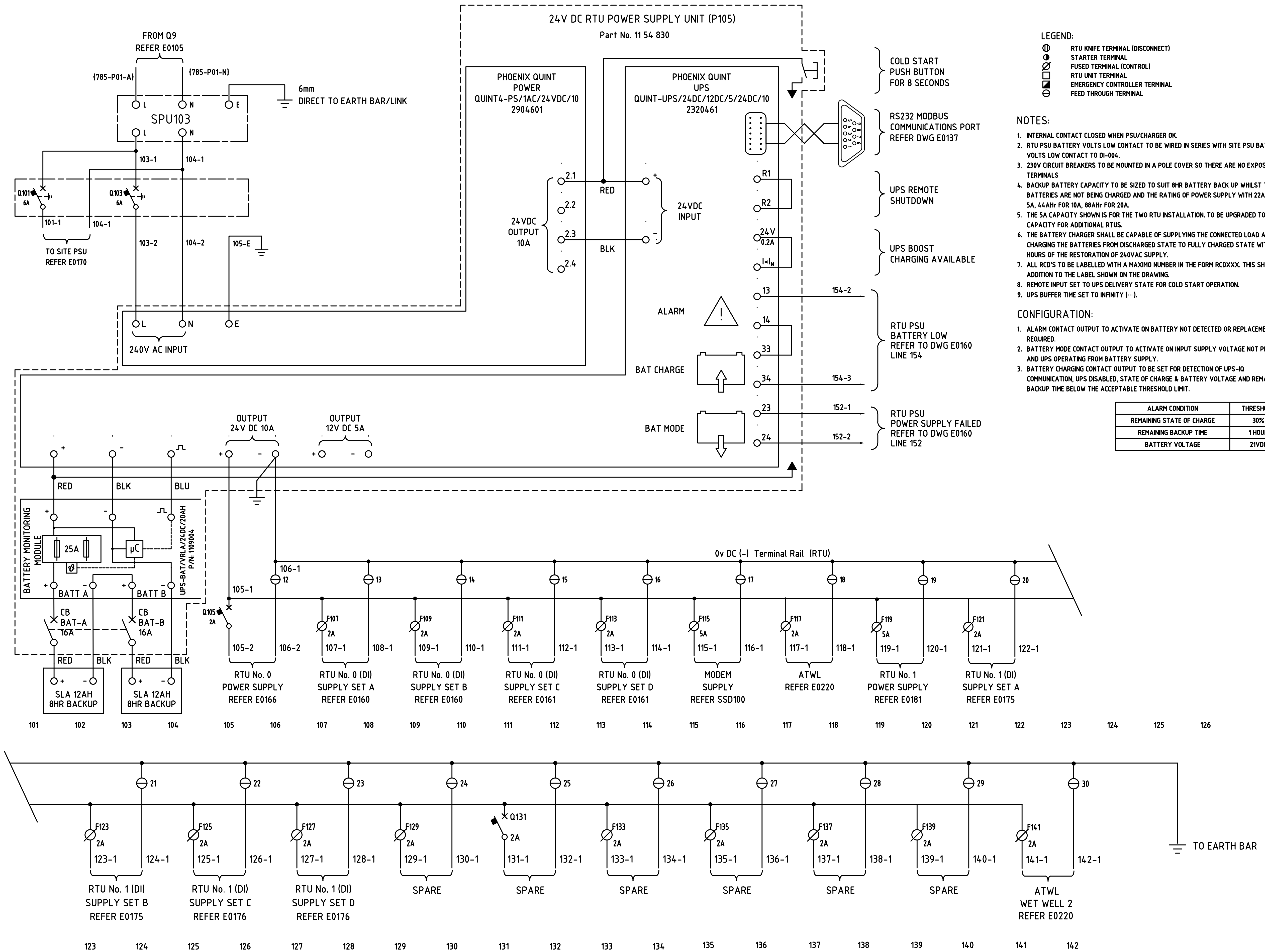
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 11.09.23

INSTRUMENT AND CONTROL STANDARDS
BRODERSEN RTU
I/O & PORT LAYOUTS

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD086

ISSUE C SHEET No. ---



LEGEND:

- RTU KNIFE TERMINAL (DISCONNECT)
- STARTER TERMINAL
- FUSED TERMINAL (CONTROL)
- RTU UNIT TERMINAL
- EMERGENCY CONTROLLER TERMINAL
- FEED THROUGH TERMINAL

NOTES:

1. INTERNAL CONTACT CLOSED WHEN PSU/CHARGER OK.
2. RTU PSU BATTERY VOLTS LOW CONTACT TO BE WIRED IN SERIES WITH SITE PSU BATTERY VOLTS LOW CONTACT TO DI-004.
3. 230V CIRCUIT BREAKERS TO BE MOUNTED IN A POLE COVER SO THERE ARE NO EXPOSED 230V TERMINALS
4. BACKUP BATTERY CAPACITY TO BE SIZED TO SUIT 8HR BATTERY BACK UP WHILST THE BATTERIES ARE NOT BEING CHARGED AND THE RATING OF POWER SUPPLY WITH 22AHr FOR 5A, 44AHr FOR 10A, 88AHr FOR 20A.
5. THE 5A CAPACITY SHOWN IS FOR THE TWO RTU INSTALLATION. TO BE UPGRADED TO 10A CAPACITY FOR ADDITIONAL RTUS.
6. THE BATTERY CHARGER SHALL BE CAPABLE OF SUPPLYING THE CONNECTED LOAD AND CHARGING THE BATTERIES FROM DISCHARGED STATE TO FULLY CHARGED STATE WITHIN 24 HOURS OF THE RESTORATION OF 240VAC SUPPLY.
7. ALL RCD'S TO BE LABELLED WITH A MAXIMO NUMBER IN THE FORM RCDXXX. THIS SHALL BE IN ADDITION TO THE LABEL SHOWN ON THE DRAWING.
8. REMOTE INPUT SET TO UPS DELIVERY STATE FOR COLD START OPERATION.
9. UPS BUFFER TIME SET TO INFINITY (∞).

CONFIGURATION:

1. ALARM CONTACT OUTPUT TO ACTIVATE ON BATTERY NOT DETECTED OR REPLACEMENT REQUIRED.
2. BATTERY MODE CONTACT OUTPUT TO ACTIVATE ON INPUT SUPPLY VOLTAGE NOT PRESENT AND UPS OPERATING FROM BATTERY SUPPLY.
3. BATTERY CHARGING CONTACT OUTPUT TO BE SET FOR DETECTION OF UPS-IQ COMMUNICATION, UPS DISABLED, STATE OF CHARGE & BATTERY VOLTAGE AND REMAINING BACKUP TIME BELOW THE ACCEPTABLE THRESHOLD LIMIT.

ALARM CONDITION	THRESHOLD
REMAINING STATE OF CHARGE	30%
REMAINING BACKUP TIME	1 HOUR
BATTERY VOLTAGE	21VDC

DESIGNED E. DALDAL SWC 08.05.00				
DRAWN S. ROSS SWC 11.09.23				
VERIFIED S. ROSS SWC 11.09.23	C	REDRAWN FOR WITH STANDARD COMPONENTS	D.F	11.09.23
	B	REDRAWN FOR COMPONENT AND EQUIPMENT UPDATES	D.F	27.11.20
APPROVED D. FRUCI SWC 11.09.23	A	ISSUED FOR FIRST USE	D.F	08.08.00
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

SWC ---
RECOMMENDED S. ROSS OT STANDARDS ENGINEER SYDNEY WATER 11.09.23
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 11.09.23

INSTRUMENT AND CONTROL STANDARDS
24V DC LINEAR POWER SUPPLY
UNIT WIRING DIAGRAM

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD
SSD087
ISSUE C
SHEET No. ---

RTU 0 WIRE NUMBERS

Cable ID		Mixed I/O module 1	Mixed I/O module 2	Mixed I/O Module 3	Mixed I/O Module 4		Digital Out Module
Cable length (mm)		1000	1000	1400	1400		1400
LH end pin/number orientation		Pin/number	Pin/number	Pin/number	Pin/number		Pin/number
RH end pin/number orientation	Mixed I/O Modules	Number/pin	Number/pin	Number/pin	Number/pin	Mixed I/O Modules	Number/pin
Core	Wire Colour	Wire number	Wire number	Wire number	Wire number	Wire Colour	Wire number
1	Grey	DO-001-1	DO-003-1	DO-004-1	DO-007-1	Grey	DO-009-1
2	Grey	DO-001-2	DO-003-2	DO-004-2	DO-007-2	Grey	DO-009-2
3	Grey	DO-002-1	DO-004-1	DO-005-1	DO-008-1	Grey	DO-010-1
4	Grey	DO-002-2	DO-004-2	DO-005-2	DO-008-2	Grey	DO-010-2
5	White/Black Twisted	AI-001 +	AI-004 +	AI-007 +	AI-010 +	Grey	DO-011-1
6	White/Black Twisted	AI-001 -	AI-004 -	AI-007 -	AI-010 -	Grey	DO-011-2
7	White/Black Twisted	AI-002 +	AI-005 +	AI-008 +	AI-011 +	Grey	DO-012-1
8	White/Black Twisted	AI-002 -	AI-005 -	AI-008 -	AI-011 -	Grey	DO-012-2
9	White/Black Twisted	AI-003 +	AI-006 +	AI-009 +	AI-012 +	Grey	DO-013-1
10	White/Black Twisted	AI-003 -	AI-006 -	AI-009 -	AI-012 -	Grey	DO-013-2
11	Grey	Com A	Com B	Com C	Com D	Grey	DO-014-1
12	Grey	DI-001	DI-009	DI-017	DI-025	Grey	DO-014-2
13	Grey	DI-002	DI-010	DI-018	DI-026	Grey	DO-015-1
14	Grey	DI-003	DI-011	DI-019	DI-027	Grey	DO-015-2
15	Grey	DI-004	DI-012	DI-020	DI-028	Grey	DO-016-1
16	Grey	DI-005	DI-013	DI-021	DI-029	Grey	DO-016-2
17	Grey	DI-006	DI-014	DI-022	DI-030		
18	Grey	DI-007	DI-015	DI-023	DI-031		
19	Grey	DI-008	DI-016	DI-024	DI-032		
20	White/Black Twisted	AO-001 +	AO-002 +	AO-003 +	AO-004 +		
21	White/Black Twisted	AO-001 -	AO-002 -	AO-003 -	AO-004 -		

RTU 1 WIRE NUMBERS

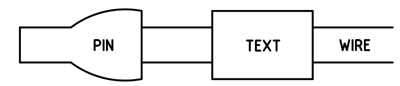
Cable ID		Mixed I/O module 1	Mixed I/O module 2	Mixed I/O Module 3	Mixed I/O Module 4		Digital Out Module
Cable length (mm)		1000	1000	1400	1400		1400
LH end pin/number orientation		Pin/number	Pin/number	Pin/number	Pin/number		Pin/number
RH end pin/number orientation	Mixed I/O Modules	Number/pin	Number/pin	Number/pin	Number/pin	Mixed I/O Modules	Number/pin
Core	Wire Colour	Wire number	Wire number	Wire number	Wire number	Wire Colour	Wire number
1	Grey	DO-101-1	DO-103-1	DO-105-1	DO-107-1	Grey	DO-109-1
2	Grey	DO-101-2	DO-103-2	DO-105-2	DO-107-2	Grey	DO-109-2
3	Grey	DO-102-1	DO-104-1	DO-106-1	DO-108-1	Grey	DO-110-1
4	Grey	DO-102-2	DO-104-2	DO-106-2	DO-108-2	Grey	DO-110-2
5	White/Black Twisted	AI-101 +	AI-104 +	AI-107 +	AI-110 +	Grey	DO-111-1
6	White/Black Twisted	AI-101 -	AI-104 -	AI-107 -	AI-110 -	Grey	DO-111-2
7	White/Black Twisted	AI-102 +	AI-105 +	AI-108 +	AI-111 +	Grey	DO-112-1
8	White/Black Twisted	AI-102 -	AI-105 -	AI-108 -	AI-111 -	Grey	DO-112-2
9	White/Black Twisted	AI-103 +	AI-106 +	AI-109 +	AI-112 +	Grey	DO-113-1
10	White/Black Twisted	AI-103 -	AI-106 -	AI-109 -	AI-112 -	Grey	DO-113-2
11	Grey	Com A	Com B	Com C	Com D	Grey	DO-114-1
12	Grey	DI-101	DI-109	DI-117	DI-125	Grey	DO-114-2
13	Grey	DI-102	DI-110	DI-118	DI-126	Grey	DO-115-1
14	Grey	DI-103	DI-111	DI-119	DI-127	Grey	DO-115-2
15	Grey	DI-104	DI-112	DI-120	DI-128	Grey	DO-116-1
16	Grey	DI-105	DI-113	DI-121	DI-129	Grey	DO-116-2
17	Grey	DI-106	DI-114	DI-122	DI-130		
18	Grey	DI-107	DI-115	DI-123	DI-131		
19	Grey	DI-108	DI-116	DI-124	DI-132		
20	White/Black Twisted	AO-101 +	AO-102 +	AO-103 +	AO-104 +		
21	White/Black Twisted	AO-101 -	AO-102 -	AO-103 -	AO-104 -		

CABLE SPECIFICATION

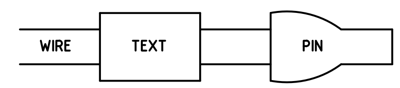
Cable size	0.5mm^2 250V tinned
Cable insulation	0.6/1kV PVC V90
Cable insulation	0.8mm
Cable stranding	16/0.2mm
Wire colour	Grey
Label	Laser etched sleeve. Black text on white tube. Matched to OD of cable.
Loom binding	Heat shrink bands

ORIENTATION GUIDE

PIN/NUMBER



NUMBER/PIN



NOTES:

1. CABLE LENGTHS BASED ON STANDARD RTU PANEL. CHANGES MAY BE REQUIRED FOR NON-STANDARD PANEL DESIGNS.
2. CABLE NUMBER FOR SUBSEQUENT RTUS TO BE PREFIXED BY RTU NUMBER. I.E. RTU2 IS 2xx (E.G. DI-201), RTU3 IS 3xx (E.G. DI-301) ETC.

DESIGNED D. FRUCI SWC 01.12.16				
DRAWN S. ROSS SWC 11.09.23				
VERIFIED S. ROSS SWC 11.09.23	C	UPDATED FOR BRODERSEN RTU	D.F	11.09.23
	B	DATA COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
APPROVED D. FRUCI SWC 11.09.23	A	ISSUED FOR USE	D.F	01.12.16
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

SWC ---

RECOMMENDED S. ROSS OT STANDARDS ENGINEER SYDNEY WATER 11.09.23

ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 11.09.23

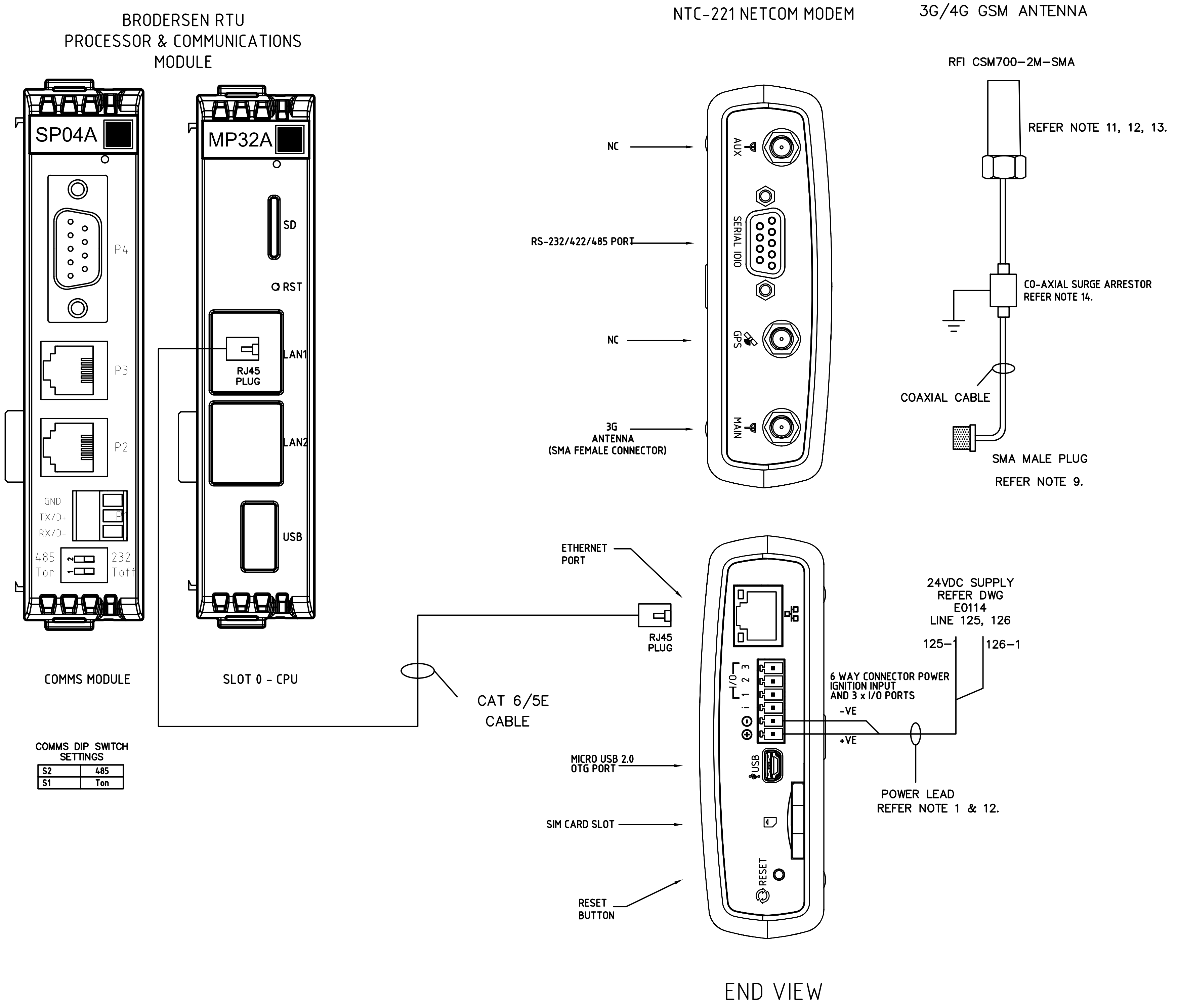
INSTRUMENT AND CONTROL STANDARDS
BRODERSEN RTU
IICATS RTU I/O WIRING DETAILS &
PIN ORIENTATION GUIDE

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD101

ISSUE C SHEET No. ---

SWA1-EXT AUG 2014



NOTES:

1. DC IN - 24 V DC. REFER TO SSD087.
2. PORT 1 - 3 WIRE RS485 PORT. DEFAULT COMMS DIP SWITCH SETTINGS FOR PORT A. S1 Ton. S2 485.
3. PORT 2 - RJ12 RS232 PORT. RESERVED FOR LOCAL MODBUS COMMS TO RTU PSU.
4. PORT 3 - RJ12 RS232 PORT. RESERVED FOR LOCAL DIAGNOSTICS SERIAL PPP CONNECTION.
5. PORT 4 - DB9 RS232 PORT.
6. LAN1 - RJ45 ETHERNET PORT. RESERVED FOR MODEM CONNECTION.
7. LAN2 - RJ45 ETHERNET PORT. RESERVED FOR LOCAL DIAGNOSTICS.
6. RTU TO BE MOUNTED ON DIN RAIL.
8. MODEM MOUNTING CRADLE SHALL BE FIXED USING DIN RAIL OR SCREWS
9. MODEM WIRELESS ANTENNA CONNECTION IS SMA FEMALE. ANTENNA CONNECTOR IS SMA MALE PLUG.
10. 24V POWER FEED TO MODEM SHALL BE FITTED WITH A DC CIRCUIT BREAKER OR FUSIBLE LINK RATED AT 2AMPS. POWER LEAD TO BE SUPPLIED BY INSTALLER.
11. AN ANTENNA SUITABLE FOR THE 4G NETWORK MUST BE INSTALLED. THE ANTENNA MUST BE SUITABLE FOR THE 698 - 960MHZ, 1710 - 2170MHZ & 2300 - 2700MHz BANDS.
12. A CSM700 ANTENNA OR EQUIVALENT MUST BE INSTALLED EXTERNAL TO EACH OUTDOOR KIOSK C/W INLINE SURGE PROTECTION AS STANDARD. WHERE SIGNAL STRENGTH IS POOR A COL7195 OR EQUIVALENT ANTENNA MUST BE USED. ANTENNA CABLE LENGTH IS NOMINAL. TO BE SELECTED BASED ON INSTALLATION.
13. A COL7195 ANTENNA OR EQUIVALENT MUST BE INSTALLED ON AN EXTERNAL WALL OF THE SWITCHROOM C/W INLINE SURGE PROTECTION AS STANDARD. WHERE SIGNAL STRENGTH IS POOR A COL7199 OR EQUIVALENT ANTENNA MUST BE USED.
14. A POLAR PLA-R, POLYPHASER IS-50NX-C2 OR EQUIVANT COAXIAL SURGE ARRESTOR SHALL BE INSTALLED IN-LINE AT THE TELSTRA ULTRALINK END OF THE COAXIAL ANTENNA LEAD. A 30CM N-TYPE MALE TO SMA-MALE FLYLEAD SHALL BE REQUIRED TO CONNECT THE TELSTRA ULTRALINK TO THE SURGE ARRESTOR. THE SURGE ARRESTOR SHALL BE CONNECTED TO THE CUBICLE EARTH VIA 6MM YELLOW/GREEN EARTH CABLE. WITH A LENGTH NOT EXCEEDING 10METRES AND A CABLE RESISTANCE NOT EXCEEDING 0.5OHMS.

DESIGNED A. BALUK SWC 20.09.16				
DRAWN A. BALUK SWC 20.09.06				
VERIFIED S. ROSS SWC 11.09.23	C	UPDATED FOR BRODERSEN RTU	D.F	11.09.23
	B	UPDATED VERSION	D.F	27.11.20
APPROVED D. FRUCI SWC 11.09.23	A	ISSUED FOR FIRST USE	E.D	20.9.16
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

SWC ---

RECOMMENDED S. ROSS OT STANDARDS ENGINEER SYDNEY WATER 11.09.23

ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 11.09.23

INSTRUMENT AND CONTROL STANDARDS
IICATS RTU PANEL
BRODERSEN RTU & WIRELESS MODEM
CONNECTION DIAGRAM

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SS102

ISSUE C | SHEET No. ---

SWA1-EXT AUG 2016

NOTES:

1. LEADIN CABLE CONDUIT BENDS SHALL HAVE BEND RADUIS OF 300mm OR GREATER FOR THE ENTIRE RUN TO THE CARRIER DEMARCATION POINT.

2. Cabinet may be embedded into a larger cubicle or may be externally mounted. In-setting 100mm into another cabinet or structure allows conduit to be run internally.

3. Where cabinet is externally mounted and ducts are run on an exposed external service that shall be protected by top hat or other suitable heavy duty metal vandal-proof shrouding method.

4. Panel is to be manufactured from 2mm 304 grade Stainless steel sheet.

5. Door lock -SELECTRIX 1107-SS02 Swinghandle Padlock to be MLV 6789 TELSTRA approved

6. hinges to be external 304 stainless steel PINTLE type with bottom hinge reversed.

7. Insulating Panel to be 15mm thick Black High Density Polyethylene PE300

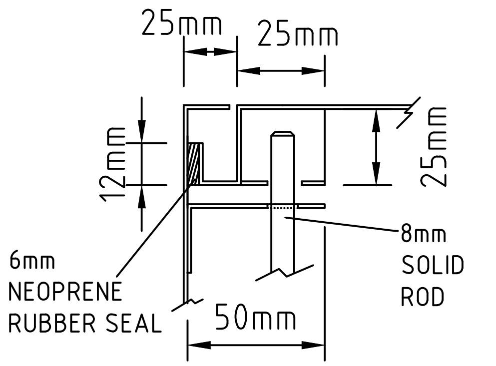
8. Enclosure door to be flush with cabinet to prevent un-authorised access. Gap to be less than 1mm when door locked. IP Rating IP56. Silicon seal all joints.

9. Utilise a waterproof sealing membrane "COMPRIBAND" or equivalent between panel and wall to avoid water ingress.

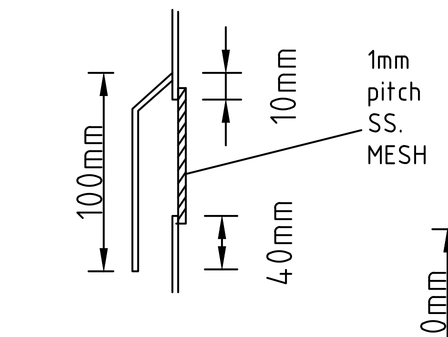
10. LEADIN cable conduit (50mm) shall enter the bottom of the cabinet (not rear) and shall not have any bends with a radius of less than 300mm to ensure it is suitable for Fibre optic cable.

11. The MDF enclosure shall be solidly earthed to the main site earth by being solidly welded and/or bolted to an existing earthed cubicle in a non-insulating manner or via a 6mm2 yellow/green earth where the enclosure is not mounted on an already site earthed location (eg brick wall of building).

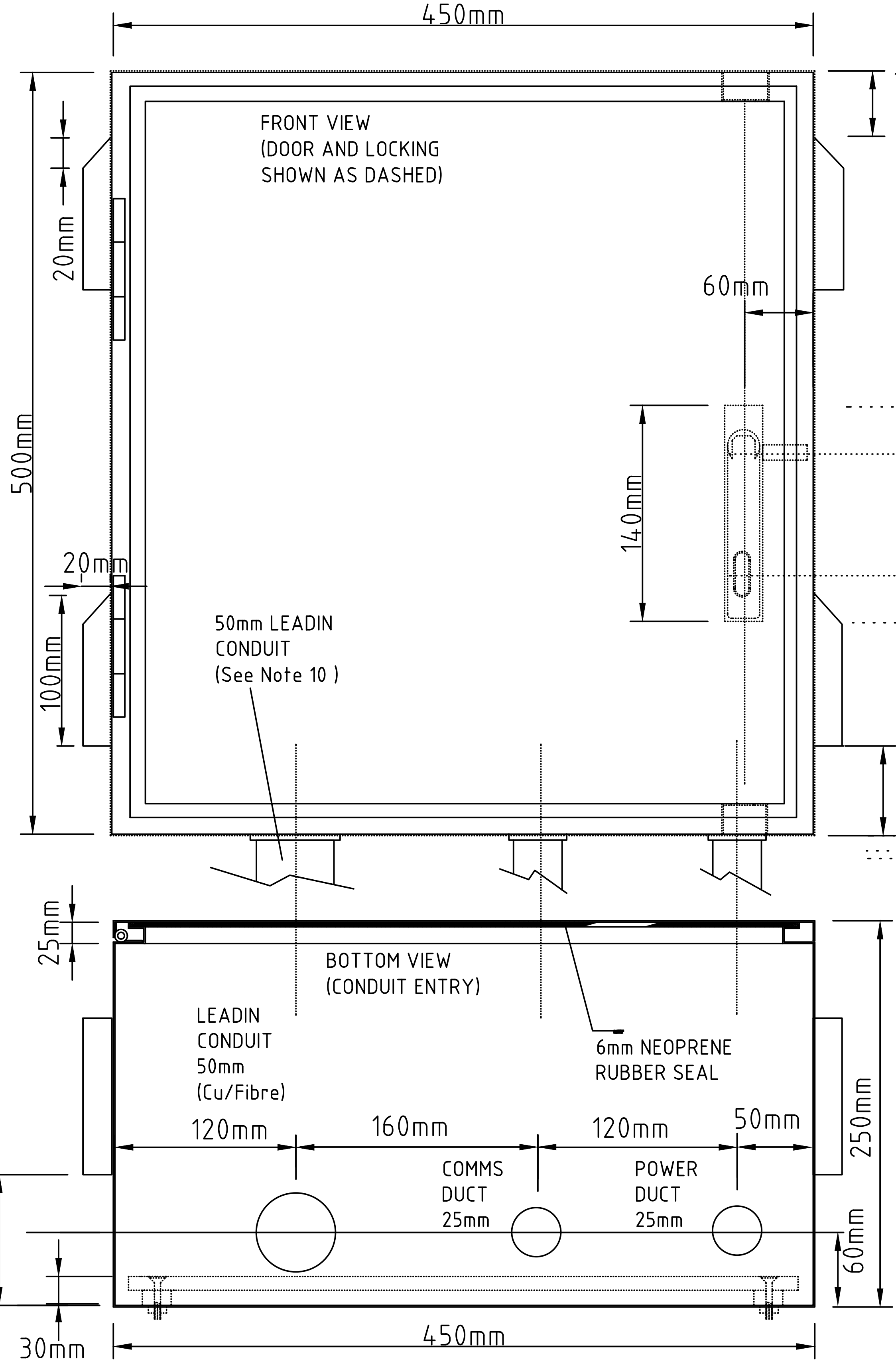
12. The MDF shall be fitted with vents at 4 locations as shown. Vents shall be shrouded type 100mmx100mm as shown to exclude water. Internal mesh opening to be 90mmWx 50mmH beneath shroud. Mesh to be 1mm pitch. When MDF is inset into another cabinet the shroud portion may be deleted. Mesh and shroud fixing to cabinet shall be of securely welded construction.

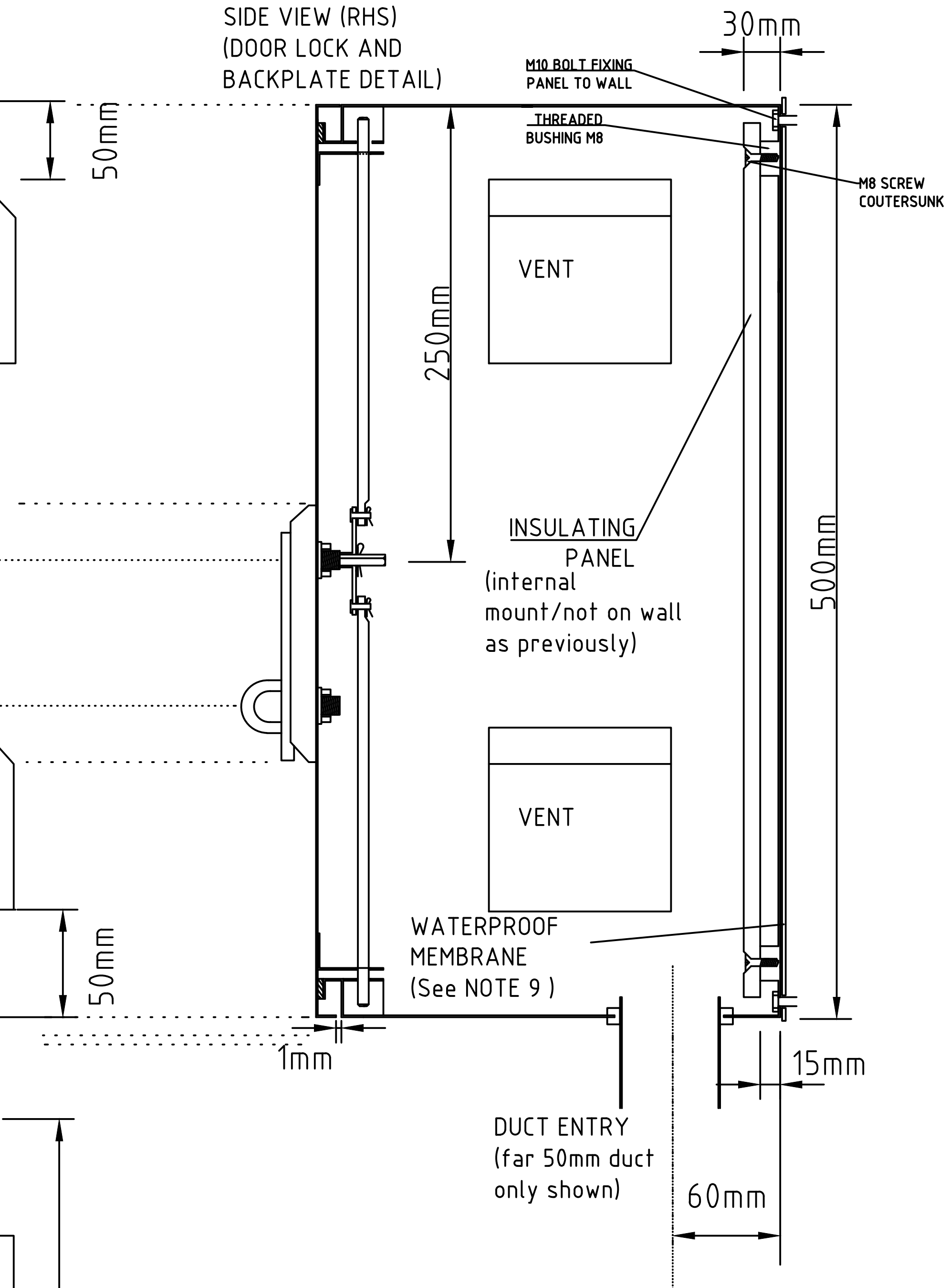


DOOR LOCK/SEAL/LIP DETAIL



VENT DETAIL (SIDE VIEW)





THIS DESIGN SUPERSEDES SSD/36 AND FORMS THE IICATS STANDARD MDF ENCLOSURE. THIS DESIGN SHALL BE USED FOR ALL IICATS SITE FROM 01-03-2011 ONWARDS INCLUDING RETROFIT SITES.

THIS ENCLOSURE DESIGN IS SUITABLE FOR:

COPPER NON-EPR: SSD/110A

COPPER EPR ADSL: SSD/110B

COPPER EPR PSTN: SSD/110C

FIBRE OPTIC FED: SSD/110D

DESIGNED	A. BALUK SWC	11.01.11	
DRAWN	A. BALUK SWC	08.02.11	
VERIFIED	S. ROSS SWC	27.11.20	
APPROVED	D. FRUCI SWC	27.11.20	

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
D	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
C	AMMENDED SS GRADE & MINOR TEXT CORRECTIONS	A.B	07.06.11
B	ADDED VENTILATION FOR ACTIVE DEVICES	A.B	18.04.11
A	AMENDED WITH PEER REVIEW COMMENTS & DESIGN CHANGES	A.B	28.02.11

Sydney WATER

SWC ---

RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 27.11.20

ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 27.11.20

INSTRUMENT AND CONTROL STANDARDS
IICATS MDF ENCLOSURE
GENERAL ARRANGEMENT

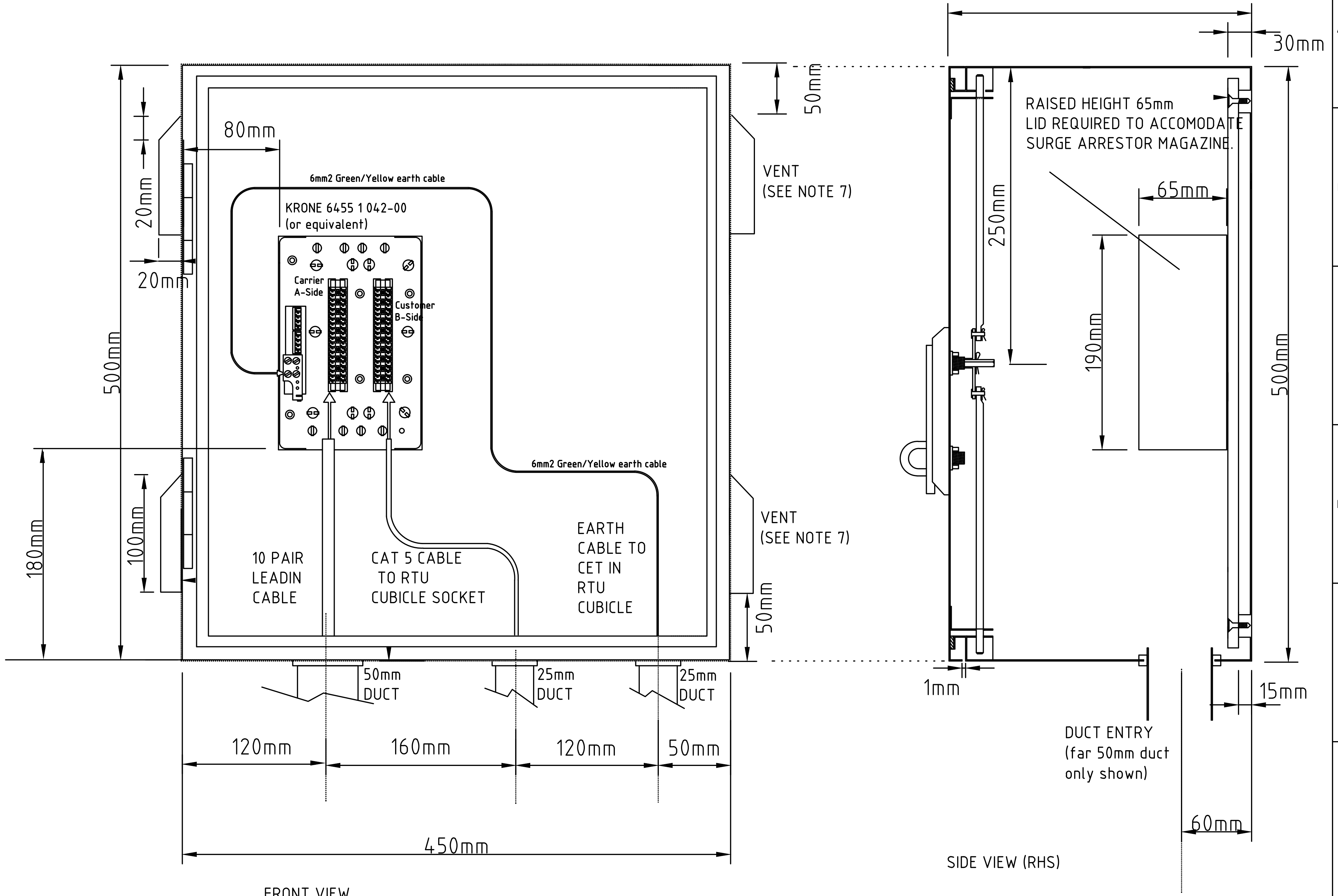
A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD110

ISSUE D SHEET No. ---

NOTES:

1. LEADIN CONDUIT MUST HAVE BENDS WITH RADIUS OF 300mm OR GREATER FOR THE ENTIRE RUN TO ENSURE COMPATABILITY WITH FUTURE FIBRE OPTIC CABLE INSTALLATION.
2. MDF SHALL USE KRONE 6455 1 042-10 (10 PAIR MDF) WITH 65mm HIGH LID TO ALLOW FITTMENT OF GAS ARRESTOR MAGAZINE
3. LEADIN CABLE SHALL BE 10 PAIR. ALL 10 PAIRS TO BE TERMINATED ON A-SIDE .
4. CARRER SIDE KRONE STRIP (A-SIDE) SHALL BE FITTED WITH A GAS ARRESTOR MAGAZINE KRONE 6462 2 095-00 WITH 230V RATED ARRESTORS FITTED TO ALL 10 POSITIONS
5. A COMMUNICATIONS EARTH TERMINAL (CET) TERMINAL SHALL BE FITTED IN THE RTU CABINET AND A 6mm2 Green/Yellow EARTH CABLE SHALL BE RUN TO THE EARTH TERMINAL OF THE KRONE MDF.
6. ALL CONSTRUCTION NOTES AND LAYOUT DETAILS FROM SSD/110 GENERAL ARRANGEMENT DIAGRAM APPLY TO THIS DRAWING.
7. VENTS SHALL BE INCORPORATED IN THE MDF AS PER SSD/110 GENERAL ARRANGEMENT DIAGRAM..



SIDE VIEW (RHS)

FRONT VIEW
(DOOR AND LOCKING NOT SHOWN)

THIS DRAWING SUPERSEDES SSD/35 AND SHALL APPLY TO ALL NON-EPR IICATS SITES SERVICED BY COPPER COMMUNICATIONS.
ALL CONSTRUCTION NOTES FROM SSD/110 GENERAL ARRANGEMENT APPLY TO THIS DRAWING

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
A	AMENDED WITH PEER REVIEW COMMENTS & DESIGN CHANGES	A.B	28.02.11

DESIGNED A. BALUK SWC 11.01.11
DRAWN A. BALUK SWC 08.02.11
VERIFIED S. ROSS SWC 27.11.20
APPROVED D. FRUCI SWC 27.11.20

Sydney WATER

SWC ---
RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 27.11.20
ACCEPTED D. FRUCI I&CS MANAGER SYDNEY WATER 27.11.20

INSTRUMENT AND CONTROL STANDARDS
IICATS MDF ENCLOSURE
COPPER NON-EPR
CABINET LAYOUT

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD110A
ISSUE B
SHEET No. ---

SWA1-EXT AUG 2016

NOTES:

1. LEADIN CONDUIT MUST HAVE BENDS WITH RADIUS OF 300mm OR GREATER FOR THE ENTIRE RUN TO ENSURE COMPATABILITY WITH FIBRE OPTIC CABLES

2. DIN RAIL TO BE FITTED WITH TWO KNIFE TERMINALS TO ALLOW CARRIER TECHNICIAN TO ISOLATE 12V DC SUPPLY FROM ONT WHILE PERFORMING SERVICE. EARTH TERMINAL SHALL BE A SOLID TERMINAL THAT CANNOT BE DISCONNECTED

3. DC SUPPLY FOR THE FIBRE ONT SHALL BE A 12V DC REGULATED SUPPLY ABLE TO PROVIDE 30WATTS MAX LOAD. ONT 12V POWER SUPPLY SHALL BE PROVIDED BY A RADAMETA P100C/12V FITTED WITH 24AH BACKUP BATTERIES LOCATED IN THE RTU CUBICLE. WHERE A SITE REQUIRES AN ALTERNATIVE POWER SUPPLY SOLUTION TO THE RADAMETA SUPPLY APPROVAL SHALL BE REQUIRED FROM SYDNEY WATER FOR ALTERNATIVE POWER SUPPLY EQUIPMENT TO BE USED.

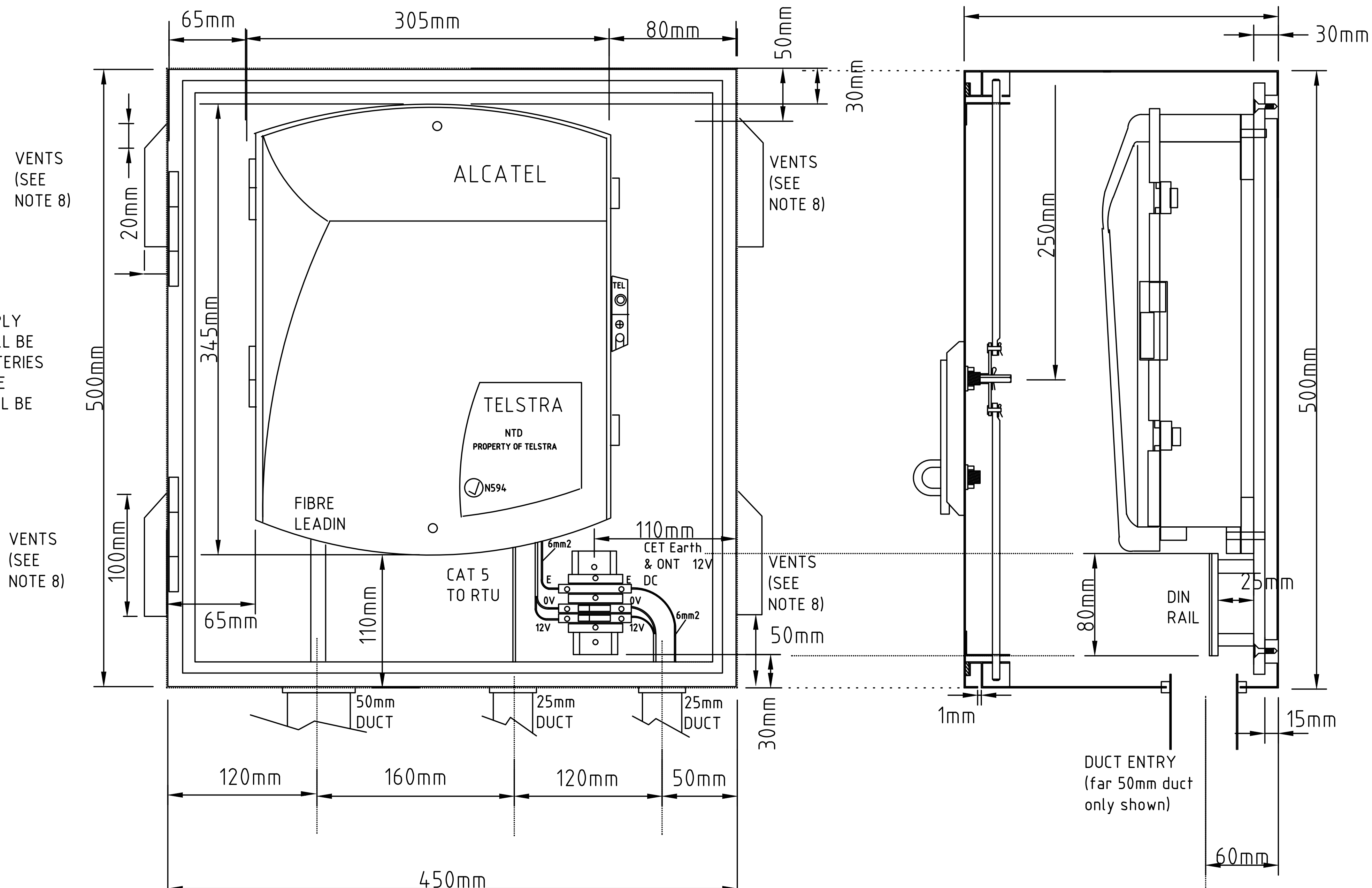
4. LAYOUT SHOWN IS FOR ALCATEL 0-SERIES ONT AS USED BY TELSTRA "VELOCITY" PRODUCT

5. OTHER VENDOR ONT UNITS SUCH AS THE NEC ME200-SFU-T MAY BE FITTED IN PLACE OF THE ALCATEL UNIT WHERE REQUIRED. THE NEC UNIT HAS COMPATIBLE LEADIN CABLE ALIGNMENT AND POWER SUPPLY REQUIREMENTS AND UTILISES A SMALLER FOOTPRINT TO THE ALCATEL UNIT.

6. WHERE AN ONT UNIT THAT DIFFERS TO THE ALCATEL 0-SERIES OR THE NEC ME200 SERIES THE DETAILS SHALL BE PROVIDED TO SYDNEY WATER FOR CONSIDERATION AND CLIENT ADVICE/APPROVAL.

7. ALL CONSTRUCTION NOTES AND LAYOUT DETAILS FROM SSD/110 GENERAL ARRANGEMENT DIAGRAM APPLY TO THIS DRAWING.

8. VENTS SHALL BE INCORPORATED IN THE MDF AS PER SSD/110 GENERAL ARRANGEMENT DIAGRAM..



SIDE VIEW (RHS)

FRONT VIEW
(DOOR AND LOCKING NOT SHOWN)

THIS DRAWING SHALL APPLY TO ALL FIBRE FED IICATS SITES
ALL CONSTRUCTION NOTES FROM SSD/110 GENERAL ARRANGEMENT APPLY TO THIS DRAWING

DESIGNED A. BALUK SWC 11.01.11				
DRAWN A. BALUK SWC 08.02.11				
VERIFIED S. ROSS SWC 27.11.20	B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
APPROVED D. FRUCI SWC 27.11.20	A	AMENDED WITH PEER REVIEW COMMENTS & DESIGN CHANGES	A.B	09.06.11
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

SWC ---

RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 27.11.20

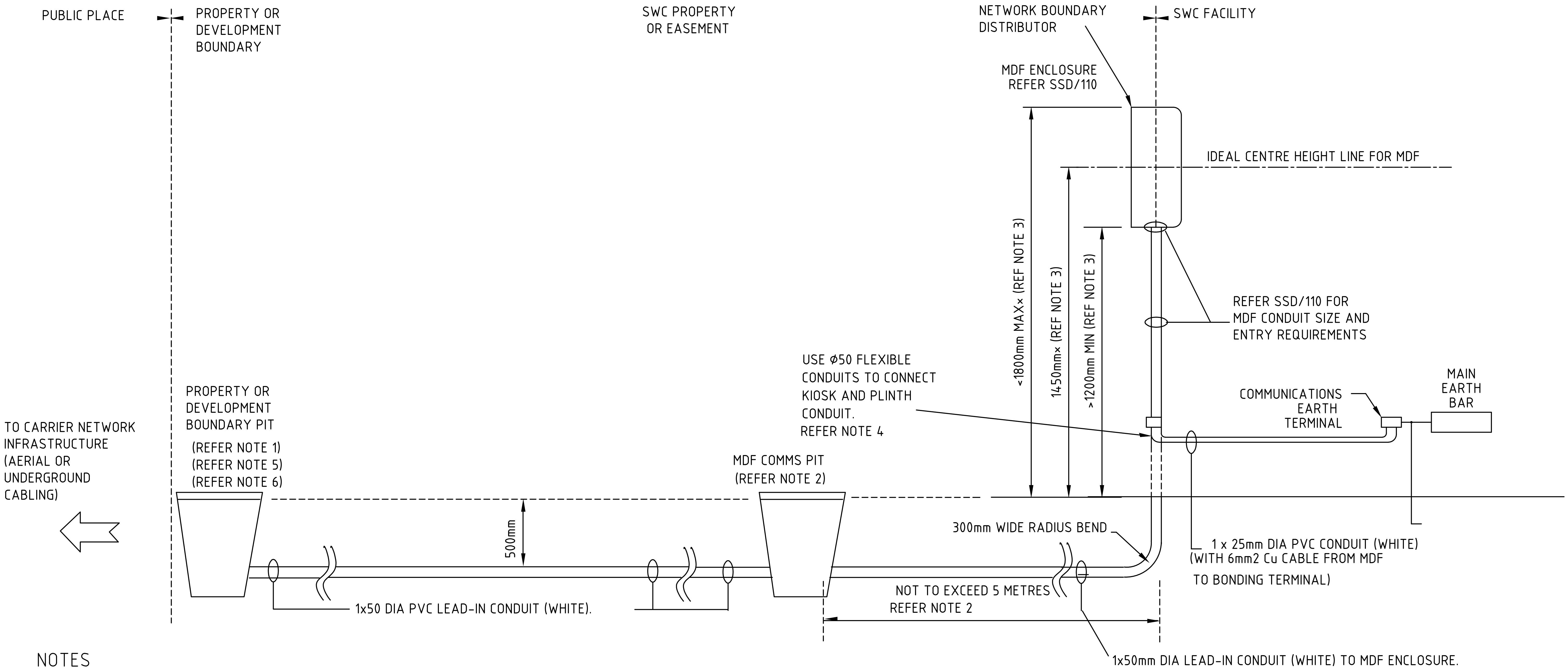
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 27.11.20

INSTRUMENT AND CONTROL STANDARDS
IICATS MDF ENCLOSURE
OPTICAL NETWORK
TERMINATOR MDF LAYOUT

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD
SSD110D

ISSUE B | SHEET No. ---



NOTES

1. P4 TYPE PIT, THE "PROPERTY OR DEVELOPMENT BOUNDARY" PIT SHALL BE INSTALLED AT THE BOUNDARY BETWEEN THE SWC PROPERTY OR EASEMENT AND A "PUBLIC PLACE". THE CARRIER SHALL BE RESPONSIBLE FOR THE CONNECTION BETWEEN THIS PIT AND THE NEAREST CARRIER NETWORK PRESENCE. AS/NZS ACIF S009 APPENDIX-J APPLIES..
2. P3 TYPE PIT. PREFERRED DISTANCE FROM MDF IS 1M. DO NOT PLACE PIT IN TRAFFICABLE AREAS
3. AS/ACIF S009 APPENDIX-D CLEARANCES APPLY
4. LEAD-IN CONDUIT AND ANY OTHER EXPOSED COMMUNICATIONS CONDUIT SHALL BE PROTECTED WITH A VANDAL PROOF GALVANISED STEEL COVER TO A HEIGHT ABOVE GROUND OF 2000mm
5. CONDUITS SHALL HAVE A DRAW WIRE INSTALLED TO ALLOW THE CARRIER TO INSTALL A LEADIN CABLE AND TERMINATE THIS LEADIN CABLE ON THE NETWORK BOUNDARY DISTRIBUTOR
6. THE "PROPERTY OR DEVELOPMENT BOUNDARY" PIT LOCATION AT THE BOUNDARY SHALL BE CHOSEN FOR ITS PROXIMITY TO EXISTING CARRIER NETWORK INFRASTRUCTURE. THE PIT LOCATION SHALL BE DETERMINED IN CONSULTATION WITH THE CARRIER TO ENSURE THE MOST EFFICIENT LEAD-IN CABLE ROUTE IS UTILISED.
7. DEPTH COMPLIANT WITH CARRIER REQUIREMENTS AT TIME OF PUBLICATION. TO BE CONFIRMED AGAINST LATEST VERSION OF CARRIER LEAD IN TRENCHING REQUIREMENTS DURING DESIGN STAGE.

DESIGNED A. BALUK SWC 26.05.11			
DRAWN A. BALUK SWC 26.05.11			
VERIFIED S. ROSS SWC 27.11.20			
APPROVED D. FRUCI SWC 27.11.20			

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
E	UPDATED TO LATEST S009 AND CARRIER REQUIREMENTS	D.F	25.09.23
D	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
C	MINOR REVIEW CORRECTIONS	A.B	27.7.11
B	AMENDMENT TO DEMARCATION	A.B	08.06.11
A	MINOR CORRECTIONS FOR RELEASE	A.B	30.05.11

Sydney WATER

SWC ---

RECOMMENDED S. ROSS OT STANDARDS ENGINEER SYDNEY WATER 25.09.23

ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 25.09.23

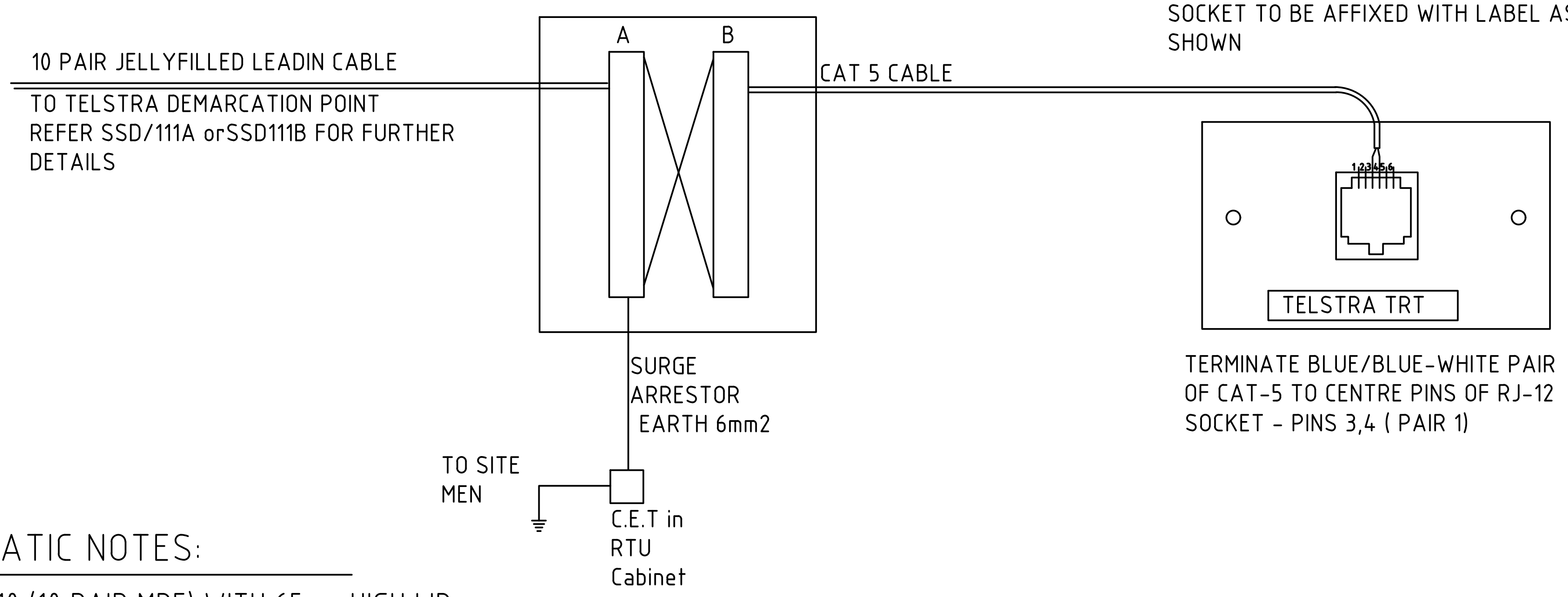
INSTRUMENT AND CONTROL STANDARDS
LEAD IN CABLE CONDUIT &
CARRIER DEMARCATION
GENERAL ARRANGEMENT

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

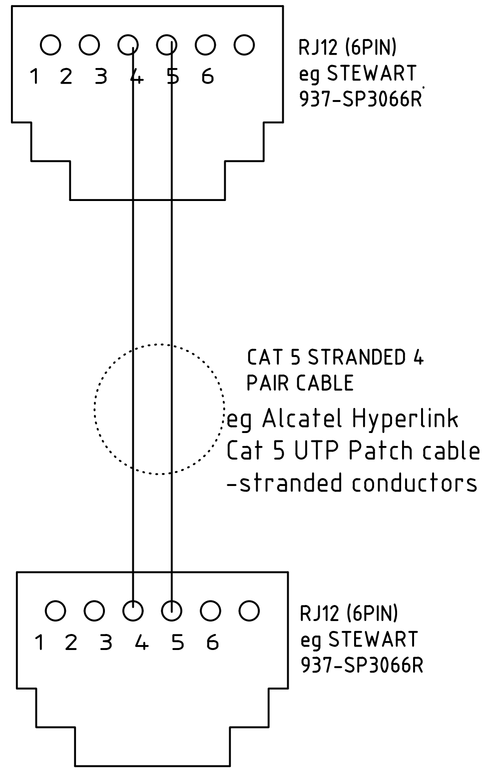
DRAWING No. SSD SSD111

ISSUE E | SHEET No. ---

NON-EPR COPPER ADSL AND DIAL IP TRT SERVICES



RJ12 SOCKET TO ULTRALINK CABLE SCHEMATIC



NON-EPR COPPER SITE SCHEMATIC NOTES:

1. MDF SHALL USE KRONE 6455 1 042-10 (10 PAIR MDF) WITH 65mm HIGH LID TO ALLOW FITTMENT OF GAS ARRESTOR MAGAZINE
2. LEADIN CABLE SHALL BE 10 PAIR. ALL 10 PAIRS TO BE TERMINATED ON A-SIDE .
3. CARRIER SIDE KRONE STRIP (A-SIDE) SHALL BE FITTED WITH A GAS ARRESTOR MAGAZINE KRONE 6462 2 095-00 WITH 230V RATED ARRESTORS FITTED TO ALL 10 POSITIONS
4. A COMMUNICATIONS EARTH TERMINAL (CET) TERMINAL SHALL BE FITTED IN THE RTU CABINET AND A 6mm2 Green/Yellow EARTH CABLE SHALL BE RUN TO THE EARTH TERMINAL OF THE MDF.
5. REFER TO SSD/110A GENERAL ARANGEMENT DIAGRAM FOR ADDITIONAL PHYSICAL CONNECTION DETAIL

THIS DRAWING SHALL APPLY TO ALL
IICATS SITES SERVICED BY COPPER COMMUNICATIONS.

DESIGNED A. BALUK SWC 28.02.11				
DRAWN A. BALUK SWC 07.03.11				
VERIFIED S. ROSS SWC 27.11.20	B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
APPROVED D. FRUCI SWC 27.11.20	A	MINOR CORRECTIONS FOR RELEASE	A.B	30.05.11
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

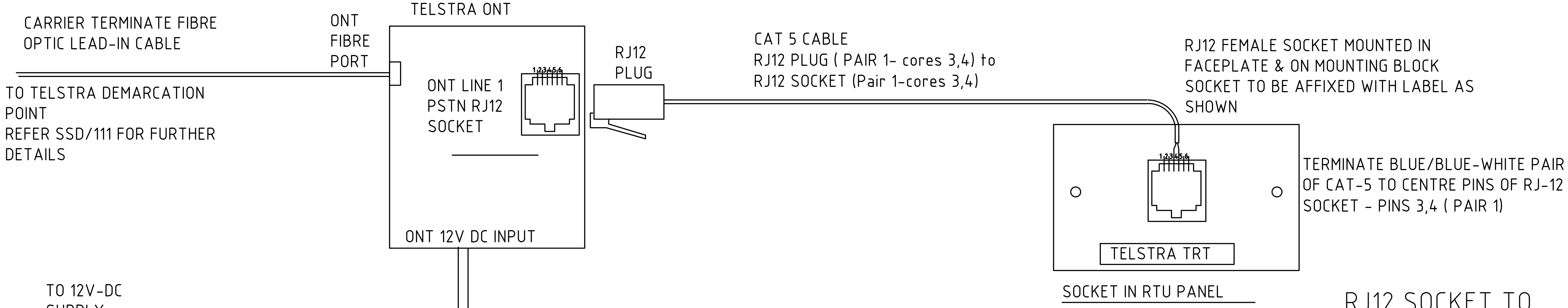
SWC ---
RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 27.11.20
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 27.11.20

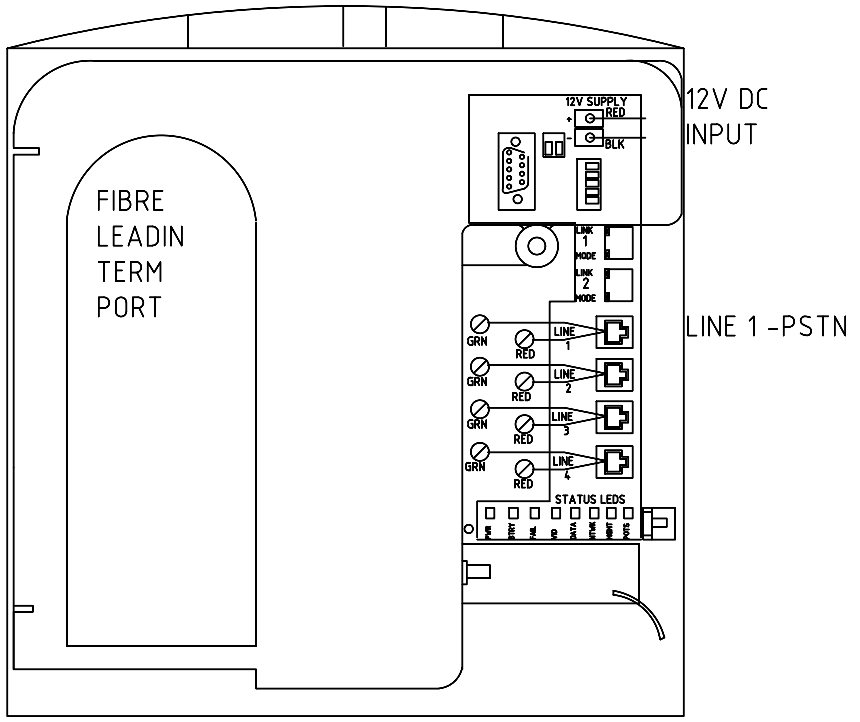
INSTRUMENT AND CONTROL STANDARDS
IICATS COPPER BASED
MDF CONNECTION SCHEMATIC
NON EPR

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD112
ISSUE B | SHEET No. ---

FIBRE OPTIC ONT BASED DIAL-IP TRT SERVICE





TELSTRA SUPPLIED ALCATEL FIBRE OPTICAL NETWORK TERMINATOR (OUTER COVER REMOVED)

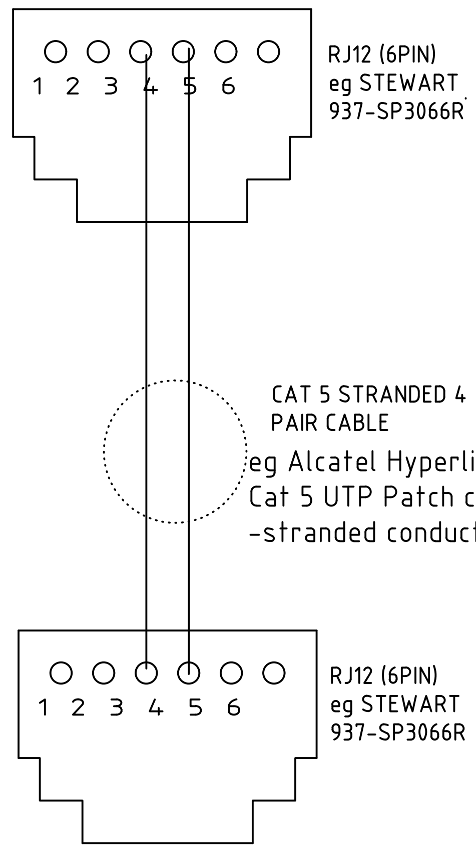
FIBRE OPTIC ONT NOTES:

1. FIBRE OPTIC CABLE SHALL BE INSTALLED AND TERMINATED BY THE CARRIER ONLY

2. ONT SHALL BE SUPPLIED BY RADAMETA SUPPLY 12V DC OUTPUT FROM RTU PANEL. RADAMETA PART NUMBER P100C/12V

3. REFER TO SSD 110/D FOR GENERAL ARRANGEMENT AND TERMINAL LAYOUT DETAILS

RJ12 SOCKET TO ULTRALINK CABLE SCHEMATIC



THIS DRAWING SHALL APPLY TO ALL IICATS SITES SERVICED BY TELSTRA REMOTE TELEMETRY FIBRE LEADIN CABLE COMMUNICATIONS.

DESIGNED	A. BALUK SWC	11.05.11	
DRAWN	A. BALUK SWC	11.05.11	
VERIFIED	S. ROSS SWC	27.11.20	
APPROVED	D. FRUCI SWC	27.11.20	

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
A	MINOR CORRECTIONS FOR RELEASE	A.B	30.05.11

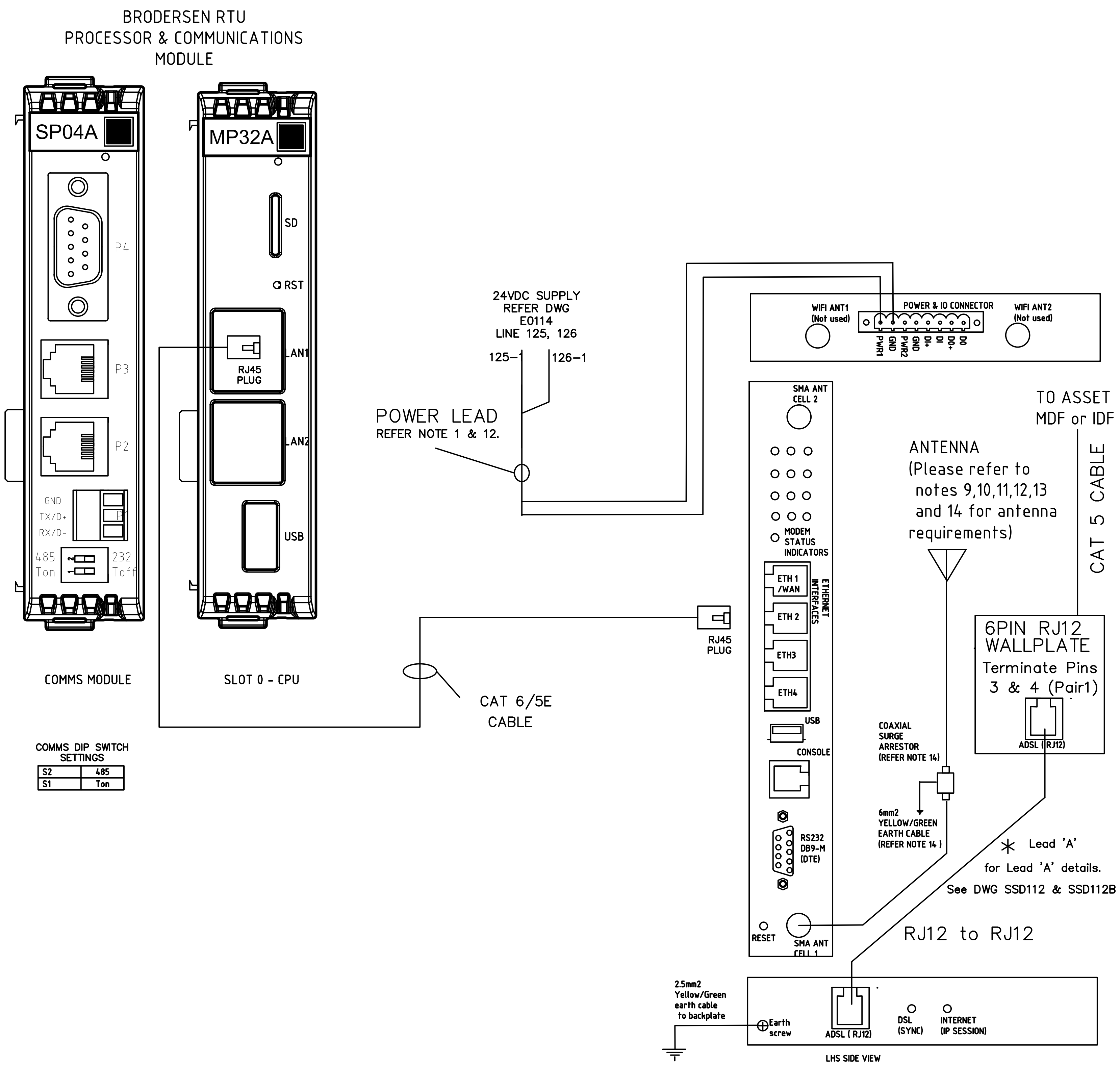
Sydney WATER

SWC ---
RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 27.11.20
ACCEPTED D. FRUCI I&CS MANAGER SYDNEY WATER 27.11.20

INSTRUMENT AND CONTROL STANDARDS
IICATS FIBRE BASED
MDF CONNECTION SCHEMATIC
TRT FIBRE

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD112B
ISSUE B
SHEET No. ---



NOTES:

1. DC IN - 24 V DC. REFER TO SSD087.
2. PORT 1 - 3 WIRE RS485 PORT. DEFAULT COMMS DIP SWITCH SETTINGS FOR PORT A. S1 Ton. S2 485.
3. PORT 2 - RJ12 RS232 PORT. RESERVED FOR LOCAL MODBUS COMMS TO RTU PSU.
4. PORT 3 - RJ12 RS232 PORT. RESERVED FOR LOCAL DIAGNOSTICS SERIAL PPP CONNECTION.
5. PORT 4 - DB9 RS232 PORT.
6. LAN1 - RJ45 ETHERNET PORT. RESERVED FOR MODEM CONNECTION.
7. LAN2 - RJ45 ETHERNET PORT. RESERVED FOR LOCAL DIAGNOSTICS.
6. RTU TO BE MOUNTED ON DIN RAIL.
8. MODEM MOUNTING CRADLE SHALL BE FIXED USING DIN RAIL OR SCREWS
9. MODEM WIRELESS ANTENNA CONNECTION IS SMA FEMALE. ANTENNA CONNECTOR IS SMA MALE PLUG.
10. 24V POWER FEED TO MODEM SHALL BE FITTED WITH A DC CIRCUIT BREAKER OR FUSIBLE LINK RATED AT 2AMPS. POWER LEAD TO BE SUPPLIED BY INSTALLER.
11. AN ANTENNA SUITABLE FOR THE 4G NETWORK MUST BE INSTALLED. THE ANTENNA MUST BE SUITABLE FOR THE 698 - 960MHZ, 1710 - 2170MHZ & 2300 - 2700MHz BANDS.
12. A CSM700 ANTENNA OR EQUIVALENT MUST BE INSTALLED EXTERNAL TO EACH OUTDOOR KIOSK C/W INLINE SURGE PROTECTION AS STANDARD. WHERE SIGNAL STRENGTH IS POOR A COL7195 OR EQUIVALENT ANTENNA MUST BE USED. ANTENNA CABLE LENGTH IS NOMINAL. TO BE SELECTED BASED ON INSTALLATION.
13. A COL7195 ANTENNA OR EQUIVALENT MUST BE INSTALLED ON AN EXTERNAL WALL OF THE SWITCHROOM C/W INLINE SURGE PROTECTION AS STANDARD. WHERE SIGNAL STRENGTH IS POOR A COL7199 OR EQUIVALENT ANTENNA MUST BE USED.
14. A POLAR PLA-R, POLYPHASER IS-50NX-C2 OR EQUIVANT COAXIAL SURGE ARRESTOR SHALL BE INSTALLED IN-LINE AT THE TELSTRA ULTRALINK END OF THE COAXIAL ANTENNA LEAD. A 30CM N-TYPE MALE TO SMA-MALE FLYLEAD SHALL BE REQUIRED TO CONNECT THE TELSTRA ULTRALINK TO THE SURGE ARRESTOR. THE SURGE ARRESTOR SHALL BE CONNECTED TO THE CUBICLE EARTH VIA 6MM YELLOW/GREEN EARTH CABLE. WITH A LENGTH NOT EXCEEDING 10METRES AND A CABLE RESISTANCE NOT EXCEEDING 0.5OHMS.

DESIGNED A. BALUK SWC 20.09.16				
DRAWN A. BALUK SWC 20.09.16				
VERIFIED S. ROSS SWC 11.09.23	C	UPDATED FOR BRODERSEN RTU	D.F	11.09.23
	B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.12
APPROVED D. FRUCI SWC 11.09.23	A	AMENDED ANTENNA DETAILS TO INCLUDE C3LA30	E.D	20.09.16
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

SWC ---
RECOMMENDED S. ROSS OT STANDARDS ENGINEER SYDNEY WATER 11.09.23
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 11.09.23

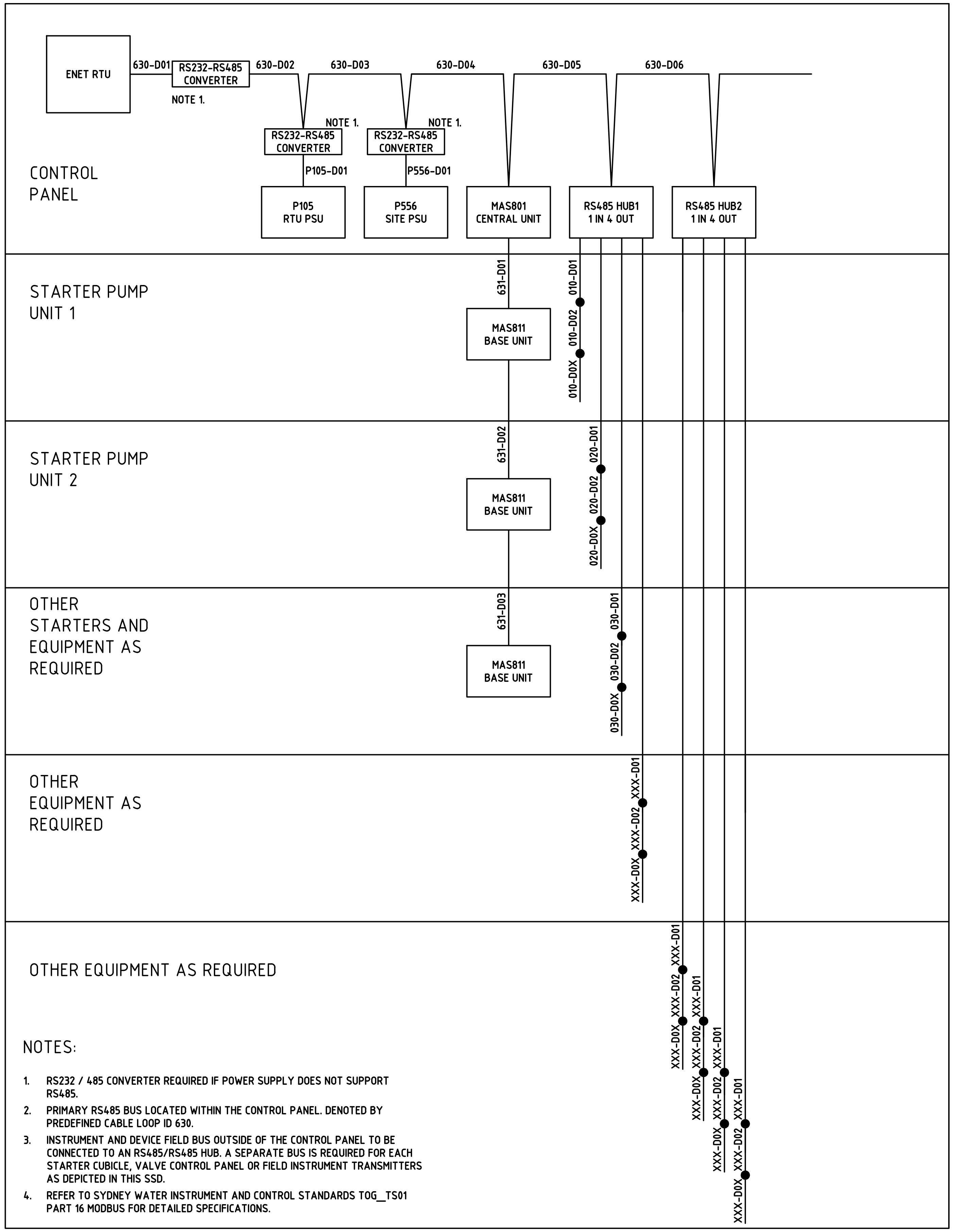
INSTRUMENT AND CONTROL STANDARDS
BRODERSEN RTU
RTU & ULTRALINK MODEM (UHS UC400T)
CONNECTION DIAGRAM

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD113
ISSUE C | SHEET No. ---

SWA1-EXT AUG 2016

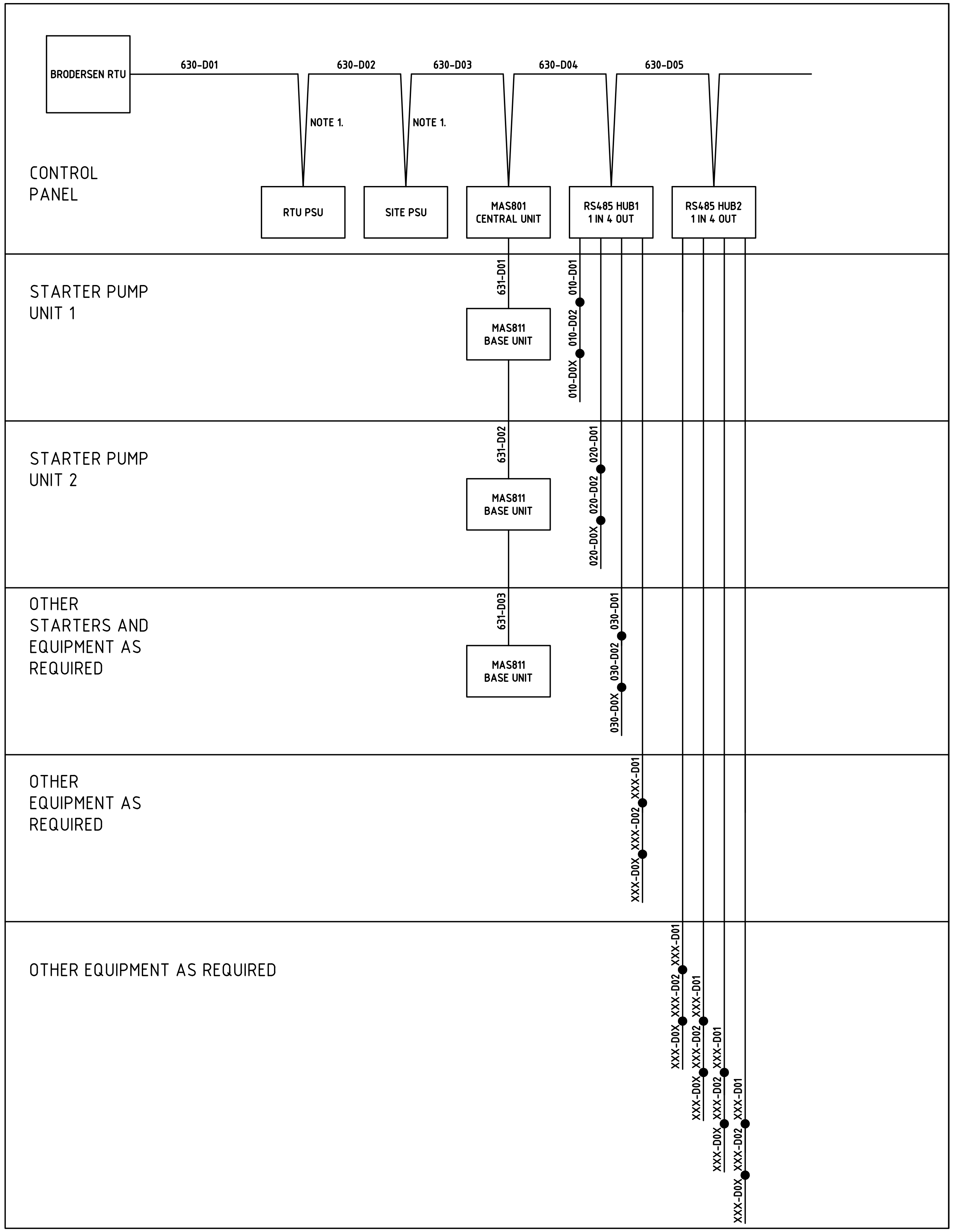
CONTROL CABINETS



NOTES:

1. RS232 / 485 CONVERTER REQUIRED IF POWER SUPPLY DOES NOT SUPPORT RS485.
2. PRIMARY RS485 BUS LOCATED WITHIN THE CONTROL PANEL. DENOTED BY PREDEFINED CABLE LOOP ID 630.
3. INSTRUMENT AND DEVICE FIELD BUS OUTSIDE OF THE CONTROL PANEL TO BE CONNECTED TO AN RS485/RS485 HUB. A SEPARATE BUS IS REQUIRED FOR EACH STARTER CUBICLE, VALVE CONTROL PANEL OR FIELD INSTRUMENT TRANSMITTERS AS DEPICTED IN THIS SSD.
4. REFER TO SYDNEY WATER INSTRUMENT AND CONTROL STANDARDS TOG_TS01 PART 16 MODBUS FOR DETAILED SPECIFICATIONS.

CONTROL CABINETS



DESIGNED	S. ROSS SWC	01.04.21
DRAWN	S. ROSS SWC	01.04.21
VERIFIED	S. ROSS SWC	15.04.21
APPROVED	D. FRUCI SWC	15.04.21

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
A	ISSUED FOR USE	D.F.	15.04.21

Sydney WATER

RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 15.04.21

ACCEPTED D. FRUCI I&CS MANAGER SYDNEY WATER 15.04.21

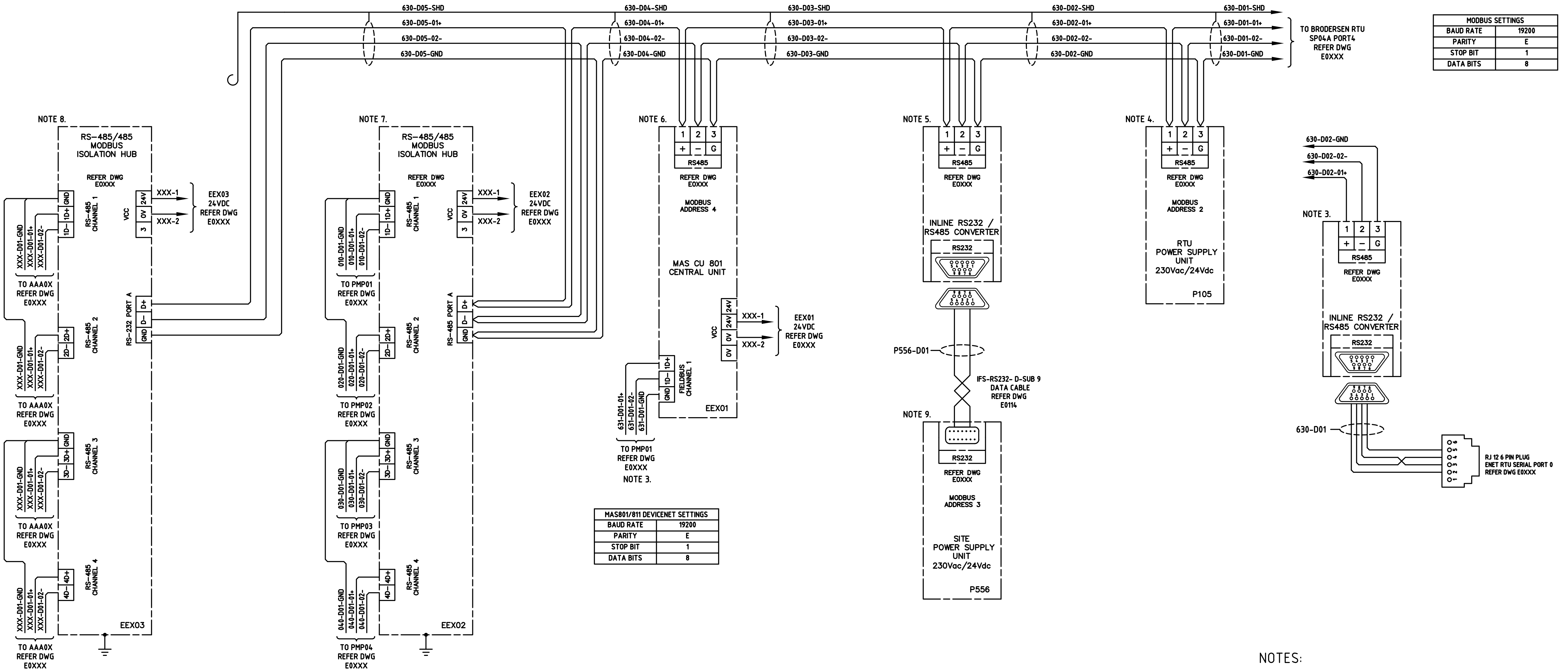
INSTRUMENT AND CONTRL STANDARDS
TYPICAL MODBUS NETWORK LAYOUT
BLOCK DIAGRAM

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD120

ISSUE A SHEET No. 1

SWA1-EXT AUG 2014



MODBUS SETTINGS	
BAUD RATE	19200
PARITY	E
STOP BIT	1
DATA BITS	8

MAS801/811 DEVICENET SETTINGS	
BAUD RATE	19200
PARITY	E
STOP BIT	1
DATA BITS	8

NOTES:

1. DATA CABLES TO BE CRIMPED IN COMMON BOOTLACE TO MITIGATE AGAINST DATA BUS SEGMENTATION. CABLE TO BE BELDIN 3106A OR EQUIVALENT.
2. 120Ω BUS TERMINATOR TO BE INSTALLED AT EACH END OF THE BUS WHERE EQUIPMENT INTERNAL TERMINATORS ARE NOT AVAILABLE.
3. INLINE RS232 / RS485 CONVERTER REQUIRED FOR ENET RTU CONNECTION. NOT REQUIRED FOR BRODERSEN RTU.
4. DIRECT RS485 CONNECTION TO BE USED TO RS485 CAPABLE DEVICES.
5. DEFAULT NETWORK IS RS485. RS232 / RS485 CONVERTER REQUIRED TO CONNECT RS232 DEVICES. INLINE CONVERTERS PREFERRED.
6. MAS801 CONNECTION ONLY REQUIRED WHERE MAS801 DEVICE INSTALLED.
7. RS485 HUB REQUIRED FOR PUMPS AND OTHER FIELD DEVICES OUTSIDE THE CONTROL PANEL.
8. ADDITIONAL RS485 HUBS REQUIRED WHERE THE NUMBER OF DEVICES EXCEEDS THE BUS LIMIT OF ONE HUB.
9. PROPRIETARY CABLE DETAILS TO BE PROVIDED IF REQUIRED.
10. ALL DEVICES MUST MEET THE DEVICE SPECIFICATION IN SYDNEY WATER INSTRUMENT AND CONTROL STANDARDS TOG_TS01 PART 16 MODBUS.

DESIGNED S. ROSS SWC 01.04.21	B	UPDATED HUB TERMINAL LAYOUT AND RS485 CABLE TYPE	D.F	29.08.23
DRAWN S. ROSS SWC 01.04.21	A	ISSUED FOR USE	D.F	15.04.21
VERIFIED S. ROSS SWC 15.04.21	LETTER	DETAILS OF AMENDMENT	APP'D	DATE
APPROVED D. FRUCI SWC 15.04.21				

Sydney WATER

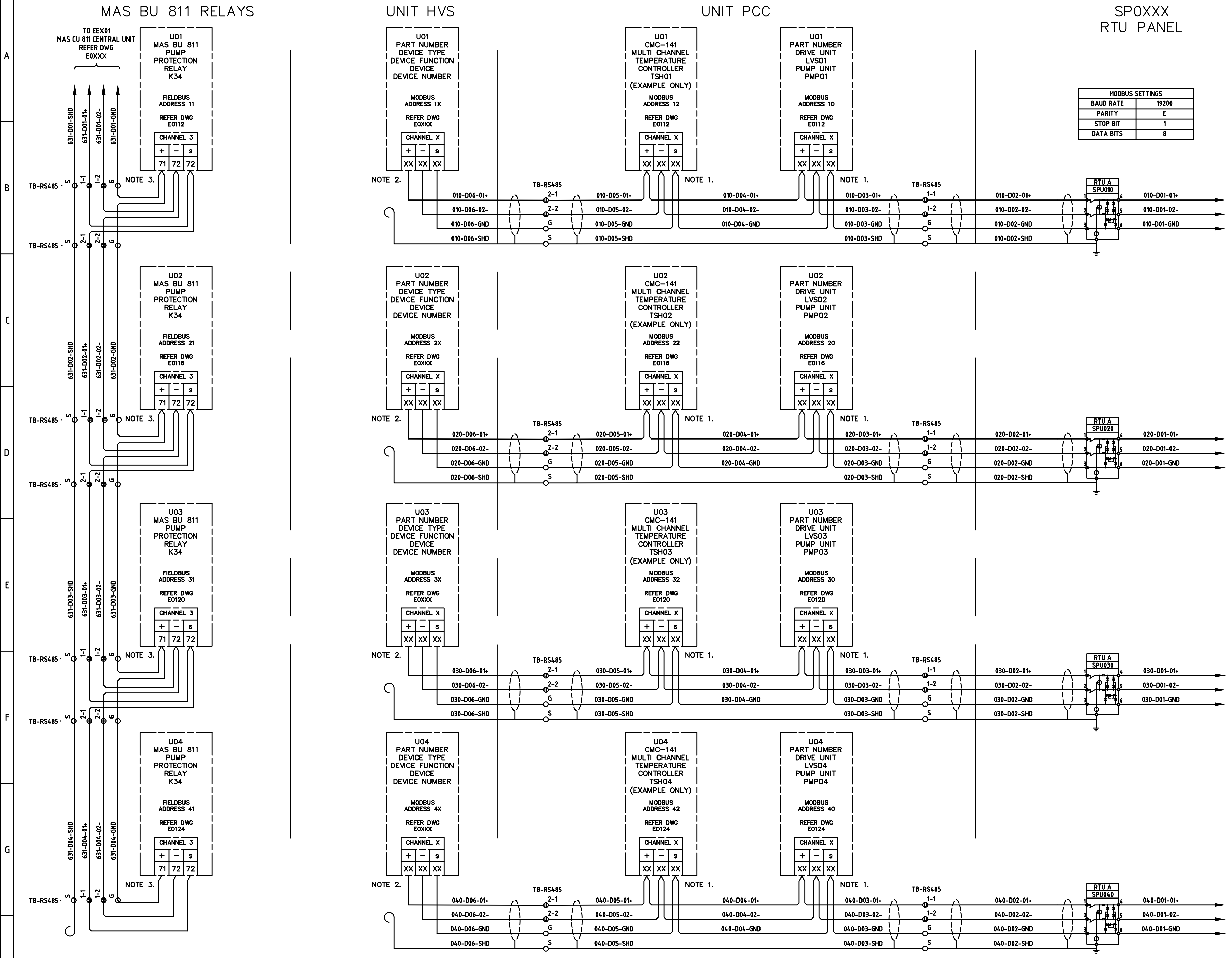
RECOMMENDED S. ROSS OT STANDARDS ENGINEER SYDNEY WATER 29.08.23
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 29.08.23

INSTRUMENT AND CONTROL STANDARDS
TYPICAL MODBUS NETWORK LAYOUT
RTU CONTROL PANEL

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C STANDARDS

DRAWING No. SSD SSD121
ISSUE B SHEET No. 1

SWA1-EXT AUG 2016



MODBUS SETTINGS	
BAUD RATE	19200
PARITY	E
STOP BIT	1
DATA BITS	8

NOTES:

1. DATA CABLES TO BE CRIMPED IN COMMON BOOTLACE TO MITIGATE AGAINST DATA BUS SEGMENTATION.
2. 120Ω BUS TERMINATOR TO BE INSTALLED AT EACH END OF THE BUS WHERE EQUIPMENT INTERNAL TERMINATORS ARE NOT AVAILABLE.
3. MAS CU 801/BU 811 CABLE ARRANGEMENT FOR KIOSKS ONLY. FOR STANDALONE STARTER PANELS BUS CABLE TO BE RUN TO AND FROM THE CONTROL PANEL TO EACH STARTER.
4. DIRECT RS485 CONNECTION TO BE USED TO RS485 CAPABLE DEVICES.
5. DEFAULT NETWORK IS RS485. RS232 / RS485 CONVERTER REQUIRED TO CONNECT RS232 DEVICES. INLINE CONVERTERS PREFERRED.
6. PROPRIETARY CABLE DETAILS TO BE PROVIDED IF REQUIRED.
7. ALL DEVICES MUST MEET THE DEVICE SPECIFICATION IN SYDNEY WATER INSTRUMENT AND CONTROL STANDARDS TOG_TS01 PART 16 MODBUS.

DESIGNED S. ROSS SWC 01.04.21				
DRAWN S. ROSS SWC 01.04.21				
VERIFIED S. ROSS SWC 15.04.21				
APPROVED D. FRUCI SWC 15.04.21	A	ISSUED FOR USE	D.F.	15.04.21
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 15.04.21

ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 15.04.21

INSTRUMENT AND CONTRL STANDARDS
TYPICAL MODBUS NETWORK LAYOUT
EEX001 RS485 MODBUS HUB
PMP01, PMP02, PMP03 MODBUS CONNECTIONS

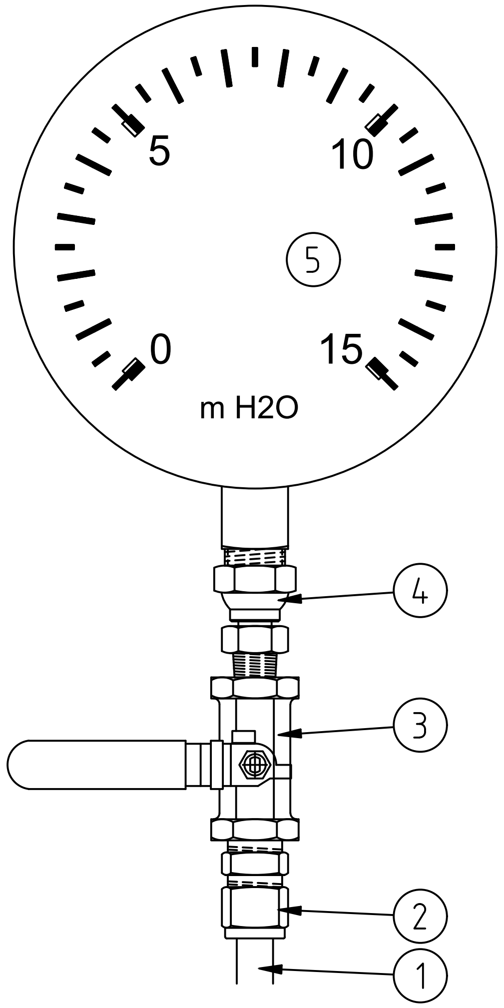
DRAWING No. SSD SSD122

ISSUE A | SHEET No. 1

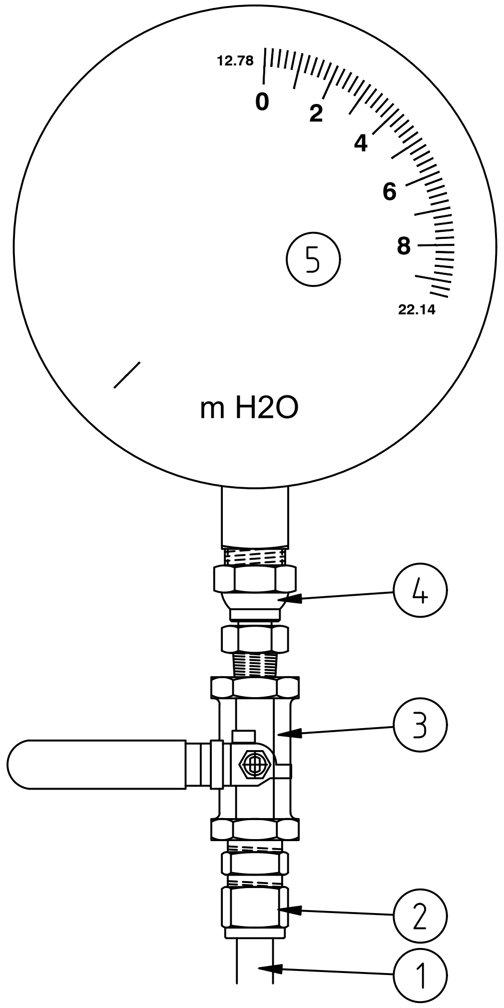
A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

SWA1-EXT AUG 2016

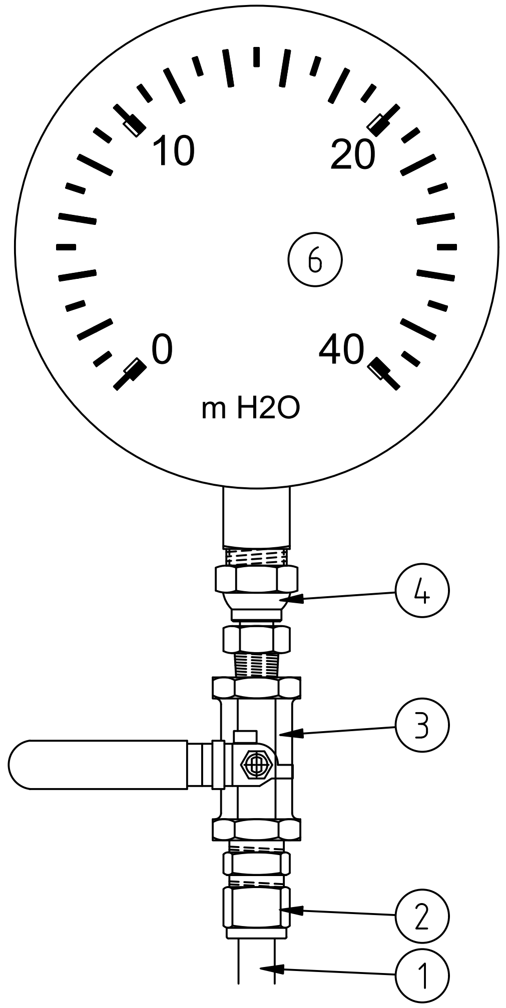
TYPICAL LOCAL PRESSURE GAUGE
SURFACE RESERVOIR OR TANK



TYPICAL LOCAL PRESSURE GAUGE
ELEVATED RESERVOIR OR TANK



TYPICAL LOCAL PRESSURE GAUGE
PUMP OR STATION SUCTION OR DISCHARGE PRESSURE



PARTS LIST

ITEM	DESCRIPTION	PART NUMBER
1	1/2" O.D. 316 STAINLESS STEEL PIPE	REFER TO RELEVANT PRESSURE BOARD LAYOUT DRAWING
2	1/2" BSP MALE CONNECTOR	768LR-SS-1/2"x1/2"
3	1/2" BALL VALVE	SB1-15NB
4	1/2" UNION	FT 2299 TYPE 22
5	PRESSURE GAUGE	270deg 160MM 316SS 1/2"BSP GLYCERINE FILLED
6	PRESSURE GAUGE	270deg 150MM 316SS 1/2"BSP GLYCERINE FILLED

NOTES:

1. LOCAL PRESSURE GAUGE TO BE BOURDON TUBE 270 DEGREE DEFLECTION MECHANICAL TYPE.
2. UNITS MUST BE METRES WATER (mH2O).
3. THE GAUGE DISPLAY MUST BE PROVIDED BY THE MANUFACTURER AND BE SCALED TO PROVIDE 80% DEFLECTION.
4. RESERVOIR AND TANK GAUGES MUST BE MECHANICALLY CALIBRATED AND REFERENCED TO MINIMUM OPERATING LEVEL (MOL).
5. RESERVOIR AND TANK GAUGES MUST BE RANGED FROM MOL TO THE OVERFLOW LEVEL. MOL TO BE SHOWN AS 0m.
6. FOR ELEVATED RESERVOIRS AND TANKS PRESSURE OUTSIDE THE MOL TO OVERFLOW RANGE MUST BE BLANK AND NOT SHOWN ON THE SCALE. EXCEPT FOR A MARK AT TRUE ZERO.THE TRUE PRESSURE AT MOL AND OVERFLOW MUST BE WRITTEN ON THE GAUGE IN NUMBERS.
7. PUMP GAUGES MUST BE MECHANICALLY CALIBRATED AND REFERENCED TO THE PUMP CENTRELINE. THE PUMP CENTRELINE MUST BE 0m.
8. SUCTION GAUGES MUST BE RANGED FROM 0m TO MAXIMUM SUCTION HEAD.
9. DISCHARGE GAUGES MUST BE RANGED FROM 0m TO MAXIMUM DISCHARGE HEAD.
10. THIS DRAWING SHOWS LOCAL GAUGES ONLY. REFER TO RELEVANT PRESSURE BOARD DRAWINGS FOR PRESSURE BOARD LAYOUT AND LOCATING DETAIL.

DESIGNED D. FRUCI SWC 01.04.21					
DRAWN S. ROSS SWC 01.04.21					
VERIFIED S. ROSS SWC 15.04.21					
APPROVED D. FRUCI SWC 15.04.21	A	ISSUED FOR USE	D.F.	15.04.21	
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE	

Sydney WATER

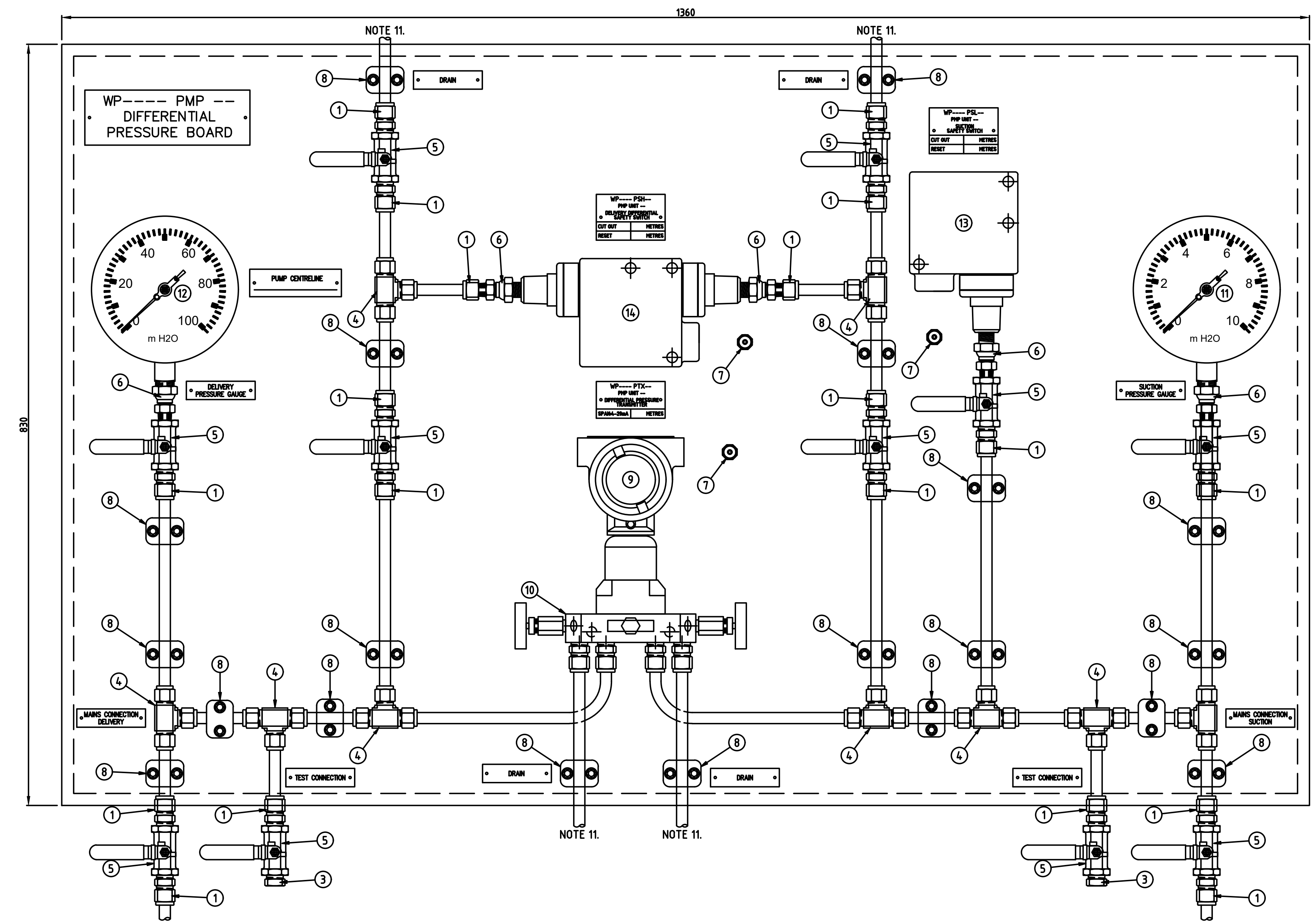
RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 15.04.21
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 15.04.21

INSTRUMENT AND CONTRL STANDARDS
LOCAL PRESSURE GAUGE DETAIL
RESERVOIR, TANK, PUMP AND STATION

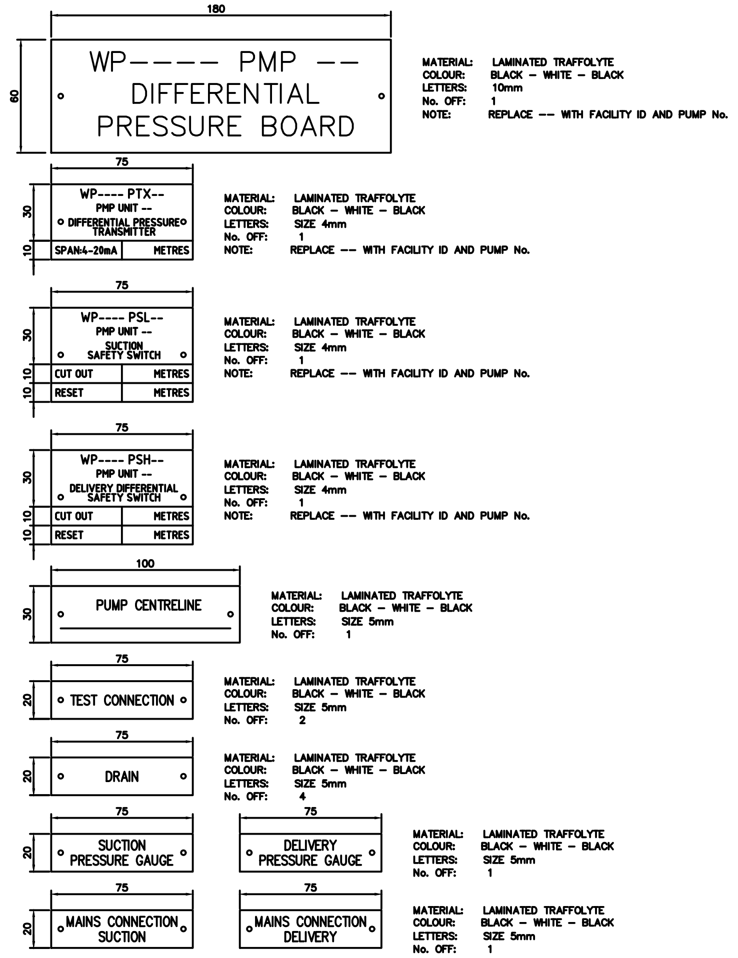
A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD / SSD130
ISSUE A | SHEET No. 1

SWA1-EXT AUG 2014



ITEM	DESCRIPTION	MATERIAL / NOTE	QTY
1	12.7mm BSP MALE CONNECTOR	SEE NOTE 1	19
2	12.7mm BSP – 6.35mm BSP MALE CONNECTOR	SEE NOTE 1. FOR INSTRUMENT CONNECTIONS	
3	12.7mm BSP PLUG	SEE NOTE 1	2
4	12.7mm UNION TEE	SEE NOTE 1	9
5	12.7mm BALL VALVE	SEE NOTE 1	13
6	12.7mm SWIVEL GAUGE ADAPTER	SEE NOTE 1	5
7	CABLE GLAND	SEE NOTE 12	3
8	TUBE CLAMPS	SEE NOTE 6 AND NOTE 1	19 SETS
9	DIFFERENTIAL PRESSURE TRANSMITTER	ROSEMOUNT 3051S1CD(2)A2A11A1BD1DOM5Q4. NOTE 14	1
10	5 VALVE COPLANAR MANIFOLD WITH BRACKET	ROSEMOUNT R305EC52B11BGL4 (INCLUDES SS BRACKET)	1
11	SUCTION PRESSURE GAUGE	270deg 160mm 316SS 12.7mm BSP GLYCERINE FILLED	1
12	DELIVERY PRESSURE GAUGE	270deg 160mm 316SS 12.7mm BSP GLYCERINE FILLED	1
13	SUCTION SAFETY PRESSURE SWITCH	ADJUSTABLE. RANGE TO SUIT PROCESS	1
14	DIFFERENTIAL PRESSURE SWITCH	ADJUSTABLE. RANGE TO SUIT PROCESS	1
15	TRANSMITTER MOUNTING HARDWARE	PROVIDE DETAIL PER OEM RECOMMENDATIONS	
16	PRESSURE SWITCH MOUNTING HARDWARE	PROVIDE DETAIL PER OEM RECOMMENDATIONS	
17	STRUT CHANNEL 40mm x 40mm	SEE NOTE 8	
18	BOARD MOUNTING HARDWARE	PROVIDE DETAIL FOR SITE INSTALLATION	
19	12.7mm OD 0.5mm WT SEAMLESS TUBE	SEE NOTE 1	



NOTES:

1. ALL TUBE TO BE 12.7mm OD 316 STAINLESS STEEL 0.5mm WT SEAMLESS. ALL FITTINGS TO BE 12.7mm BSP 316 STAINLESS STEEL. ADAPTERS TO BE SIZED TO INSTRUMENTS.
2. CHARACTER LINE WIDTH IS 1/10 OF THE CHARACTER HEIGHT.
3. PUMP PRESSURE GAUGES MUST BE BOURDON TUBE 270 DEGREE DEFLECTION MECHANICAL TYPE. UNITS MUST BE METRES WATER (mH20). THE GUAGE DISPLAY MUST BE SUPPLIED BY THE MANUFACTURER, SCALED TO SUIT THE PROCESS, AND PROVIDE 80% DEFLECTION UNDER NORMAL CONDITIONS.
4. PUMP PRESSURE GAUGES MUST BE MECHANICALLY CALIBRATED TO PUMP CENTRELINE. THE PUMP CENTRELINE MUST BE 0m.
5. PUMP CENTRELINE LABEL, PRESSURE GAUGE AND SWITCH DIAPHRAGMS MUST LIE ON THE SAME HORIZONTAL LINE AND BE REFERENCED TO PUMP CENTRELINE.
6. CENTRE LINE OF PIPEWORK ON THE PRESSURE BOARD TO BE LOCATED TO SUIT INSTRUMENTS. PLASTIC PACKING TO BE PROVIDED AS REQUIRED. ASSEMBLY TO BE SECURELY FASTENED USING TUBE CLAMPS.
7. PRESSURE BOARD TO BE 3mm STAINLESS STEEL WITH 13mm RETURN ALL AROUND AND WELDED CORNERS.
8. BOARD TO BE MOUNTED TO FLOOR USING STANDARD STRUT CHANNEL. EXACT LOCATION TO BE CONFIRMED ON SITE AND APPROVED BY SYDNEY WATER.
9. MAINS CONNECTIONS TO BE SITE RUN TO TAPPING POINTS. RODDING POINT TO BE PROVIDED AT PIPE SUCTION AND DELIVERY TAPPING POINT. REFER TO SSD0207 FOR TYPICAL RODDING POINT ARRANGEMENT.
10. THE DELIVERY TAPPING POINT FOR EACH PUMP MUST BE PROVIDED BEFORE THE PUMP DELIVERY CONTROL AND NON-RETURN VALVE.
11. ALL DRAIN/VENT LINE CONNECTIONS TO BE SITE RUN TO NEAREST FLOOR DRAIN.
12. IP68 CABLE GLANDS TO BE PROVIDED AND MOUNTED TO THE BOARD WITHIN 100mm OF INSTRUMENT CONNECTION. LOCATION TO BE DETERMINED BASED ON INSTRUMENT SELECTION. INSTRUMENT CABLE TO RUN IN CONDUIT TO BACK OF PRESSURE BOARD, PASS THROUGH CABLE GLAND, AND TERMINATE AT INSTRUMENT.
13. THIS DRAWING IS PROVIDED AS A TYPICAL SAMPLE ONLY. ALL MEASUREMENTS TO BE VERIFIED BY THE DESIGNER PRIOR TO MANUFACTURE. DESIGNER TO PROVIDE INSTALLATION PARTS DETAIL BASED ON EQUIPMENT SELECTION AND OEM RECOMMENDATIONS.
14. NINTH DIGIT DENOTES PRESSURE CODE. SELECT PRESSURE RANGE OF INSTRUMENT TO SUIT PROCESS.

DESIGNED	IACS SWC	17.08.21
DRAWN	S. ROSS SWC	17.08.21
VERIFIED	L. CRAMP SWC	17.08.21
APPROVED	D. FRUCI SWC	17.08.21

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
B	UPDATE NOTES AND PART NUMBERS	D.F.	17.08.21
A	ISSUED FOR USE	D.F.	12.08.21

Sydney WATER

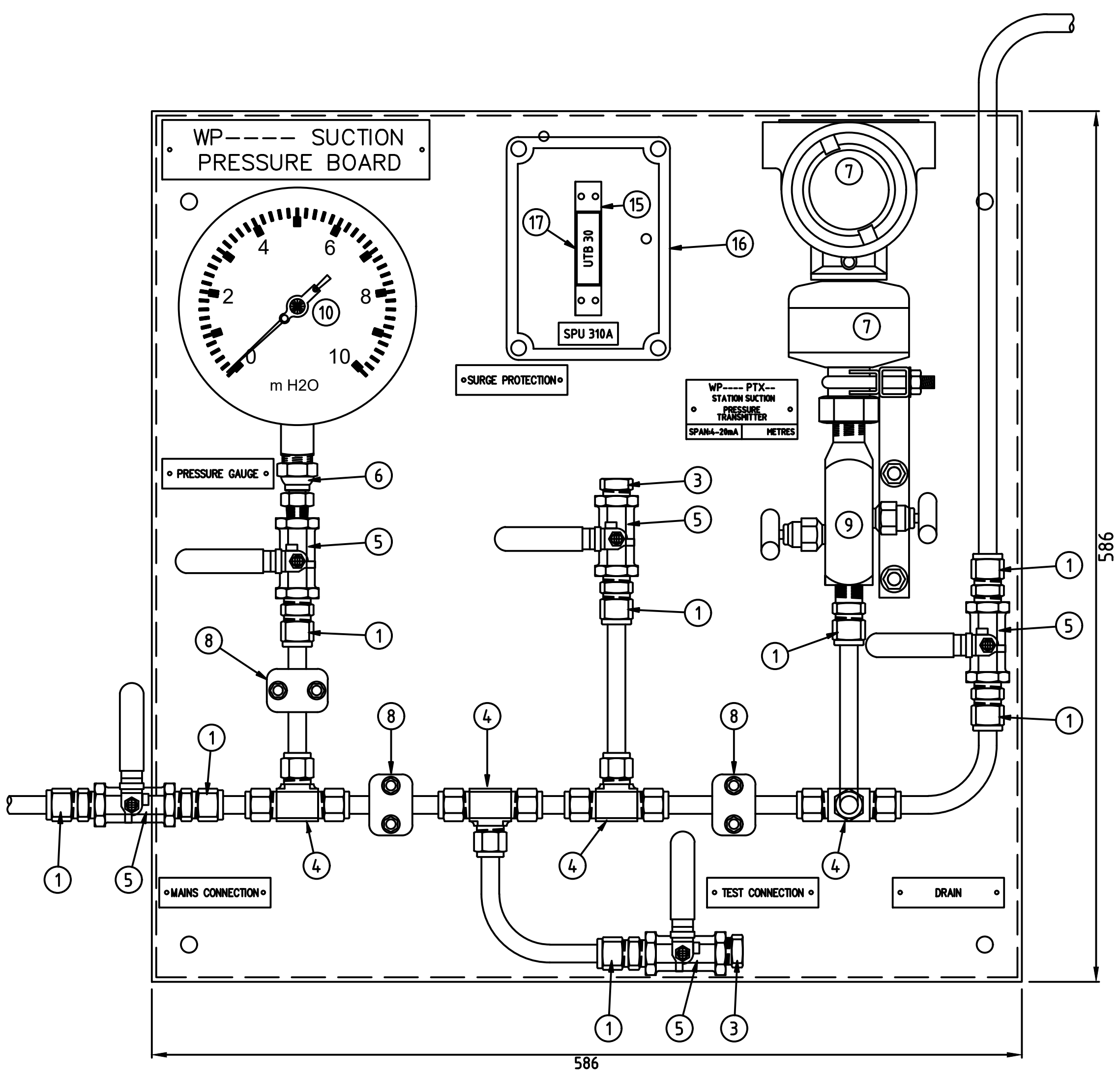
RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 17.08.21
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 17.08.21

INSTRUMENT AND CONTROL STANDARDS
PUMP DIFFERENTIAL PRESSURE BOARD
TYPICAL GENERAL LAYOUT

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD131
ISSUE B
SHEET No. 1

SWA1-EXT AUG 2016



ITEM	DESCRIPTION	MATERIAL / NOTE	QTY
1	12.7mm BSP MALE CONNECTOR	SEE NOTE 1	8
2	12.7mm BSP – 6.35mm BSP MALE CONNECTOR	SEE NOTE 1. FOR INSTRUMENT CONNECTIONS	
3	12.7mm BSP PLUG	SEE NOTE 1	2
4	12.7mm UNION TEE	SEE NOTE 1	4
5	12.7mm BALL VALVE	SEE NOTE 1	5
6	12.7mm SWIVEL GAUGE ADAPTER	SEE NOTE 1	1
7	LEVEL TRANSMITTER	ROSEMOUNT 3051S1TG(3)A2A11A1BB4DM5Q4Q8. NOTE 14	1
8	TUBE CLAMPS	SEE NOTE 6 AND NOTE 1	3 SETS
9	2 VALVE MANIFOLD	ROSEMOUNT 0306RT22BA11	1
10	PRESSURE GAUGE	270deg 160mm 316SS 12.7mm BSP GLYCERINE FILLED	1
11	STRUT CHANNEL 40mm x 40mm	SEE NOTE 8	1
12	BOARD MOUNTING HARDWARE	HS830S BOLT + E1007S BOLT	4 EA
13	TRANSMITTER MOUNTING HARDWARE	M8x30 SS BOLT + M8 SS NUT + WASHER	2 EA
14	LEVEL SWITCH MOUNTING HARDWARE	M5x40 SS SCREW + M5 SS NUT + WASHER	2 EA
15	SURGE PROTECTION UNIT	CRITEC UTB-30SP – SEE NOTE 16	
16	PVC ENCLOSURE	B&R PJ151115T – SEE NOTE 16	
17	DIN RAIL	TS35 – SEE NOTE 16	
18	12.7mm OD 0.5mm WT SEAMLESS TUBE	SEE NOTE 1	

SUCTION PRESSURE BOARD SPECIFIC LABELS

WP---- SUCTION PRESSURE BOARD (180 x 40)

MATERIAL: LAMINATED TRAFFOLYTE
COLOUR: BLACK – WHITE – BLACK
LETTERS: SIZE 10mm
No. OFF: 1
NOTE: REPLACE -- WITH FACILITY ID

WP---- PTX-- STATION SUCTION PRESSURE TRANSMITTER / SPAN:4-20mA / METRES (75 x 30, 10)

MATERIAL: LAMINATED TRAFFOLYTE
COLOUR: BLACK – WHITE – BLACK
LETTERS: SIZE 4mm
No. OFF: 1
NOTE: REPLACE -- WITH FACILITY ID AND ASSET ID

DELIVERY PRESSURE BOARD SPECIFIC LABELS

WP---- DELIVERY PRESSURE BOARD (180 x 40)

MATERIAL: LAMINATED TRAFFOLYTE
COLOUR: BLACK – WHITE – BLACK
LETTERS: SIZE 10mm
No. OFF: 1
NOTE: REPLACE -- WITH FACILITY ID

WP---- PTX-- STATION DELIVERY PRESSURE TRANSMITTER / SPAN:4-20mA / METRES (75 x 30, 10)

MATERIAL: LAMINATED TRAFFOLYTE
COLOUR: BLACK – WHITE – BLACK
LETTERS: SIZE 4mm
No. OFF: 1
NOTE: REPLACE -- WITH FACILITY ID AND ASSET ID

COMMON LABELS

TEST CONNECTION (75 x 20) | MAINS CONNECTION (75 x 20) | DRAIN (75 x 20) | PRESSURE GAUGE (75 x 20)

MATERIAL: LAMINATED TRAFFOLYTE
COLOUR: BLACK – WHITE – BLACK
LETTERS: SIZE 3.5mm
No. OFF: 1

SURGE PROTECTION (75 x 20)

MATERIAL: LAMINATED TRAFFOLYTE
COLOUR: BLACK – WHITE – BLACK
LETTERS: SIZE 3.5mm
No. OFF: 1
NOTE: SEE NOTE 16

NOTES:

1. ALL TUBE TO BE 12.7mm OD 316 STAINLESS STEEL 0.5mm WT SEAMLESS. ALL FITTINGS TO BE 12.7mm BSP 316 STAINLESS STEEL. ADAPTERS TO BE SIZED TO INSTRUMENTS.
2. CHARACTER LINE WIDTH IS 1/10 OF THE CHARACTER HEIGHT.
3. PRESSURE GAUGES MUST BE BOURDON TUBE 270 DEGREE DEFLECTION MECHANICAL TYPE. UNITS MUST BE METRES WATER (mH20). THE GUAGE DISPLAY MUST BE SUPPLIED BY THE MANUFACTURER, SCALED TO SUIT THE PROCESS, AND PROVIDE 80% DEFLECTION UNDER NORMAL CONDITIONS.
4. PRESSURE GAUGE MUST BE MECHANICALLY CALIBRATED AND REFERENCED TO SUCTION OF DELIVERY PIPE CENTRELINE.
5. SUCTION GAUGES MUST BE RANGED FROM 0m TO MAXIMUM SUCTION HEAD. DELIVERY GAUGES MUST BE RANGED FROM 0m TO MAXIMUM DISCHARGE HEAD.
6. CENTRE LINE OF PIPEWORK ON THE PRESSURE BOARD TO BE LOCATED TO SUIT INSTRUMENTS. PLASTIC PACKING TO BE PROVIDED AS REQUIRED. ASSEMBLY TO BE SECURELY FASTENED USING TUBE CLAMPS.
7. PRESSURE BOARD TO BE 3mm STAINLESS STEEL WITH 13mm RETURN ALL AROUND AND WELDED CORNERS.
8. PRESSURE BOARD TO BE MOUNTED ON STANDARD STRUT CHANNEL. EXACT LOCATION TO BE CONFIRMED ON SITE AND APPROVED BY SYDNEY WATER.
9. MAINS CONNECTIONS TO BE SITE RUN TO TAPPING POINTS. RODDING POINT TO BE PROVIDED..
10. ALL DRAIN/VENT LINE CONNECTIONS TO BE SITE RUN TO NEAREST FLOOR DRAIN.
11. MAIN AND DRAIN CONNECTIONS CAN BE REVERSED AS DETERMINED ON SITE.
12. INSTRUMENT CABLE TO RUN IN CONDUIT TO BACK OF PRESSURE BOARD, PASS THROUGH CABLE GLAND, AND TERMINATE AT INSTRUMENT.
14. NINTH DIGIT DENOTES PRESSURE CODE. SELECT PRESSURE RANGE OF INSTRUMENT TO SUIT PROCESS.
15. THIS DRAWING IS PROVIDED AS A TYPICAL SAMPLE ONLY. ALL DIMENSIONS ARE EXTERNAL FROM FOLDED EDGES. ALL MEASUREMENTS TO BE VERIFIED BY THE DESIGNER PRIOR TO MANUFACTURE. DESIGNER TO PROVIDE INSTALLATION PARTS DETAIL BASED ON EQUIPMENT SELECTION AND OEM RECOMMENDATIONS.
16. SURGE PROTECTION UNIT ONLY REQUIRED ON EXTERNAL PRESSURE BOARDS.
17. USE 1 SET OF SUCTION LABELS FOR STATION SUCTION BOARD. USE 1 SET OF DELIVERY LABELS FOR STATION DELIVERY BOARD. 1 SET OF COMMON LABELS REQUIRED FOR EACH BOARD.

DESIGNED IACS SWC 19.08.21					
DRAWN S. ROSS SWC 19.08.21					
VERIFIED L. CRAMP SWC 19.08.21					
APPROVED D. FRUCI SWC 19.08.21	A	ISSUED FOR USE	D.F.	19.08.21
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

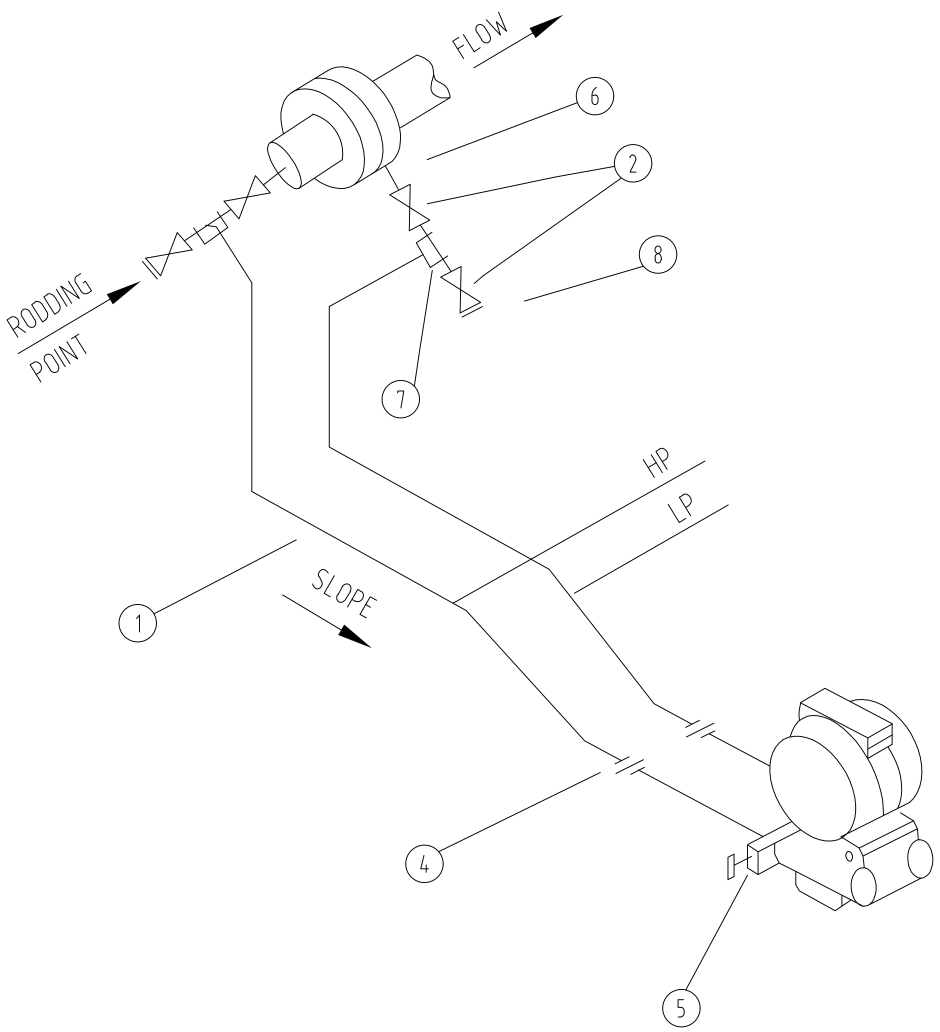
Sydney WATER

RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 19.08.21
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 19.08.21

INSTRUMENT AND CONTROL STANDARDS SUCTION OR DELIVERY PRESSURE BOARD TYPICAL GENERAL LAYOUT

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD / SSD132
ISSUE A SHEET No. 1



BILL OF MATERIALS		
ITEM No.	SIZE	DESCRIPTION
1	12.7mm	LINE PIPE
2	12.7mm	ISOLATION VALVE
4	12.7mm	UNION
5	1/2" BSP	5 VALVE MANIFOLD
6	100mm LONG	NIPPLE
7	12.7mm	FULL BORE EQUAL
8	12.7mm	PLUG

NOTES :

1.- IMPULSE LINES SHOULD NOT FALL LESS THAN 1:10
2.- IMPULSE LINES SHALL RUN AS CLOSE TOGETHER AS IS MECHANICALLY POSSIBLE
3.- ISOLATION VALVES MAY BE INSTALLED IN A STAGGERED PATTERN TO ALLOW FOR (2) ABOVE
4.- ALL IMPULSE PIPEWORK TO BE LAGGED AGAINST AMBIENT CONDITONS
5.- INSTALLATION CONTRACTOR SHALL DETERMINE THE REQUIRED QUANTITY OF MATERIALS FOR EACH INSTRUMENT
6.- MATERIALS SHALL BE SS316
7.- FLANGE TAPS -- WHERE THESE CANNOT BE ACCOMMODATED PIPE TAP OR CARRIER RINGS TO BS 1042 MAY BE USED
8.- IF INSTRUMENT IS REMOTE (>15 METRES) FROM PROCESS TAPPING POINT. A SECOND ISOLATION VALVE SHOULD BE INSTALLED ADJACENT TO INSTRUMENT
9.- TRANSMITTER MAY BE MOUNTED ABOVE LINE IN ACCORDANCE WITH BS1042
10.- WHERE TRANSMITTERS ARE INSTALLED IN PARALLEL WITH EXISTING SUCTION AND DELIVERY PRESSURE INSTRUMENTS CONNECT INTO EXISTING IMPULSE LINES USING COMPRESSION FITTING TEES & SIMILAR MATERIALS TO THE EXISTING IMPULSE LINE PIPEWORK (FOR RETROFITS ONLY)

DESIGNED L. C SWC	02.02.99		
DRAWN A.JONES SWC	24.08.23		
VERIFIED S. ROSS SWC	24.08.23		
APPROVED D. FRUCI SWC	24.08.23		

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
G	LAYERS AMENDED TO CURRENT CAD STANDARD	D.F	24.08.23
F	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
E	CHANGE TO SS MATERIAL AND RETROFIT NOTE ADDED.	D.F	24.08.11
D	ISSUED FOR USE. PREVIOUS CHANGES NOT RECORDED.		02.02.99

Sydney WATER

THIS DRAWING SUPERSEDES ---

RECOMMENDED 24.08.23 S. ROSS PROJECT ENGINEER SYDNEY WATER

ACCEPTED 24.08.23 D. FRUCI IACS MANAGER SYDNEY WATER

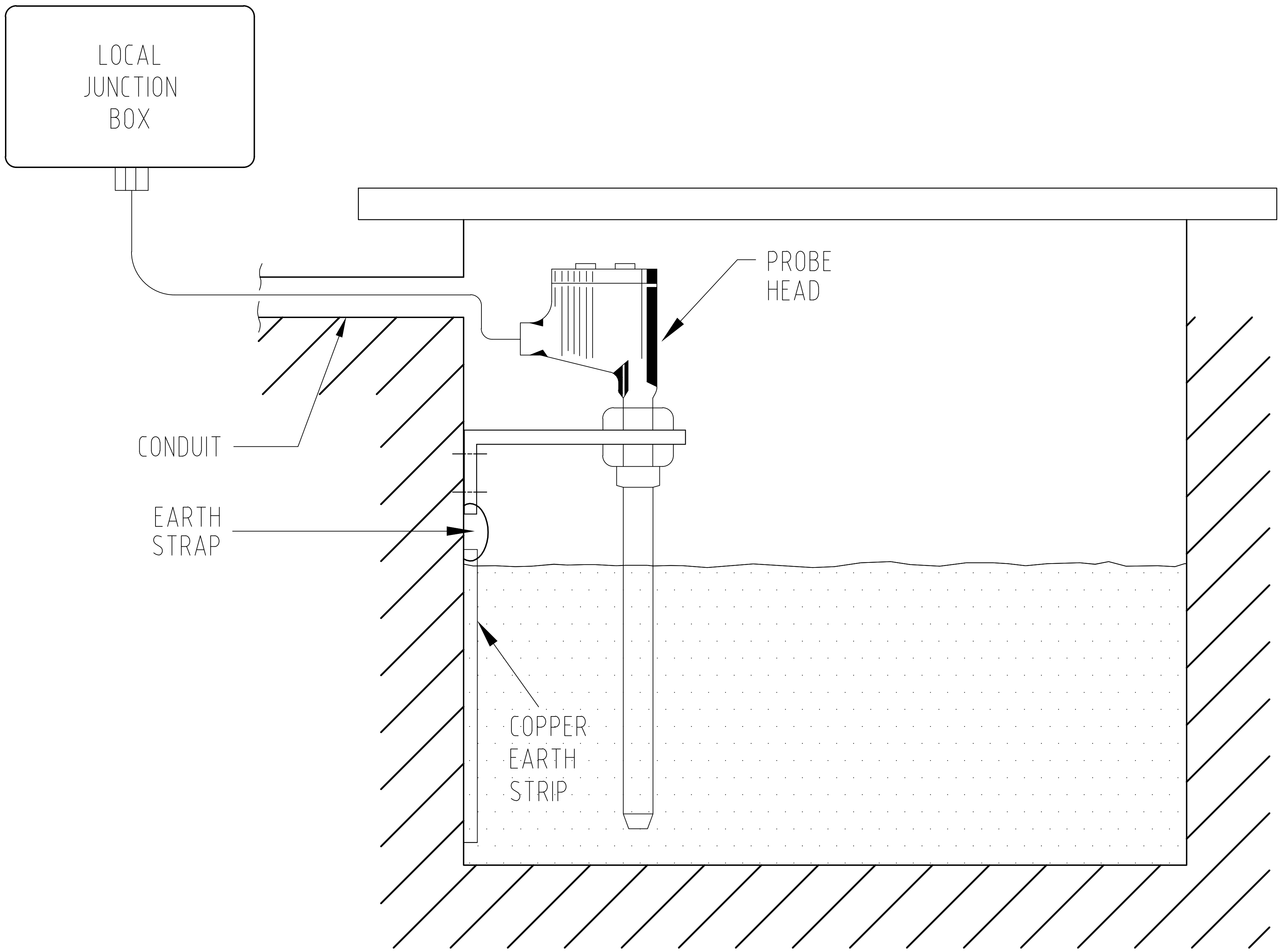
INSTRUMENT AND CONTROL STANDARDS TYPICAL DIFFERENTIAL PRESSURE TRANSMITTER ARRANGEMENT

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD207

ISSUE G SHEET No. 1

SWA1-EXT AUG 2014



NOTES

1. WHERE POSSIBLE THE PROBE SHALL BE SUPPLIED WITH ADEQUATE LENGTH OF INTEGRAL CABLE TO REACH CUBICLE TERMINATIONS. ie NO EXTERNAL JUNCTION BOX SHALL BE USED.
2. WHERE EXTERNAL JUNCTION BOXES ARE USED THEY SHALL BE IP65 COMPLETE WITH TERMINAL STRIP AND LABELING.
3. ALL METAL FIXTURES SHALL BE 316 S/S.

DESIGNED	L. C SWC	18.01.99
DRAWN	A.JONES SWC	30.08.23
VERIFIED	S. ROSS SWC	30.08.23
APPROVED	D. FRUCI SWC	30.08.23

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
C	LAYERS AMENDED TO CURRENT CAD STANDARD	D.F	30.08.23
B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
A	ISSUED FOR USE.		18.01.99

Sydney WATER

THIS DRAWING SUPERSEDES ---

RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 30.08.23

ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 30.08.23

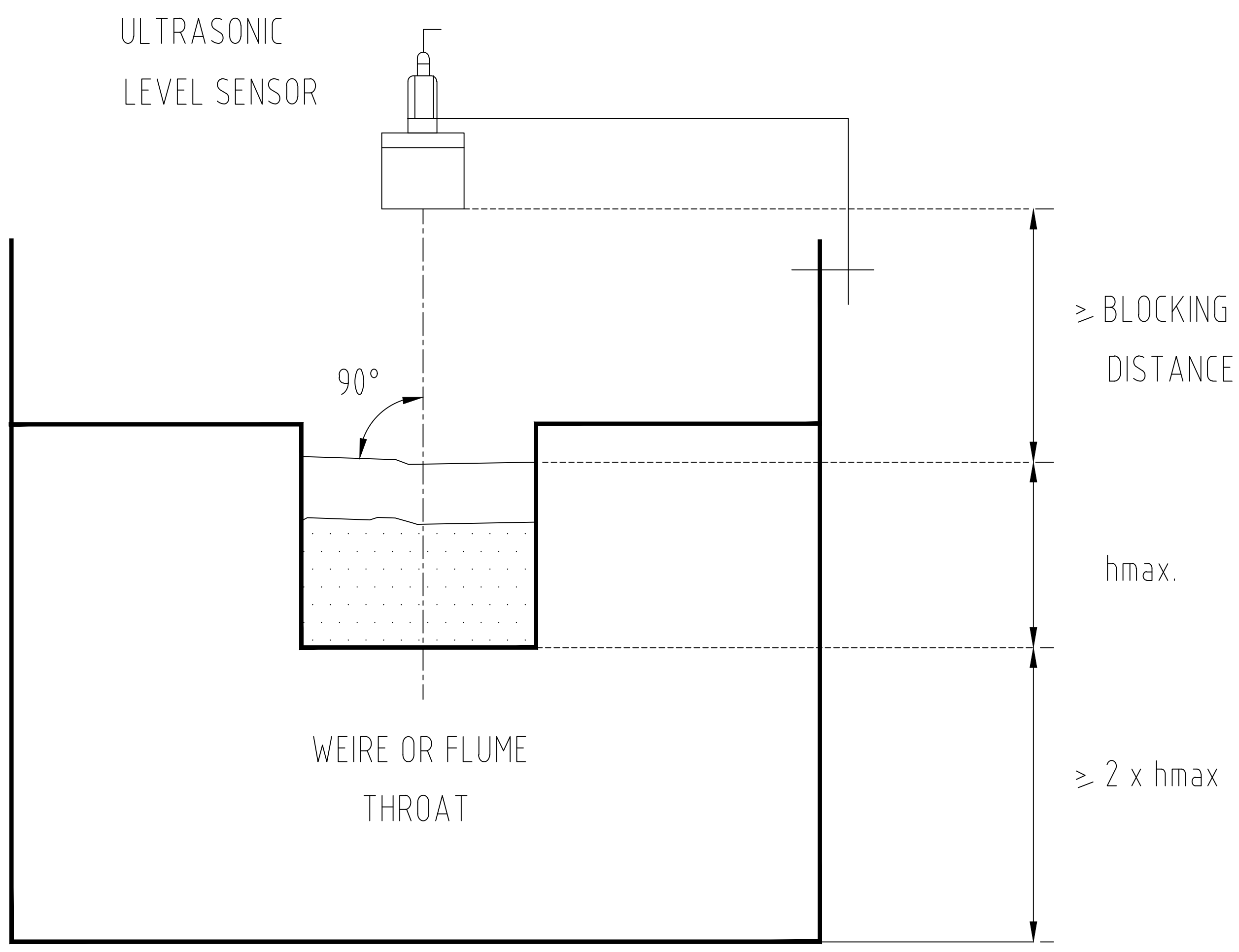
INSTRUMENT AND CONTROL STANDARDS
TYPICAL RF ADMITTANCE
LEVEL PROBE INSTALLATION

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD211

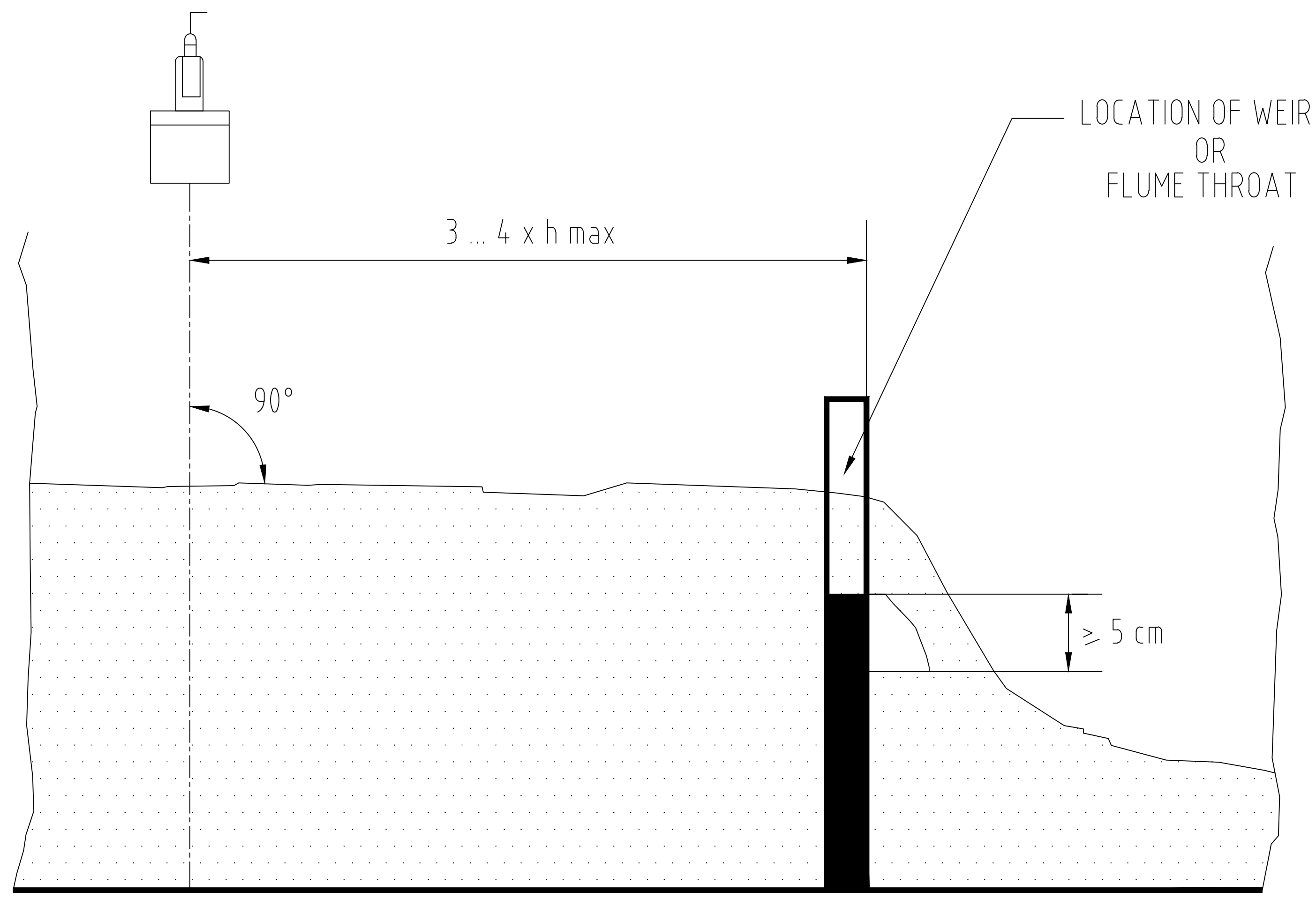
ISSUE C SHEET No. 1

END VIEW OF OPEN CHANNEL



hmax = max water level

LONGITUDINAL SECTION OF OPEN CHANNEL



DESIGNED L. C SWC 19.01.99				
DRAWN A.JONES SWC 7.09.23				
VERIFIED S. ROSS SWC 7.09.23	C	LAYERS AMENDED TO CURRENT CAD STANDARD	D.F	7.09.23
	B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
APPROVED D. FRUCI SWC 7.09.23	A	ISSUED FOR USE.		19.01.99
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES ---

RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 7.09.23

ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 7.09.23

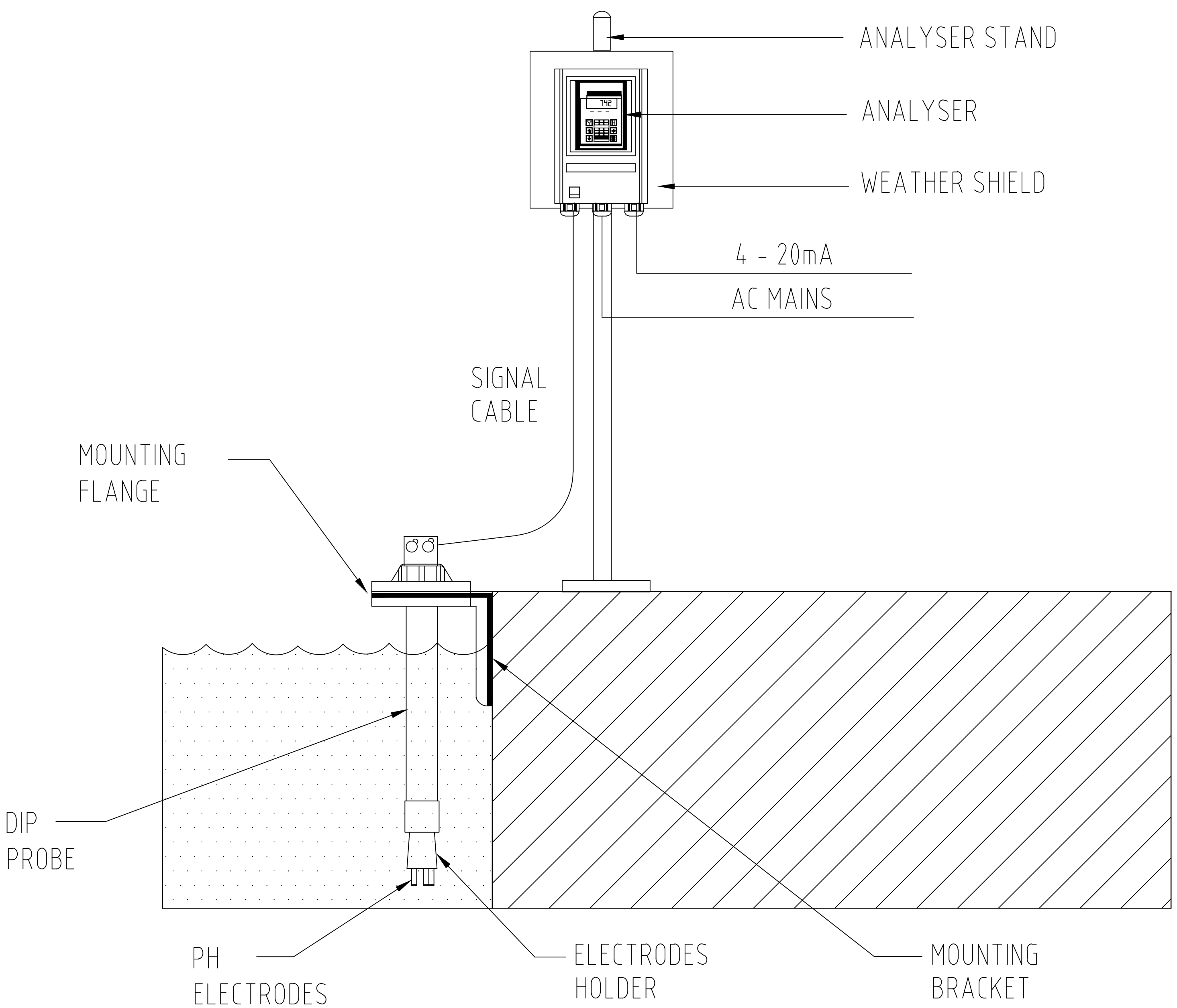
INSTRUMENT AND CONTROL STANDARDS
TYPICAL OPEN CHANNEL
FLOW MEASUREMENT INSTALLATION

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

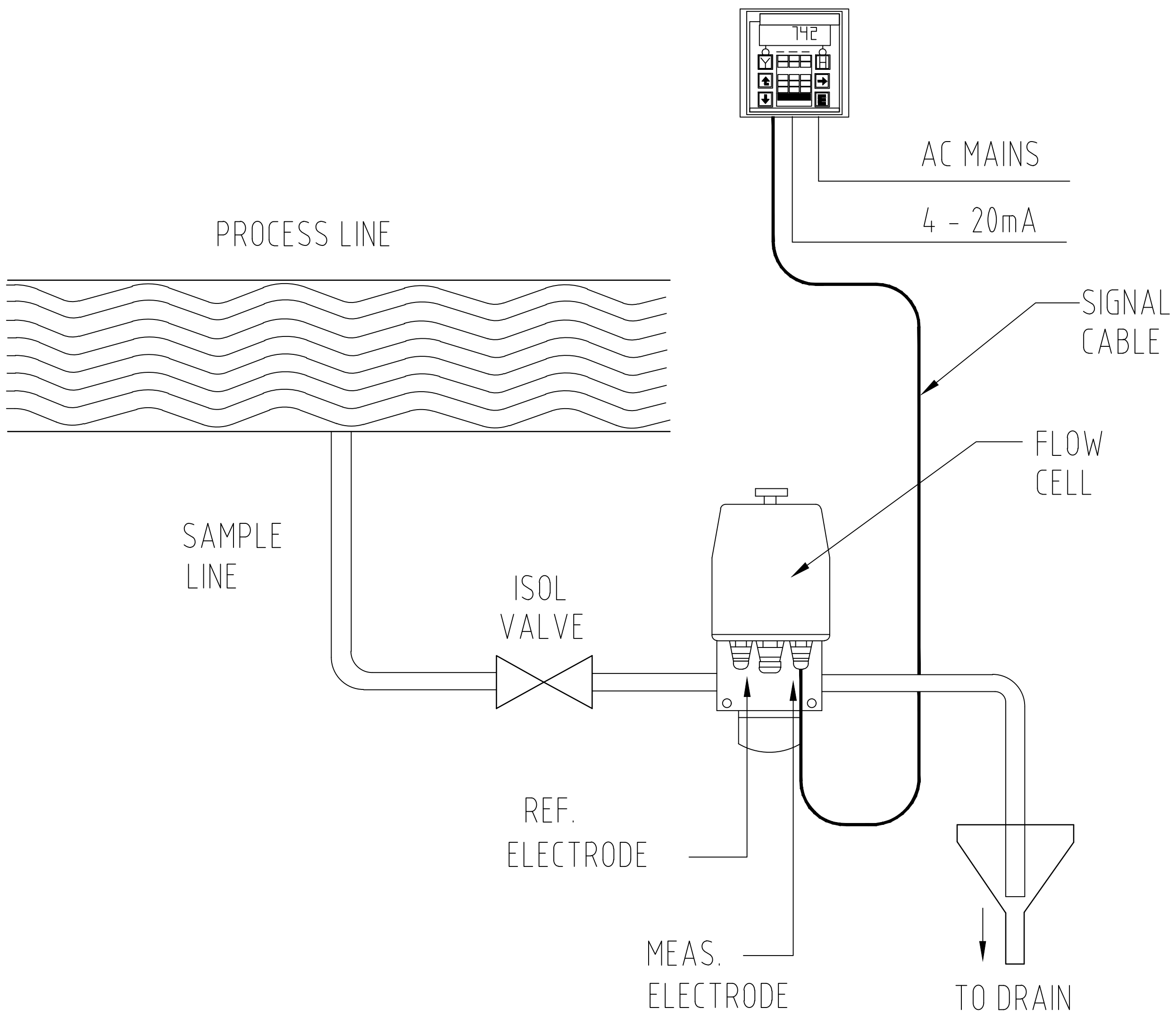
DRAWING No. SSD / SSD214

ISSUE C SHEET No. 1

DIP PROBE ARRANGEMENT



FLOW THROUGH CELL ARRANGEMENT



DESIGNED L. C SWC 19.01.99			
DRAWN A.JONES SWC 7.09.23			
VERIFIED S. ROSS SWC 7.09.23	C	LAYERS AMENDED TO CURRENT CAD STANDARD	D.F 7.09.23
	B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F 27.11.20
APPROVED D. FRUCI SWC 7.09.23	A	ISSUED FOR USE.	19.01.99
	LETTER	DETAILS OF AMENDMENT	APP'D DATE

Sydney WATER

THIS DRAWING SUPERSEDES ---

RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 7.09.23

ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 7.09.23

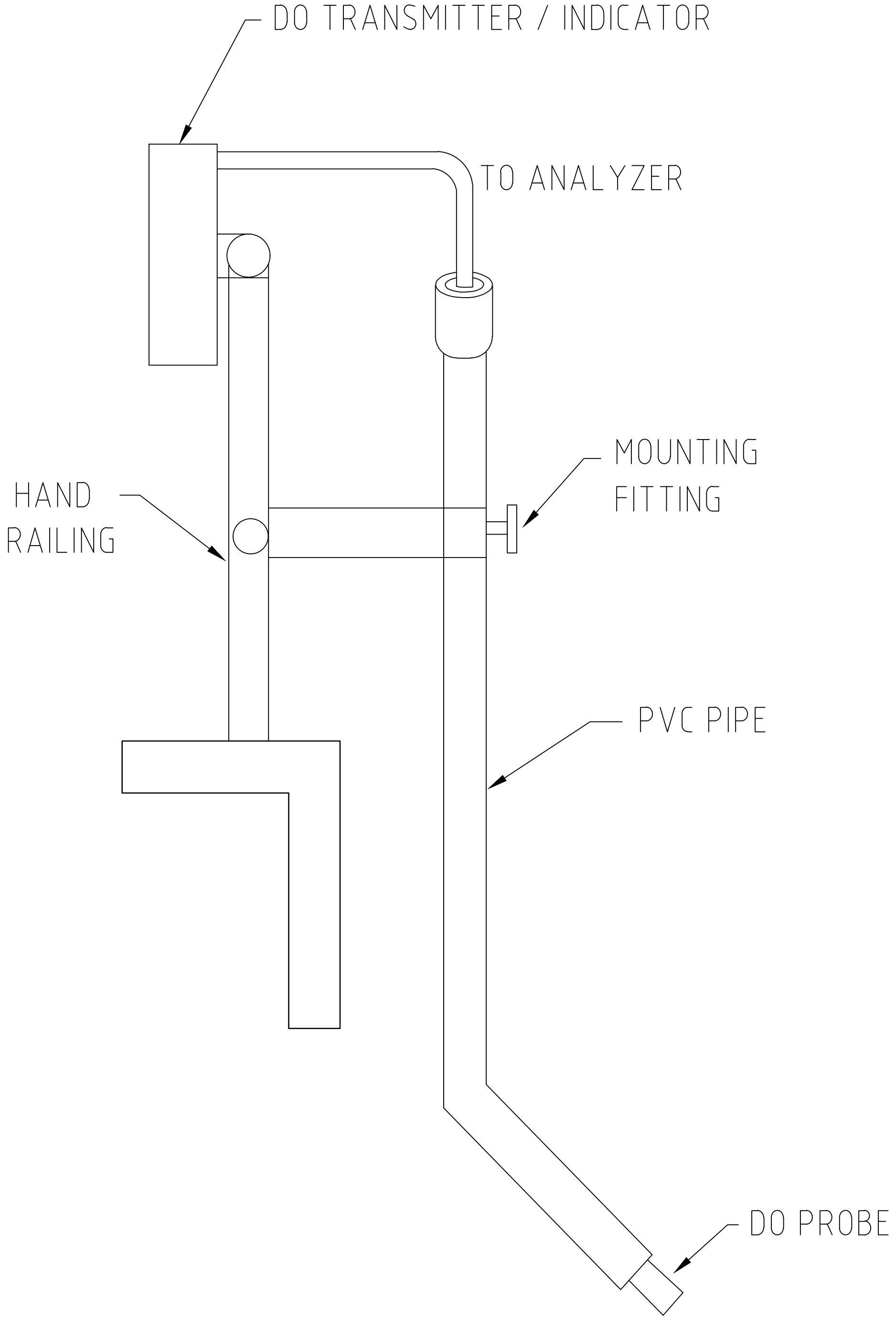
INSTRUMENT AND CONTROL STANDARDS
TYPICAL PH / ORP
PROBE INSTALLATION

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

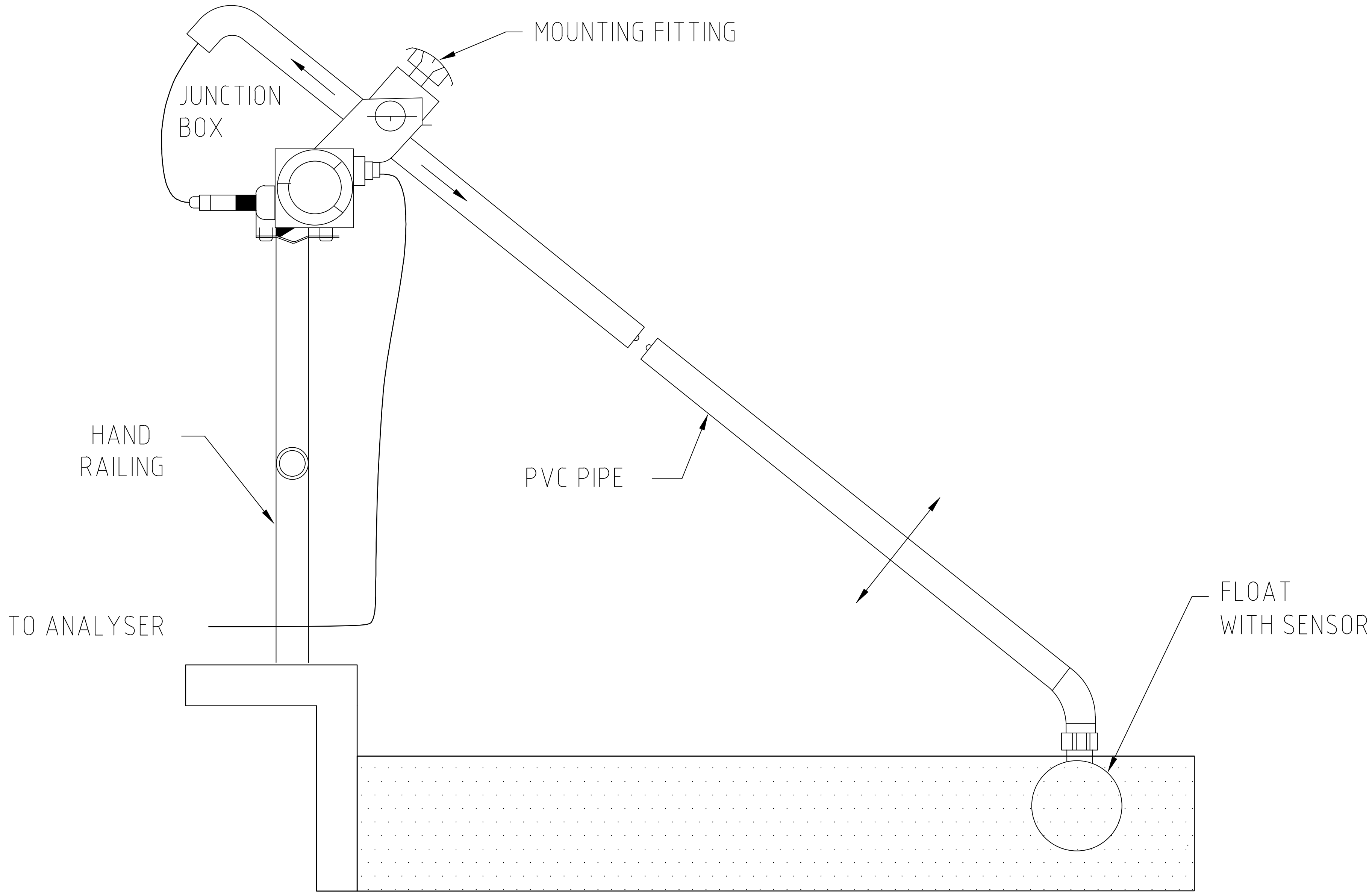
DRAWING No. SSD SSD215

ISSUE C SHEET No. 1

DIP PROBE ARRANGEMENT



FLOATING BALL ARRANGEMENT



DESIGNED	L. C SWC	20.01.99	
DRAWN	A.JONES SWC	7.09.23	
VERIFIED	S. ROSS SWC	7.09.23	
APPROVED	D. FRUCI SWC	7.09.23	

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
C	LAYERS AMENDED TO CURRENT CAD STANDARD	D.F	7.09.23
B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
A	ISSUED FOR USE.		20.01.99

Sydney WATER

THIS DRAWING SUPERSEDES ---

RECOMMENDED S. ROSS PROJECT ENGINEER SYDNEY WATER 7.09.23

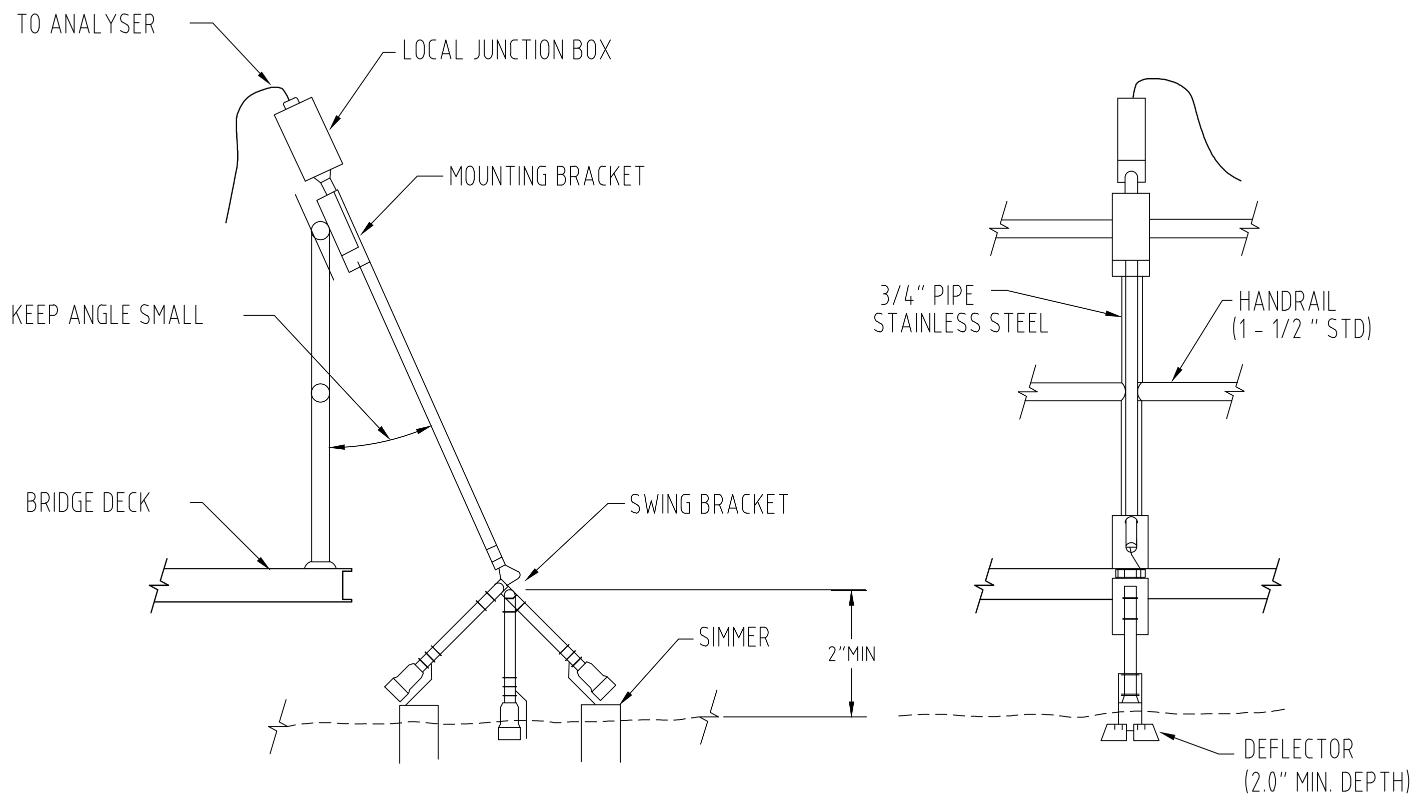
ACCEPTED D. FRUCI IACS MANAGER SYDNEY WATER 7.09.23

INSTRUMENT AND CONTROL STANDARDS
TYPICAL DO PROBE
INSTALLATION

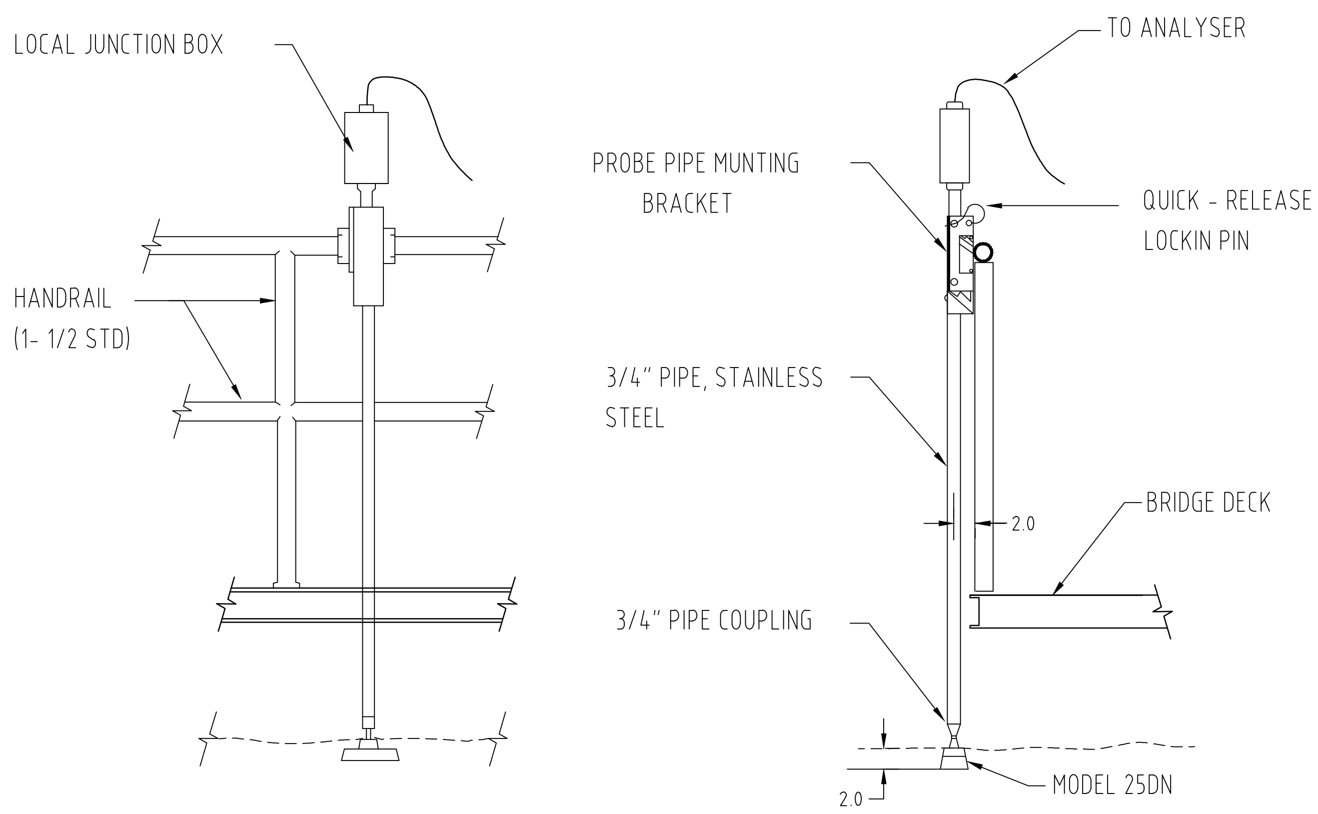
A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD216

ISSUE C SHEET No. 1



SWING-OUT BRACKET ARRANGEMENT
FOR FIXED BRIDGE WITH
SEPARATE SKIMMER



FIXED BRACKET ARRANGEMENT
FOR ROTATING BRIDGE WITH
SKIMMER BLADES

DESIGNED L. C SWC 20.01.99				
DRAWN A.JONES SWC 7.09.23				
VERIFIED S. ROSS SWC 7.09.23	C	LAYERS AMENDED TO CURRENT CAD STANDARD	D.F	7.09.23
	B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
APPROVED D. FRUCI SWC 7.09.23	A	ISSUED FOR USE.		20.01.99
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED 7.09.23
S. ROSS
PROJECT ENGINEER
SYDNEY WATER

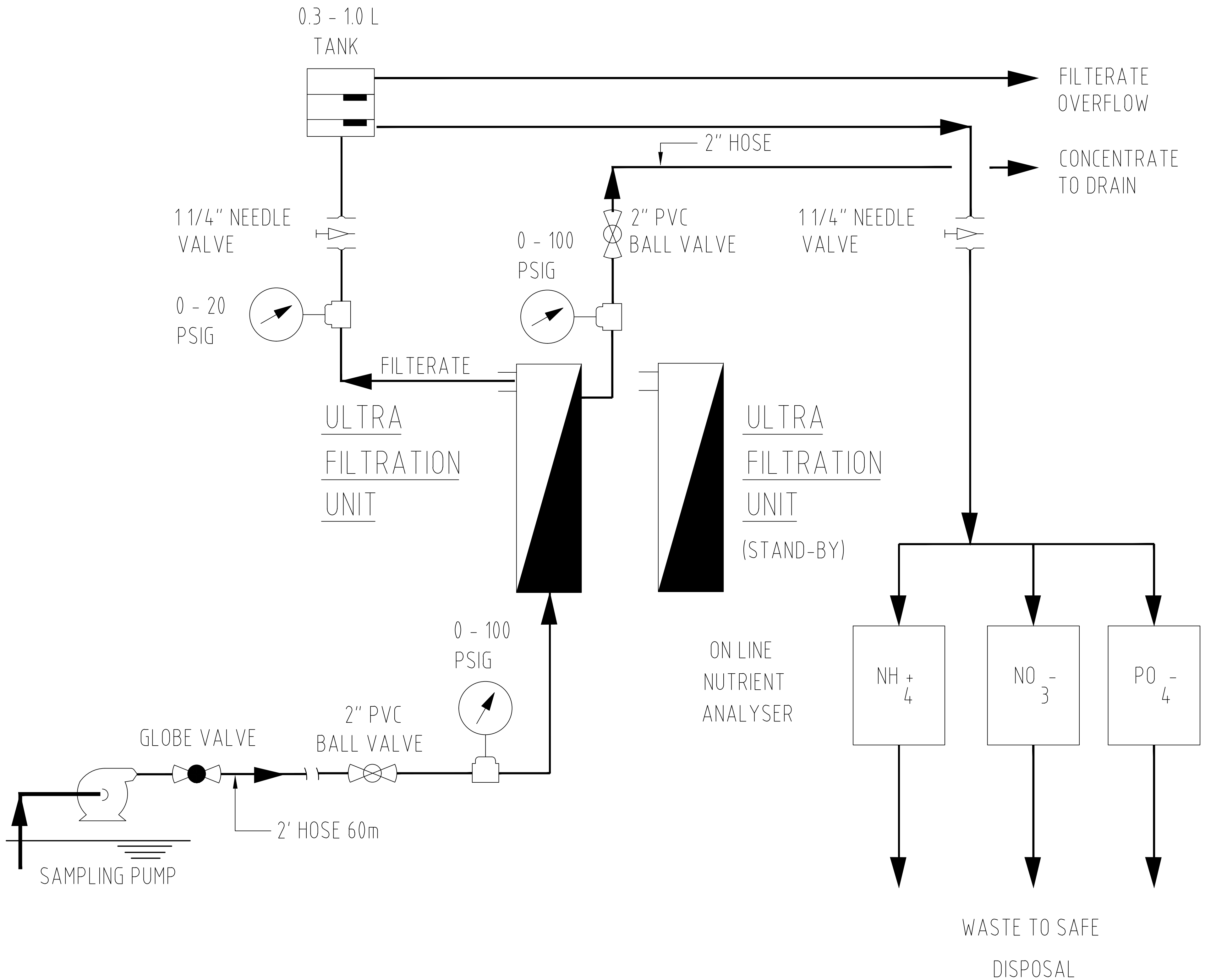
ACCEPTED 7.09.23
D. FRUCI
IACS MANAGER
SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL SLUDGE BLANKET
MONITORING PROBE INSTALLATION

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD / SSD217

ISSUE C | SHEET No. 1



DESIGNED L. C SWC 18.01.99				
DRAWN A.JONES SWC 8.09.23				
VERIFIED S. ROSS SWC 8.09.23	C	LAYERS AMENDED TO CURRENT CAD STANDARD	D.F	7.09.23
	B	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	27.11.20
APPROVED D. FRUCI SWC 8.09.23	A	ISSUED FOR USE.		18.01.99
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES ---

RECOMMENDED 8.09.23 S. ROSS PROJECT ENGINEER SYDNEY WATER

ACCEPTED 8.09.23 D. FRUCI IACS MANAGER SYDNEY WATER

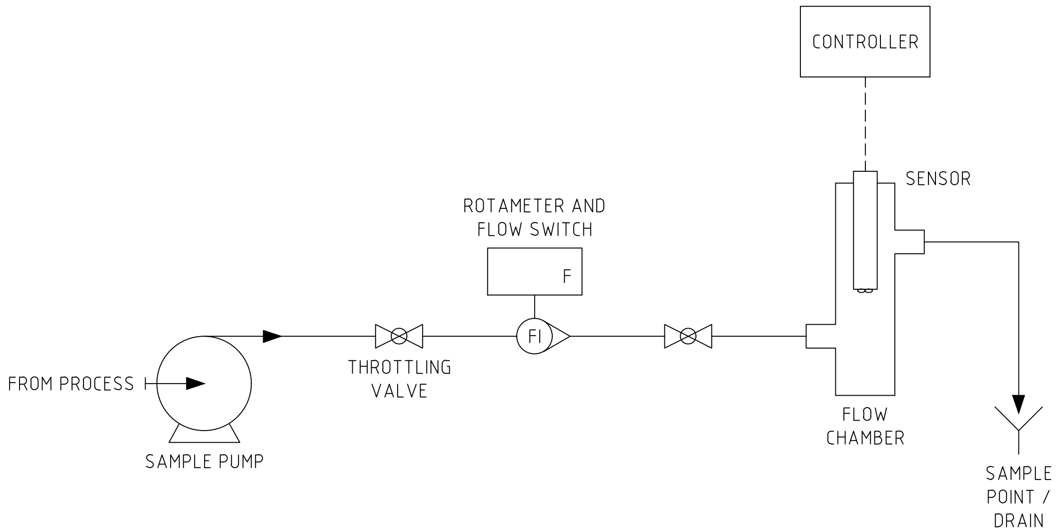
INSTRUMENT AND CONTROL STANDARDS TYPICAL SCHEMATIC FOR NUTRIENT ANALYSER SAMPLING SYSTEM

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD / SSD218

ISSUE C | SHEET No. 1

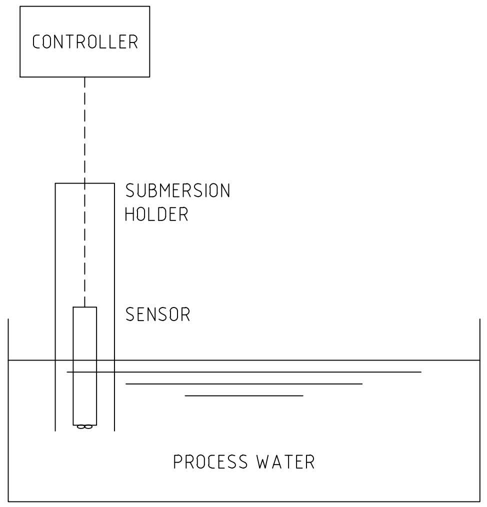
FLOW-THROUGH HOLDER INSTALLATION



NOTES:

1. MOUNT THE SENSOR ON THE SIDES OF VERTICAL PIPE RUNS, TO ENSURE DRAINING WHEN THE LINE IS NOT UNDER PRESSURE AND MINIMISE AIR BUBBLES.
2. THERE MUST BE A MEANS OF DETECTING A STOP IN PROCESS FLOW (EG. FLOW SWITCH).

SUBMERSION HOLDER INSTALLATION



NOTES:

1. INSTALLATION SHOULD BE MOUNTED TO ADDITIONAL SUPPORT FRAME (DESIGN SUPPLIED BY SYDNEY WATER) AND NOT MOUNTED ON EXISTING HANDRAILS.
2. VENDORS TO PROVIDE INSTALLATION ANGLES AND DISTANCES FROM MOUNTING SURFACE, BASE OF TANK, SIDE WALLS, SUBMERSIBLE DEPTH, DIFFUSION HEADS OR ANY OTHER SURFACE THAT MAY CAUSE INTERFERENCE EG FLOW, INCONSISTENT BUBBLES, RAGGING OR FOULING.
3. QUICK RELEASE OF SENSOR. LOCK TO SUPPORT FRAME OF CHAIN AND/OR TUBING TO ENABLE STABILISATION DURING MAINTENANCE.

DESIGNED	P.LINGAT	5.03.2021
DRAWN	A.JONES	2.05.2023
VERIFIED	S.ROSS	2.05.2023
APPROVED	D.FRUCI	2.05.2023

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	2.05.23

Sydney WATER

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RECOMMENDED S.ROSS 2.05.2023 SYDNEY WATER

ACCEPTED D.FRUCI 2.05.2023 CLIENT SYDNEY WATER

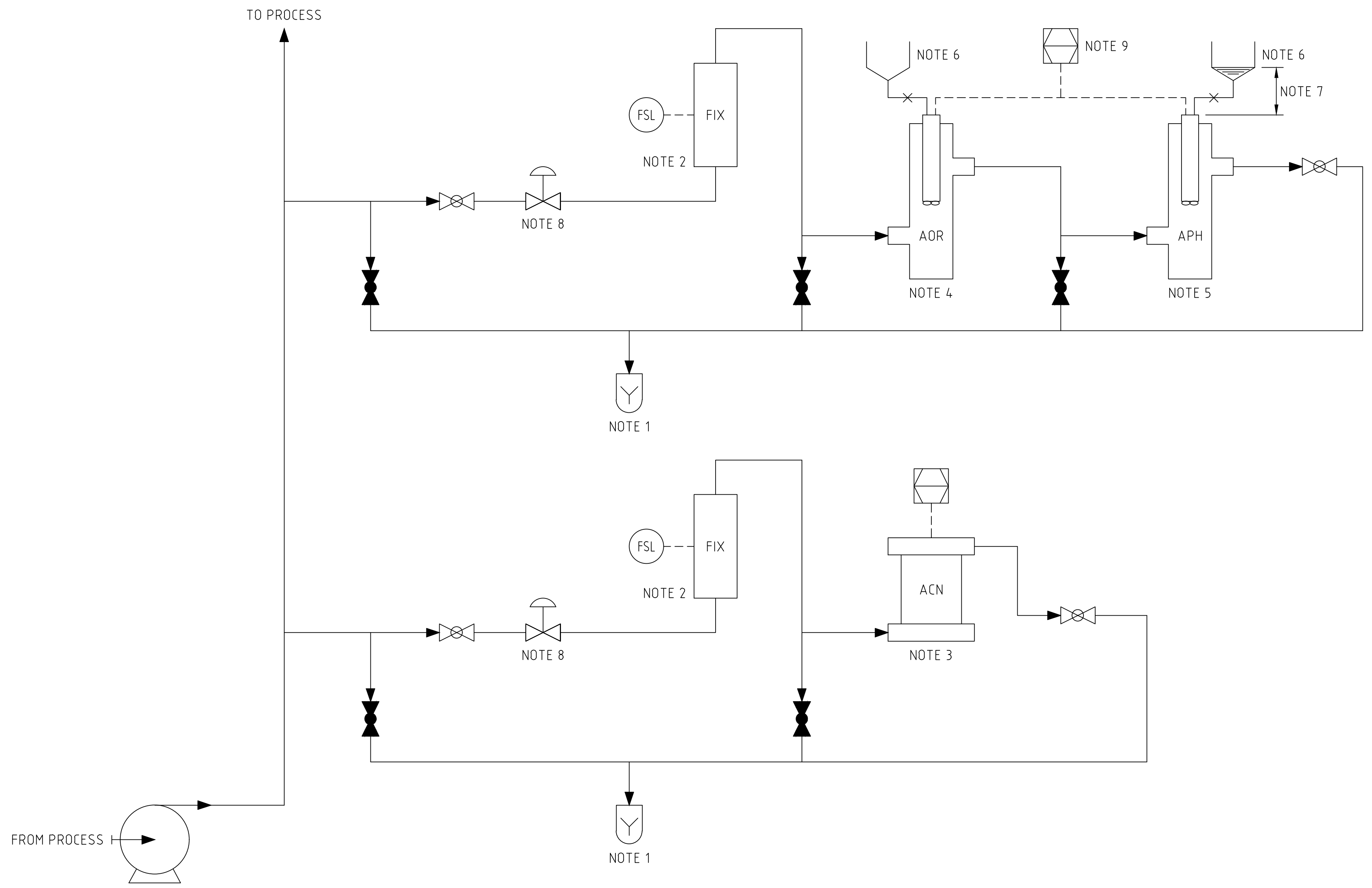
INSTRUMENT AND CONTROL STANDARDS
TYPICAL CONDUCTIVITY
INSTRUMENT INSTALLATION

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD / SSD219

ISSUE A SHEET No. 1

NOTES:
1. TO DRAIN, ACCESSIBLE FOR GRAB SAMPLING.
2. FIELD FLOW INDICATOR E.G. ROTAMETER.
3. CONDUCTIVITY ANALYSER, FLOW-THROUGH TOROIDAL TYPE.
4. ORP ANALYSER, FLOW-THROUGH TYPE.
5. pH ANALYSER, FLOW-THROUGH TYPE.
6. POTASSIUM CHLORIDE (KCl) RESERVOIR FOR CONTINUOUS ELECTROLYTE SUPPLY TO ORP AND pH PROBE.
7. MINIMUM 200 MM HEAD FOR ELECTROLYTE RESERVOIR.
8. DIAPHRAGM TYPE THROTTLING VALVE.
9. DUAL OUTPUT CONTROLLER FOR ORP AND pH PROBES.



DESIGNED C.RAYNOR 5.03.2021				
DRAWN A.JONES 2.05.2023				
VERIFIED S.ROSS 2.05.2023				
APPROVED D.FRUCI 2.05.2023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	2.05.23
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED S.ROSS 2.05.2023 SYDNEY WATER

ACCEPTED D.FRUCI 2.05.2023 CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL PH/ORP/CONDUCTIVITY
INSTRUMENT INSTALLATION
WET RACK

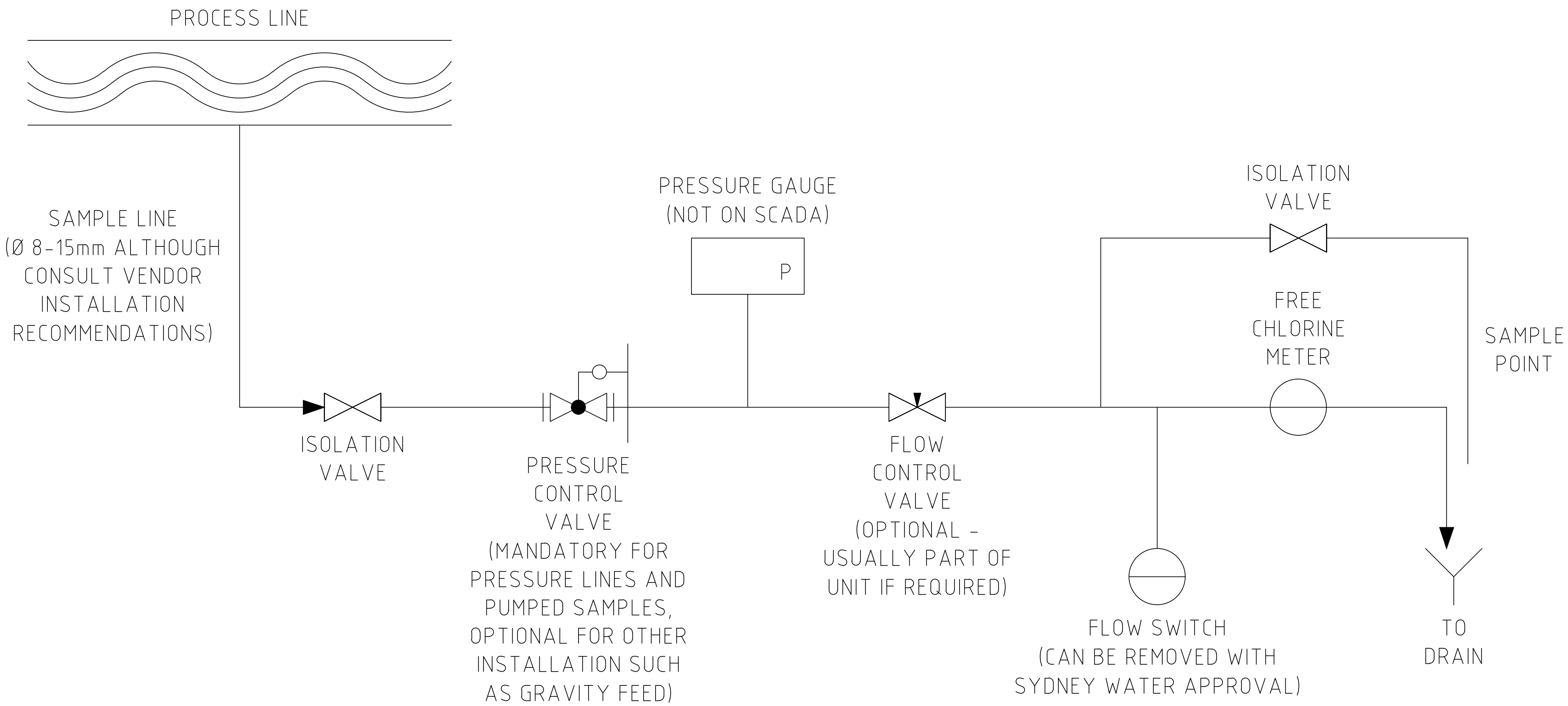
A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD / SSD220

ISSUE A SHEET No. 1

SWA1-EXT AUG 2014

MEASURING TECHNIQUE: AMPEROMETRIC



DESIGNED B.WRIGHT 5.03.2021				
DRAWN A.JONES 30.05.2023				
VERIFIED S.ROSS 30.05.2023				
APPROVED D.FRUCI 30.05.2023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	30.05.23
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED S.ROSS 30.05.2023 SYDNEY WATER

ACCEPTED D.FRUCI 30.05.2023 CLIENT SYDNEY WATER

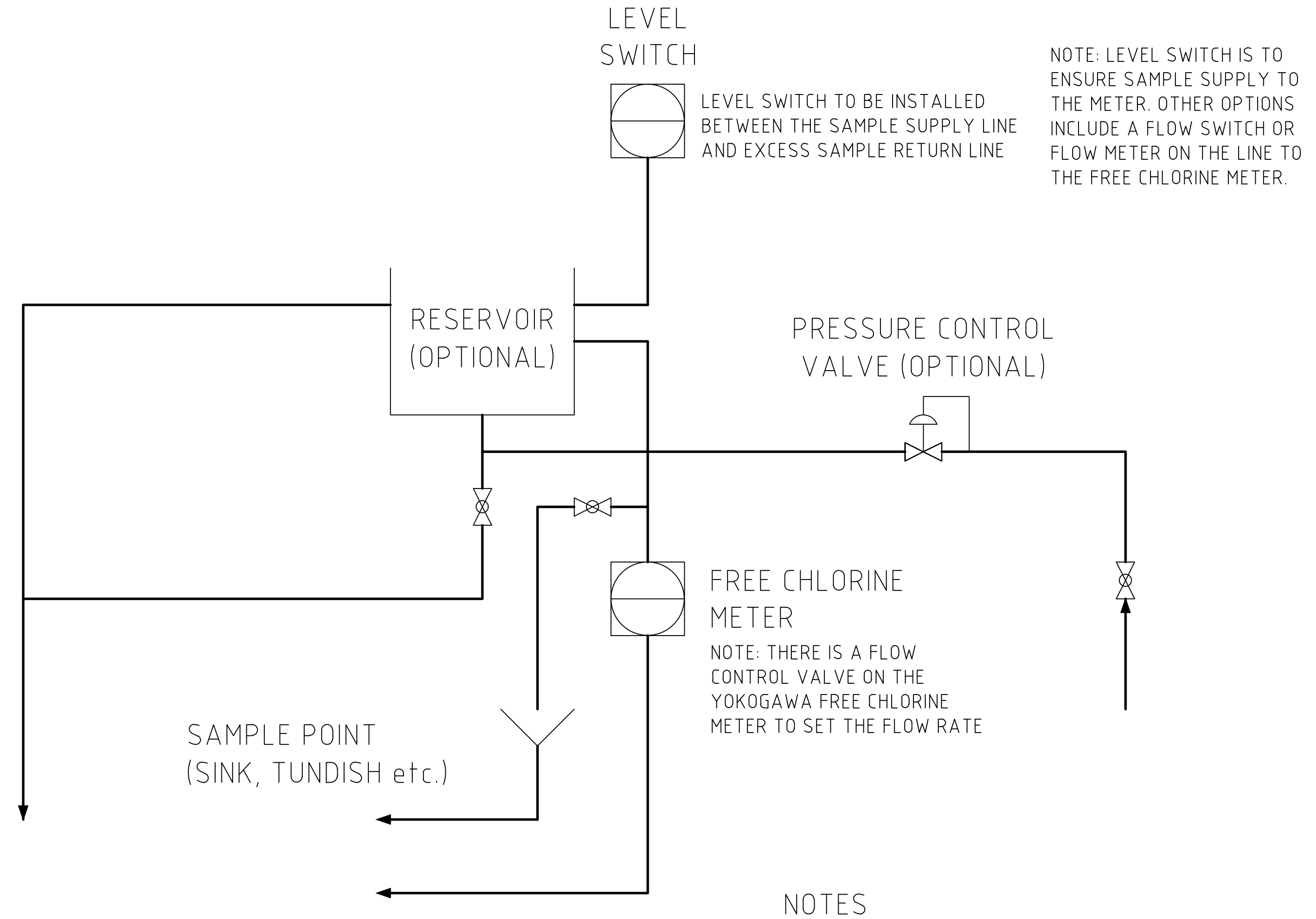
INSTRUMENT AND CONTROL STANDARDS
TYPICAL FREE/TOTAL CHLORINE
INSTRUMENT INSTALLATION
AMPEROMETRIC

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD / SSD221

ISSUE A | SHEET No. 1

MEASURING TECHNIQUE: POTENTIOMETRIC



NOTES

1. BALANCE TANK MUST BE ABOVE THE FREE CHLORINE METER. THE AIM IS TO PROVIDE A RELATIVELY CONSTANT HEAD PRESSURE SO THERE IS CONSTANT FLOW. HAVING A SMALL DIFFERENCE IN SAMPLE AND EXCESS SAMPLE LINE WILL ALLOW FINER CONTROL OF THE FLOW RATE.
2. DEPENDING ON THE SETUP A PRESSURE CONTROL VALVE MAY BE REQUIRED ON THE INLET.
3. CONSIDERATION SHOULD BE GIVEN TO WHERE SAMPLES CAN BE RETURNED TO. FOR SOME FREE CHLORINE MEASUREMENTS THIS SHOULD NOT BE TO THE PROCESS.
4. IF USING A GRAVITY SUPPLY THEN FLOW SHOULD BE INTO THE TOP OF THE TANK.
5. TOTAL FLOW TO THE RESERVIOR SHOULD ENSURE THAT SOME EXCESS SAMPLE OVERFLOWS TO THE OVERFLOW LINE.
6. SAMPLE RESIDENCE TIME IN THE RESERVOIR SHOULD BE LOW TO MINIMISE LOSS OF FREE CHLORINE RESIDUAL.

DESIGNED B.WRIGHT 5.03.2021	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F 16.06.23
DRAWN A.JONES 16.06.2023	LETTER	DETAILS OF AMENDMENT	APP'D DATE
VERIFIED S.ROSS 16.06.2023			
APPROVED D.FRUCI 16.06.2023			

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED S.ROSS 16.06.2023 SYDNEY WATER

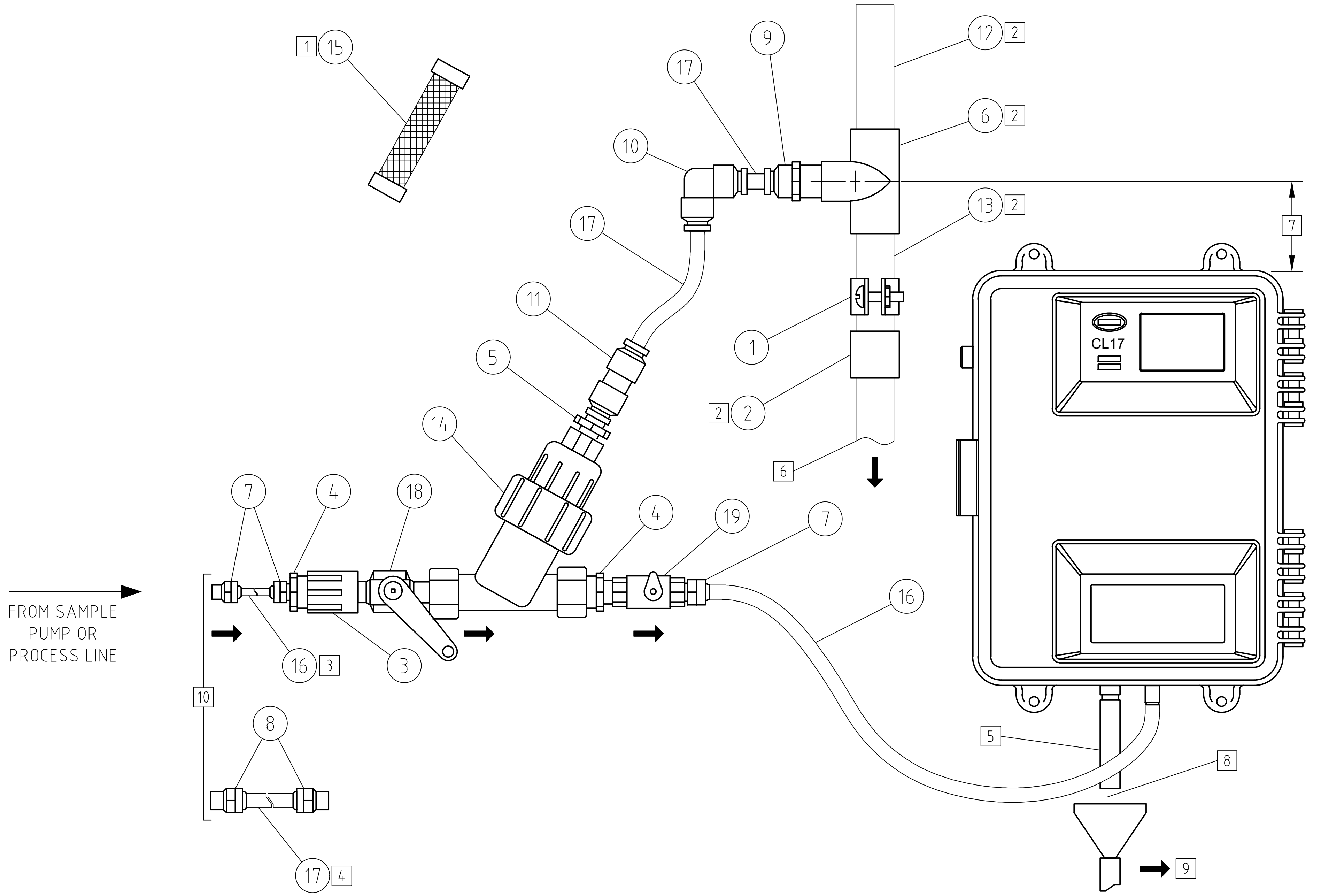
ACCEPTED D.FRUCI 16.06.2023 CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL FREE/TOTAL CHLORINE
INSTRUMENT INSTALLATION
POTENTIOMETRIC

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD222

ISSUE A SHEET No. 1



MEASURING TECHNIQUE: COLORIMETRIC

TABLE 1 SAMPLE CONDITIONING PARTS LIST

ITEM	DESCRIPTION	QTY	CATALOG NUMBER
1	CLAMP, CONDUIT HANGER, 1-INCH	4	4734900
2	COUPLING, 1-INCH, SCH 40, PVC PIPE	1	5417500
3	COUPLING, 1/2-INCH FPT x 1/2 FPT PVC	1	5417600
4	FITTING, REDUCE BUSHING, PVC, HEX	2	2300200
5	FITTING, STEM ADAPTOR, 1/2-INCH O.D., 1/4 NPT	1	5418000
6	FITTING,TEE, 1-INCH x 1-INCH	1	4662200
7	FITTING, TUBE, CONNECTOR, MALE (1/4-INCH TUBING)	3	5124600
8	FITTING, TUBE, CONNECTOR, MALE (1/2-INCH TUBING)	2	5126200
9	FITTING, TUBE, 1/2-INCH O.D. x 1/2-INCH MALE NPT	1	5417800
10	FITTING, TUBE, 1/2-INCH O.D. UNION ELBOW	1	5417900
11	FITTING, TUBE, 1/2-INCH O.D. UNION STRAIGHT	1	5418100
12	PIPE, PRE-CUT DRAIN, 1-INCH DIAMETER, PVC	1	5123900
13	PIPE, DRAIN, CLEAR	1	5417400
14	STRAINER, Y-BODY	1	5418300
	FILTER, 40-MESH SCREEN (PROVIDED WITH STRAINER AND IN MAINTENANCE KIT)	1	5418400
15	PTFE THREAD TAPE, 1/4-INCH WIDE	1	7060824
16	TUBING, POLYETHYLENE, 0.250 O.D., 0.040 W, BLACK	15 feet	3061600
17	TUBING, POLYETHYLENE, 0.500 O.D., 0.062 W, BLACK	10 feet	5115900
18	VALVE, BALL, PVC, 1/2 NPT, PVC	1	5417700
19	VALVE, BALL, PVC, 1/4 NPT, PVC	1	5139500

TABLE 2 SAMPLE CONDITION KIT PARTS LIST NOTES

1	THE FILTER ELEMENT IS FACTORY INSTALLED. A SPARE FILTER IS PROVIDED IN THE MAINTENANCE KIT.
2	USE PVC PIPE CEMENT TO ASSEMBLE. LEAVE PIPE OPEN TO THE ATMOSPHERE.
3	THIS IS THE "LOW FLOW" OPTION.
4	THIS IS THE "HIGH FLOW" OPTION.
5	THE 1/2 INCH DRAIN TUBE MUST HAVE AN AIR-BREAK. (MUST BE SUPPLIED BY THE CUSTOMER)
6	USE THE UNFILTERED SAMPLE BYPASS TO RETURN TO SYSTEM UNDER ZERO PRESSURE, IF POSSIBLE, OR TO DRAIN. USE CUSTOMER SUPPLIED PVC PIPE AS REQUIRED TO RUN TO DRAIN LOCATION.
7	INSTALL THE SAMPLE FLOW REGULATOR (CONSTANT HEAD DEVICE) 24 INCHES ABOVE THE INSTRUMENT.
8	AIR GAP
9	DRAIN
10	USE EITHER 7 AND 16 OR 8 AND 17.

DESIGNED J.BUDGEN 10.03.2021					
DRAWN A.JONES 10.08.2023					
VERIFIED S.ROSS 10.08.2023					
APPROVED D.FRUCI 10.08.2023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	10.08.23	
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE	

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED S.ROSS SYDNEY WATER 10.08.2023

ACCEPTED D.FRUCI CLIENT SYDNEY WATER 10.08.2023

INSTRUMENT AND CONTROL STANDARDS
TYPICAL FREE/TOTAL CHLORINE
INSTRUMENT INSTALLATION
COLORIMETRIC

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD223

ISSUE A | SHEET No. 1

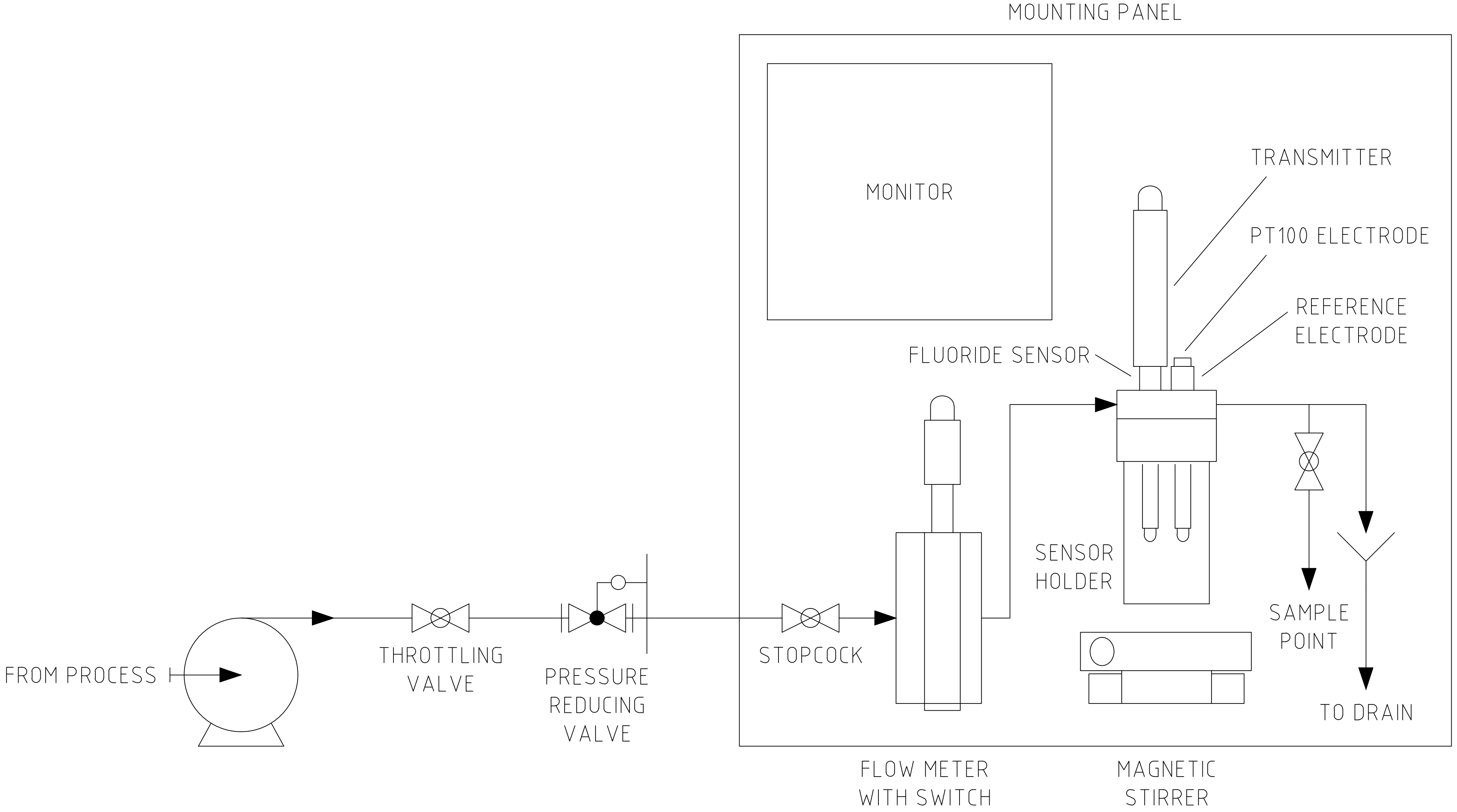
SWA1-EXT AUG 2014

ONLINE FLUORIDE METER

GENERAL INSTALLATION INSTRUCTIONS:

1. ENSURE THAT THE FLOW METER IS INSTALLED VERTICALLY TO PREVENT THE FLOAT FROM BECOMING WEDGED INSIDE THE FLOW METER.
2. THE PRESSURE REDUCING VALVE LIMITS THE PRESSURE OF THE SAMPLE WATER TO MAX. 1 BAR. IF NOT USED, THE MAXIMUM OPERATING PRESSURE OF THE IN-LINE PROBE HOUSING WILL BE EXCEEDED.

FLOW-THROUGH HOLDER INSTALLATION



DESIGNED C.RAYNOR 5.03.2021				
DRAWN A.JONES 1.06.2023				
VERIFIED S.ROSS 1.06.2023				
APPROVED D.FRUCI 1.06.2023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	1.06.23
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED S.ROSS 1.06.2023 SYDNEY WATER

ACCEPTED D.FRUCI 1.06.2023 CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL FLUORIDE
INSTRUMENT INSTALLATION
FLOW THROUGH HOLDER

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD224

ISSUE A | SHEET No. 1

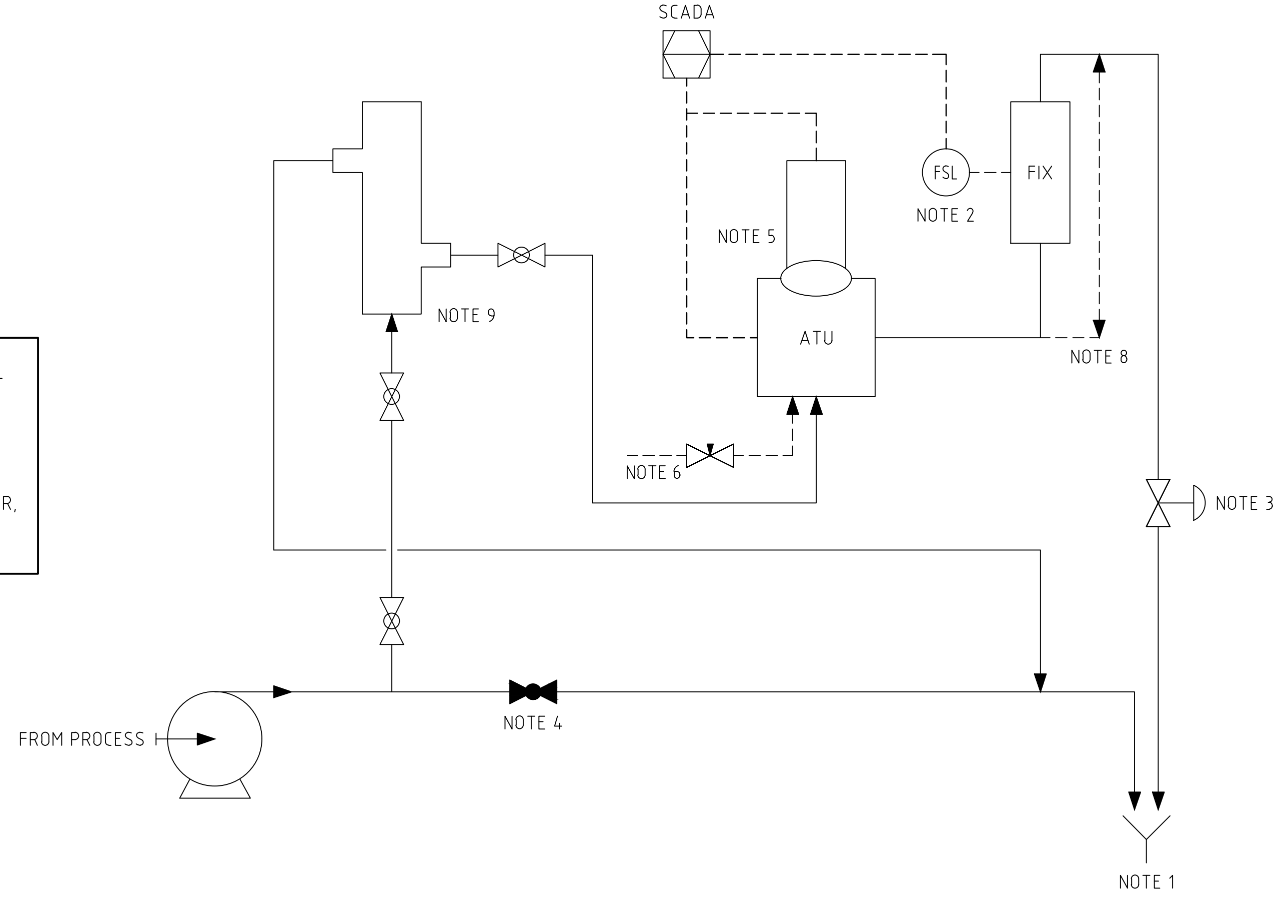
SWA1-EXT AUG 2014

NOTES:
1. TO DRAIN, ACCESSIBLE FOR GRAB SAMPLING.
2. OPTIONAL FIELD FLOW INDICATOR E.G. ROTAMETER.
3. DIAPHRAGM TYPE THROTTLING VALVE.
4. BYPASS VALVE FOR ONLINE MAINTENANCE IF PUMP FEEDING MULTIPLE INSTRUMENTS.
5. AUTOMATED CLEANING MODULE.
6. OPTIONAL AIR SUPPLY FOR CLEANING.
7. FREE-FALL TYPE ANALYSER PREFERRED FOR NON-CONTACT APPLICATIONS.
8. MINIMUM 400mm HEAD FROM METER OUTLET.
9. OPTIONAL DE-AERATOR/BUBBLE TRAP WITH OVERFLOW.

TURBIDITY ANALYSER - CONTACT
TYPE STANDARD P&ID

DRAWN 19/01/2021

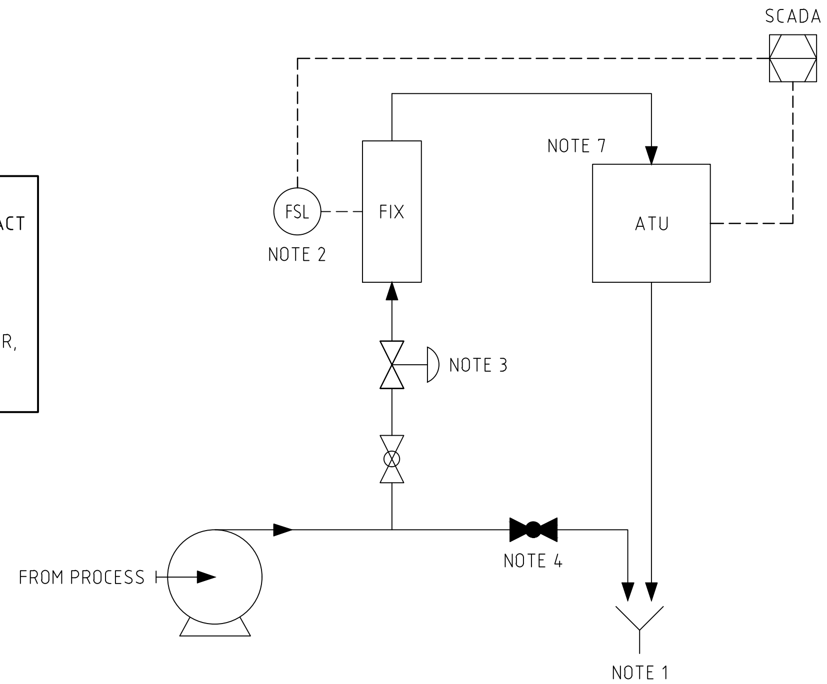
CHRIS RAYNOR - PROCESS ENGINEER,
WATER RECOVERED RESOURCES



TURBIDITY ANALYSER - NON-CONTACT
TYPE STANDARD P&ID

DRAWN 19/01/2021

CHRIS RAYNOR - PROCESS ENGINEER,
WATER RECOVERED RESOURCES



DESIGNED C.RAYNOR 19.01.2021				
DRAWN A.JONES 1.06.2023				
VERIFIED S.ROSS 1.06.2023				
APPROVED D.FRUCI 1.06.2023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	1.06.23
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

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RECOMMENDED S.ROSS 1.06.2023 SYDNEY WATER

ACCEPTED D.FRUCI 1.06.2023 CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL TURBIDITY
INSTRUMENT INSTALLATION
CONTACT AND NON-CONTACT

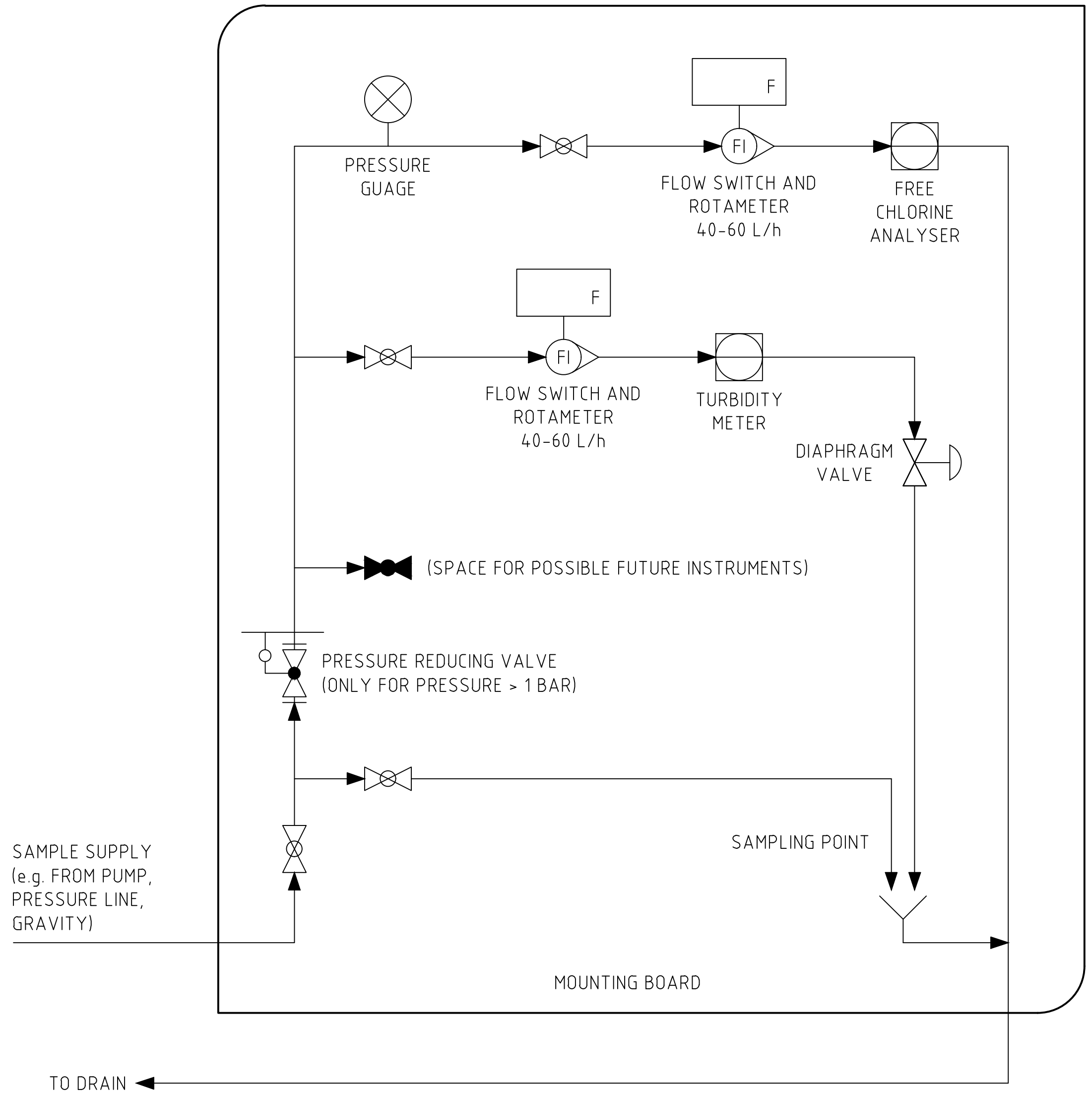
A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD / SSD225

ISSUE A SHEET No. 1

NOTES:
1. FOR PRESSURES > 1 BAR, A PRESSURE REDUCING VALVE IS REQUIRED ON THE INLET.
2. INSTRUMENT PANEL NEEDS TO BE INSTALLED IN AN ENCLOSED AREA. IT MAY ALSO NEED TO BE PLACED INSIDE A CABINET, DEPENDING ON THE LOCATION AND WEATHER CONDITIONS.
3. ADDITIONAL LINE IS INCLUDED ON THE PANEL FOR POSSIBLE FUTURE INSTRUMENTS SUCH AS pH METERS (PIPEWORK, VALVE AND SPACE).

WATER QUALITY MONITORING INSTRUMENT PANEL



DESIGNED P.LINGAT 5.03.2021					COPYRIGHT	
DRAWN A.JONES 1.06.2023					THIS DESIGN IS NOT TO BE COPIED OR AMENDED WITHOUT WRITTEN PERMISSION FROM SYDNEY WATER	Sydney WATER
VERIFIED S.ROSS 1.06.2023						
APPROVED D.FRUCI 1.06.2023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	1.06.23		
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE		

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RECOMMENDED S.ROSS 1.06.2023 SYDNEY WATER

ACCEPTED D.FRUCI 1.06.2023 CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL WATER QUALITY MONITORING PANEL
TREATMENT PLANTS

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

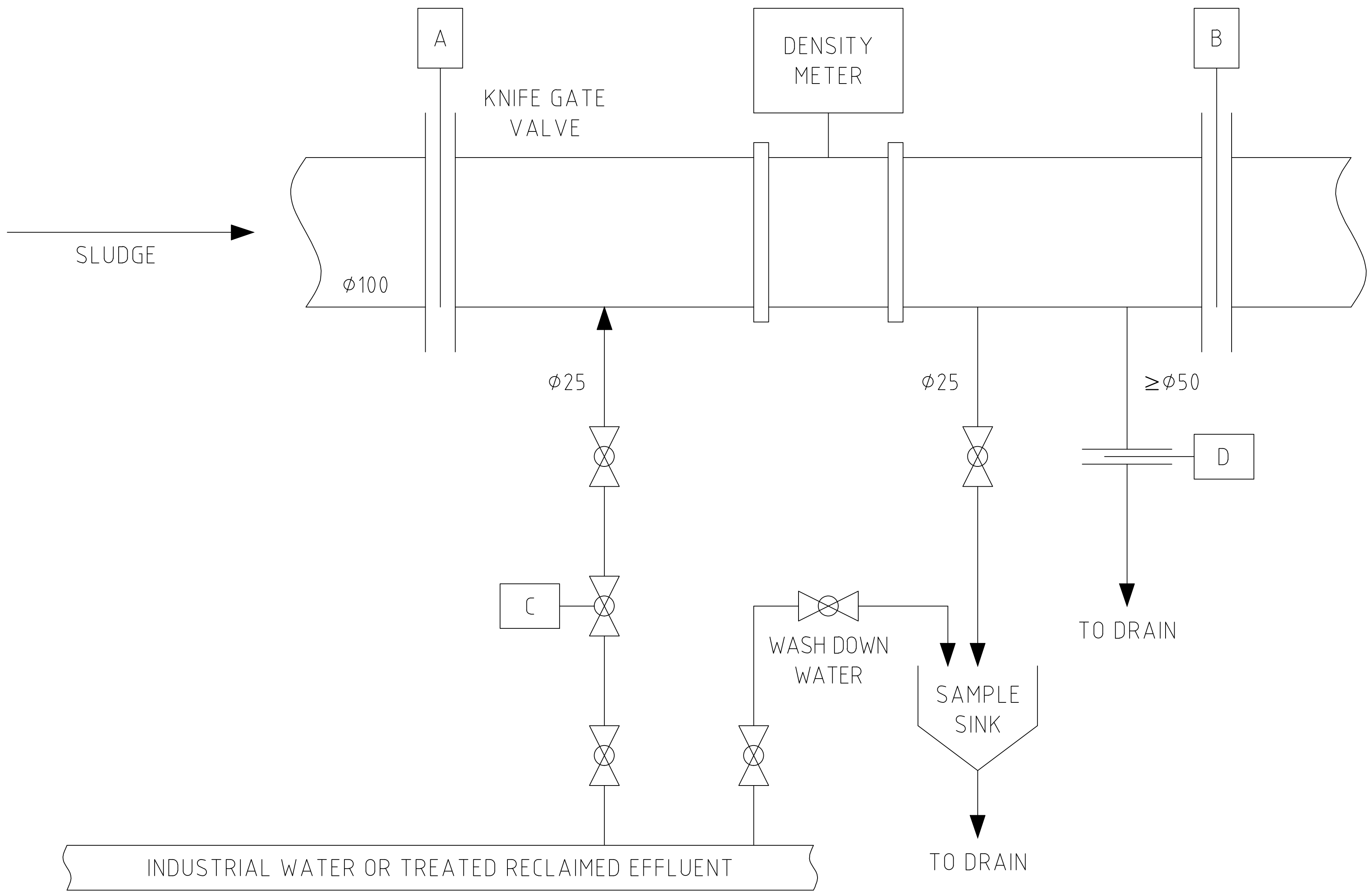
DRAWING No. SSD / SSD226

ISSUE A | SHEET No. 1

SWA1-EXT AUG 2014

NOTES
1. A, B, C, D ARE SCADA CONTROLLED VALVES.
2. DRAIN VALVE (D) MUST BE AS CLOSE AS POSSIBLETO THE PROCESS LINE (<40mm) TO AVOID BUILD UP IN DRAIN LINE.

MICROWAVE TECHNOLOGY
- FOR RAW SLUDGE AND ANAEROBIC
DIGESTED SLUDGE ONLY



DESIGNED J.BUDGEN 12.03.2021				
DRAWN A.JONES 2.06.2023				
VERIFIED S.ROSS 2.06.2023				
APPROVED D.FRUCI 2.06.2023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	2.06.23
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED S.ROSS 2.06.2023 SYDNEY WATER

ACCEPTED D.FRUCI 2.06.2023 CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL SUSPENDED SOLIDS SLUDGE DENSITY
INSTRUMENT INSTALLATION
MICROWAVE

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

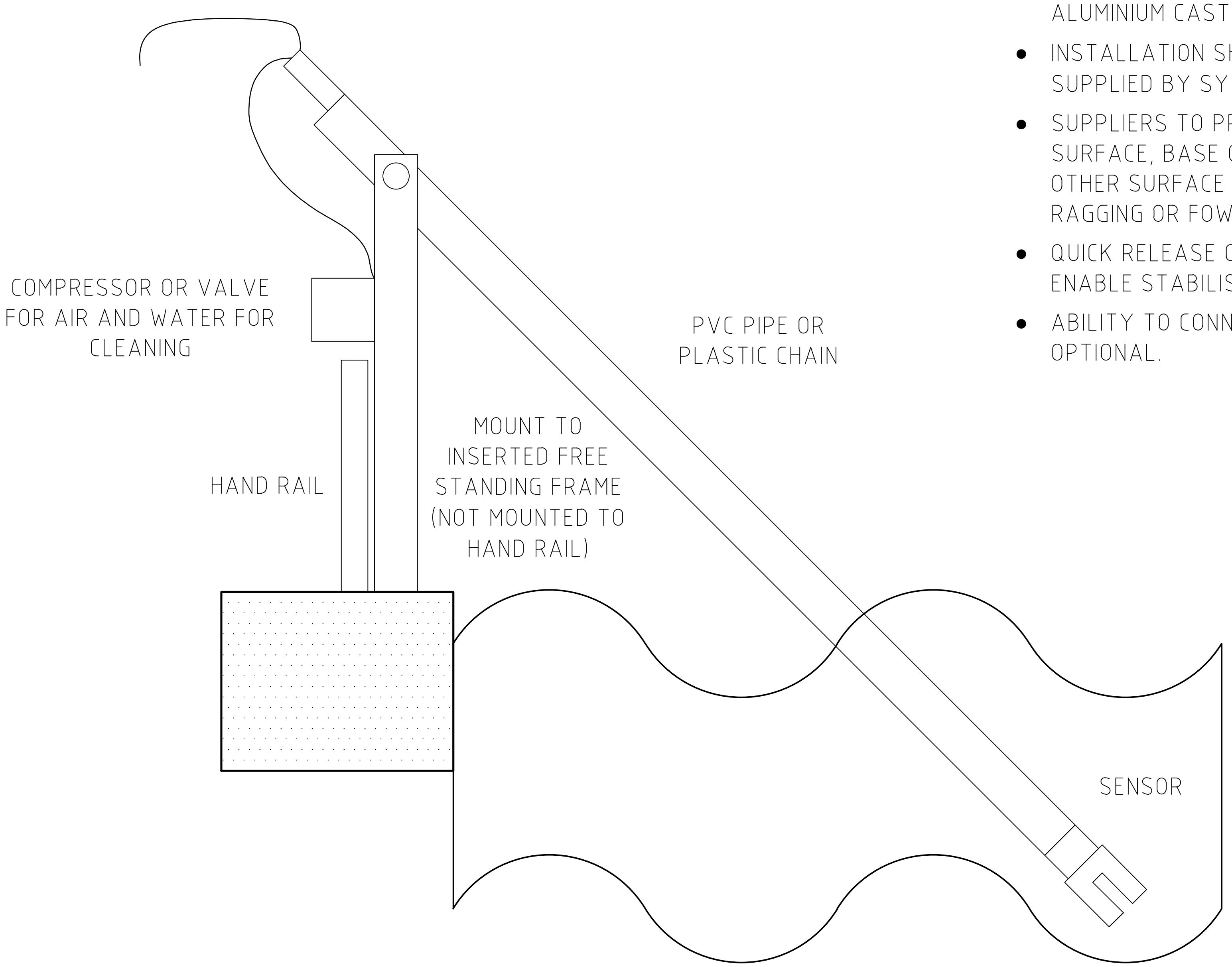
DRAWING No. SSD / SSD227

ISSUE A SHEET No. 1

SWA1-EXT AUG 2014

OPTICAL/LIGHT/NIR TECHNOLOGY –FOR WASTE ACTIVATED SLUDGE, MLSS AND AEROBICALLY DIGESTED SLUDGE

DIP OR SUBMERSIBLE SUSPENDED SOLIDS ANALYSER INSTALLATION



- PARTS AND ACCESSORIES SHOULD BE MADE FROM PVC PIPING, GALVANISED OR ALUMINIUM CASTING OR PLASTIC CHAINS DEPENDING ON SUPPLIERS SETUP.
- INSTALLATION SHOULD BE MOUNTED TO ADDITIONAL SUPPORT FRAME (DESIGN SUPPLIED BY SYDNEY WATER) AND NOT MOUNTED ON EXISTING HANDRAILS.
- SUPPLIERS TO PROVIDE INSTALLATION ANGLES AND DISTANCES FROM MOUNTING SURFACE, BASE OF TANK, SIDE WALLS, SUBMERSIBLE DEPTH, DIFFUSION HEADS OR ANY OTHER SURFACE THAT MAY CAUSE INTERFERENCE eg. FLOW, INCONSISTENT BUBBLES, RAGGING OR FOWLING, LIGHT OR REFLECTIVE SURFACE IMPACT ON OPTICAL WINDOW.
- QUICK RELEASE OF SENSOR. LOCK TO SUPPORT FRAME OF CHAIN AND/OR TUBING TO ENABLE STABILISATION DURING MAINTENANCE.
- ABILITY TO CONNECT TO WATER AND AIRLINE FOR AUTO CLEANING. CHEMICAL SUPPLY IS OPTIONAL.

DESIGNED J.DAVIS 12.03.21				
DRAWN A.JONES 3.08.2023				
VERIFIED S.ROSS 3.08.2023				
APPROVED D.FRUCI 3.08.2023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	3.08.23
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED S.ROSS SYDNEY WATER 3.08.2023

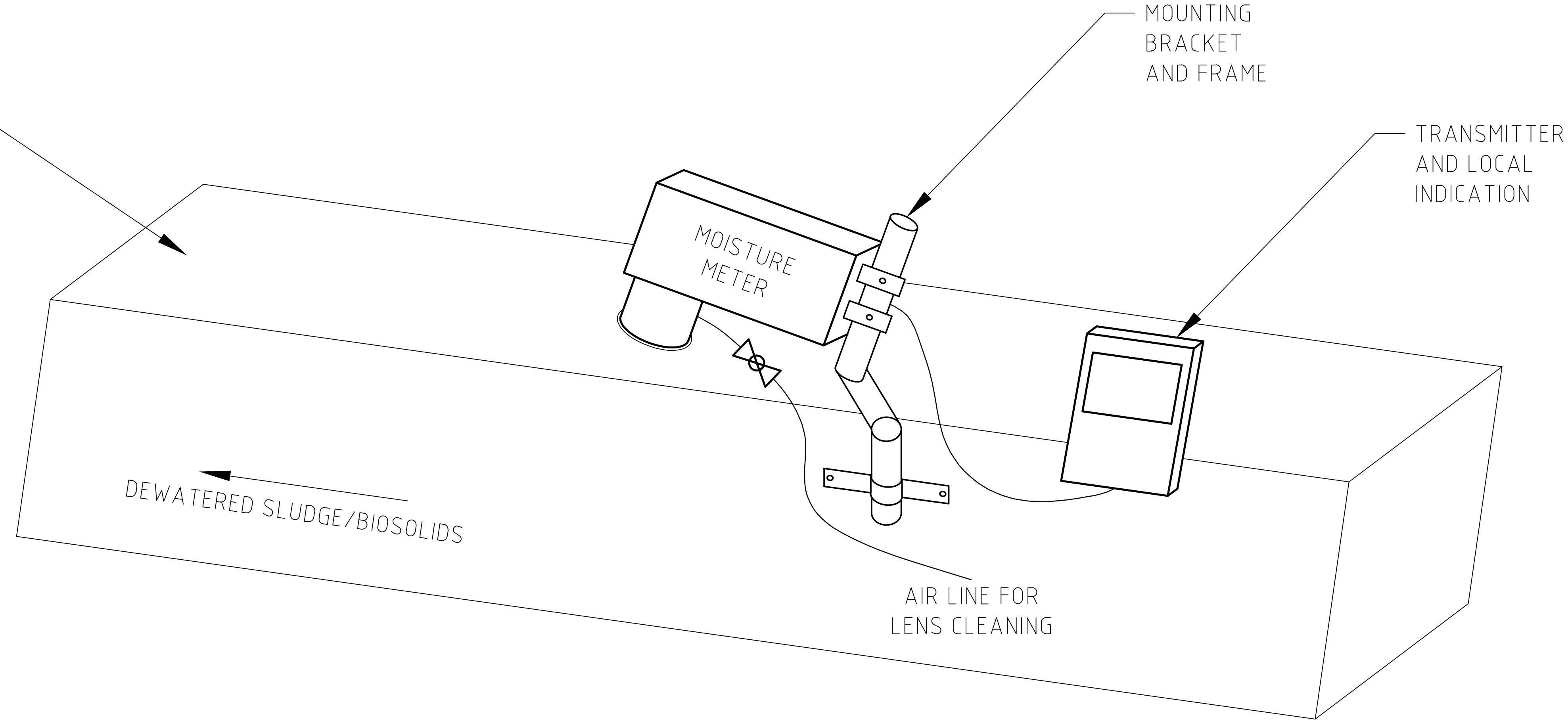
ACCEPTED D.FRUCI CLIENT SYDNEY WATER 3.08.2023

INSTRUMENT AND CONTROL STANDARDS
TYPICAL SUSPENDED SOLIDS SLUDGE DENSITY
INSTRUMENT INSTALLATION
OPTICAL/LIGHT/NIR

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD / SSD228

ISSUE A SHEET No. 1



DESIGNED J.BUDGEN 12.03.21				
DRAWN A.JONES 4.08.2023				
VERIFIED S.ROSS 4.08.2023				
APPROVED D.FRUCI 4.08.2023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	4.08.23
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED S.ROSS 4.08.2023 SYDNEY WATER

ACCEPTED D.FRUCI 4.08.2023 CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL DEWATERED SLUDGE MOISTURE INSTRUMENT INSTALLATION CONVEYOR

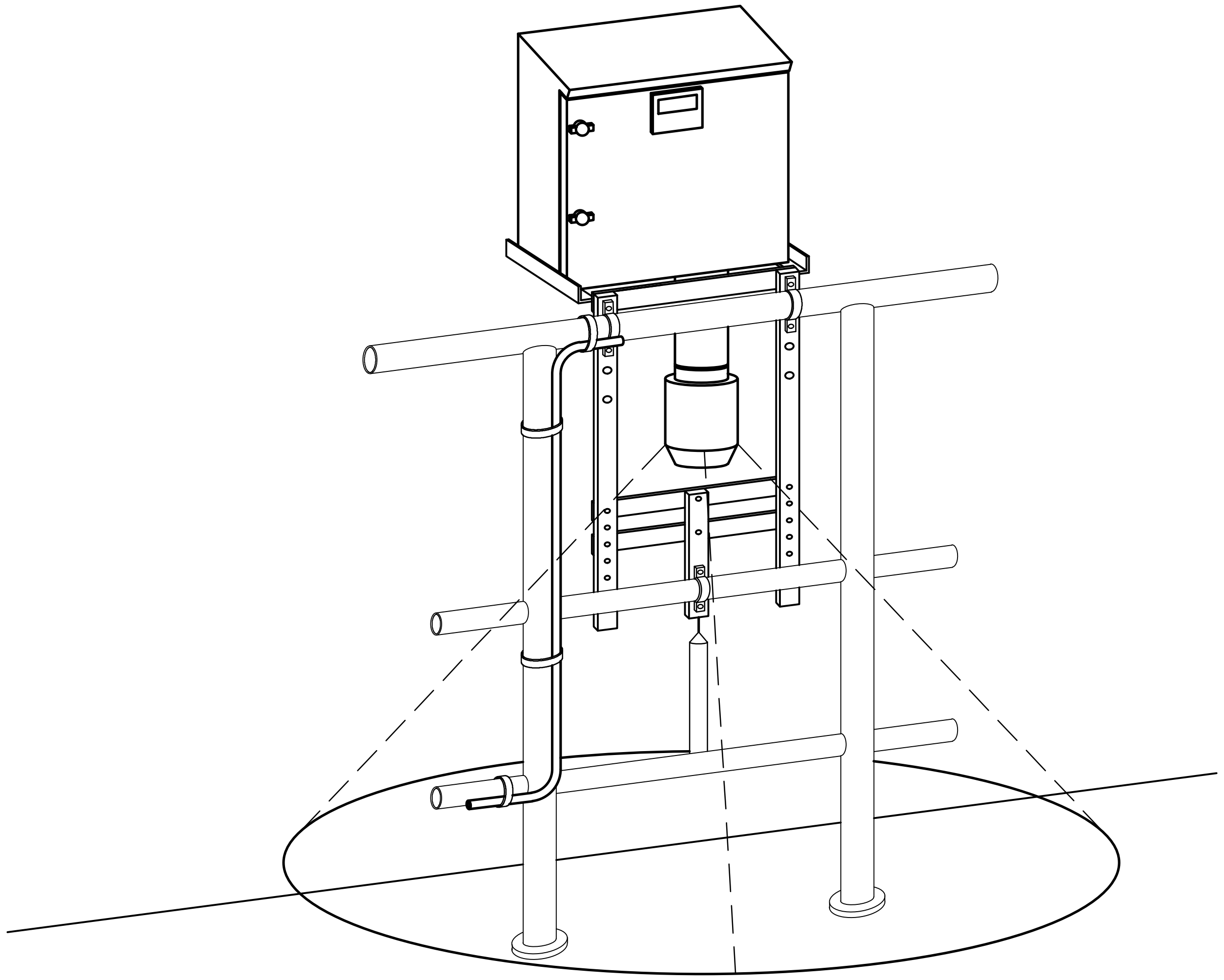
A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD229

ISSUE A | SHEET No. 1

SWA1-EXT AUG 2014

WINCHED INFRARED TECHNOLOGY
MOUNTING THE UNIT TO A FALSE HANDRAIL
WITH SELF CLEANING



NOTES:

THE CLEANING UNIT, MOUNTED UNDER THE DEVICE, CONSISTS OF A VALVE AND A SPRAYING SYSTEM TO KEEP THE SENSOR AND CABLE FREE OF DEPOSITS ENSURING LOW MAINTENANCE EFFORTS OF THE DEVICE. THE CLEANING UNIT IS MOUNTED AND ELECTRICALLY CONNECTED TO THE DEVICE BY THE MANUFACTURER WITH EXCEPTION OF THE SPRAY SHIELD AND THE WATER CONNECTION.

A FLEXIBLE EXTENSION SHALL BE ADDED TO THE CLEANING UNIT TO REDUCE WATER BEING SPRAYED IN THE RADIUS SHOWN ON THE DRAWING (2m).

DESIGNED J.BUDGEN 12.03.21
DRAWN A.JONES 10.08.2023
VERIFIED S.ROSS 10.08.2023
APPROVED D.FRUCI 10.08.2023

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	10.08.23

Sydney WATER

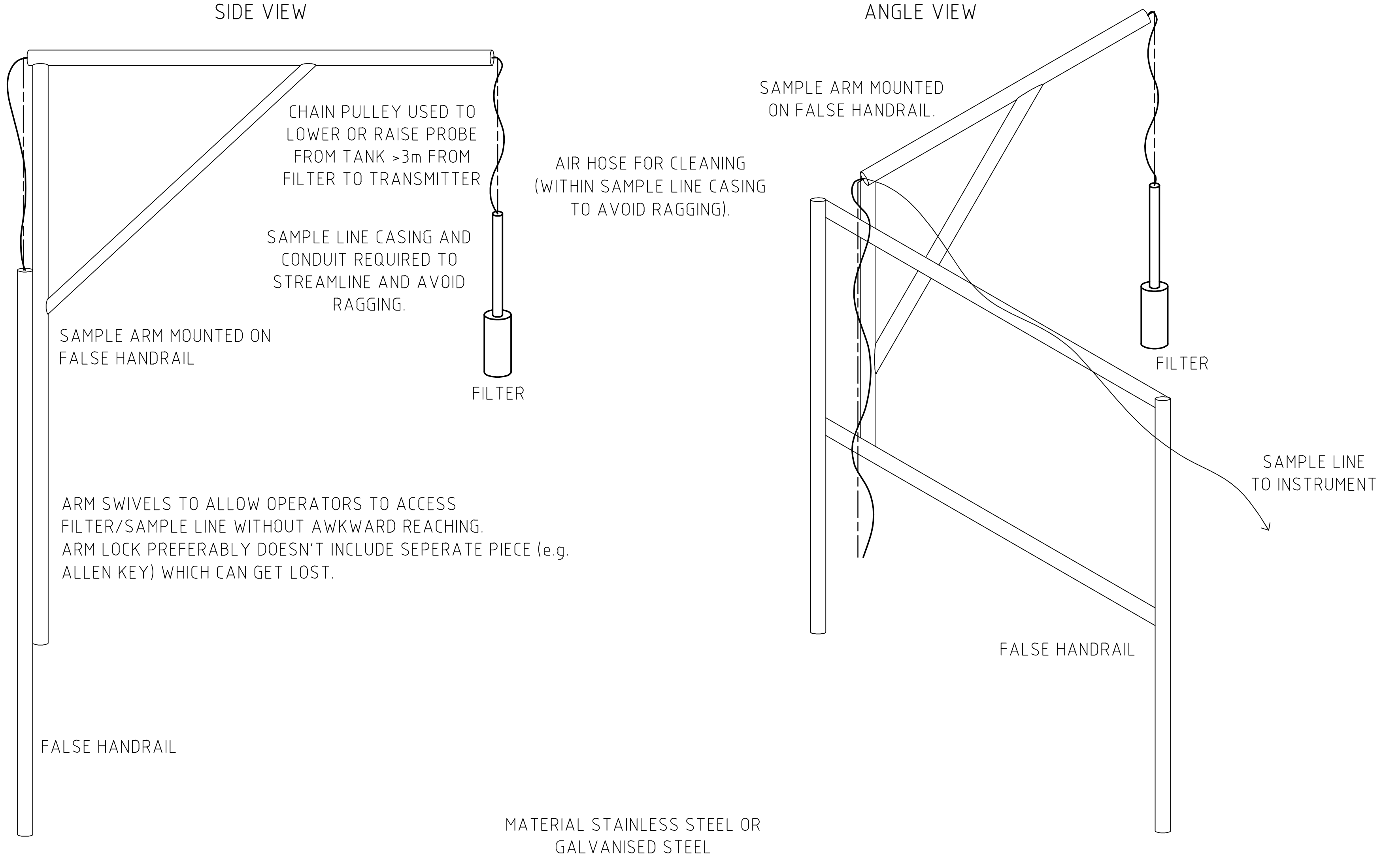
THIS DRAWING SUPERSEDES
RECOMMENDED S.ROSS 10.08.2023 SYDNEY WATER
ACCEPTED D.FRUCI 10.08.2023 CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL SLUDGE BLANKET MONITORING PROBE
INSTRUMENT INSTALLATION
WINCHED INFRARED

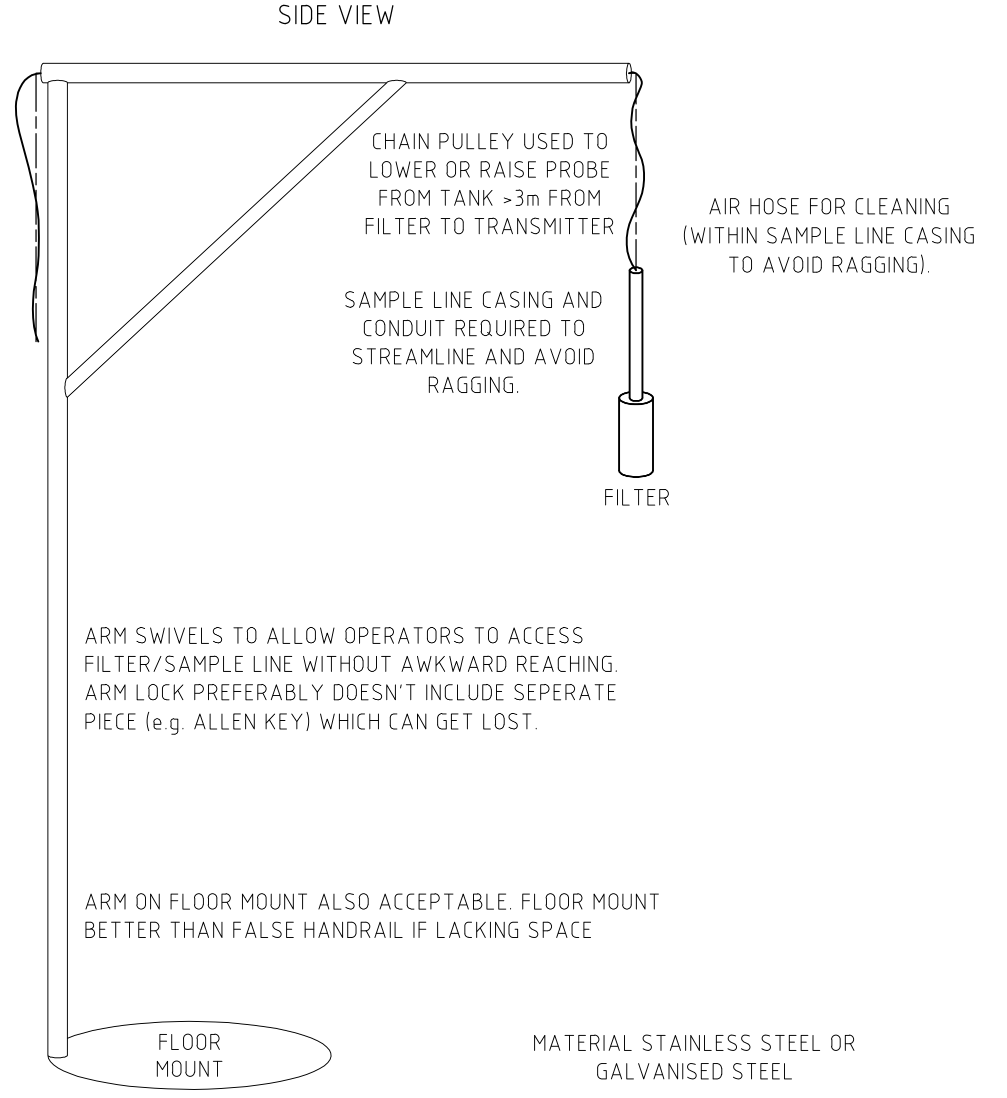
A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD / SSD230
ISSUE A SHEET No. 1

INSTALLATION METHOD: FALSE HANDRAIL



INSTALLATION METHOD: FLOOR MOUNT



DESIGNED	R.LOCKETT	05.03.2021
DRAWN	A.JONES	22.08.2023
VERIFIED	S.ROSS	22.08.2023
APPROVED	D.FRUCI	22.08.2023

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	22.08.23

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED S.ROSS 22.08.2023 SYDNEY WATER

ACCEPTED D.FRUCI 22.08.2023 CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL AMMONIA, NOX AND ORTHOPHOSPHATE INSTRUMENT INSTALLATION IN TANK

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

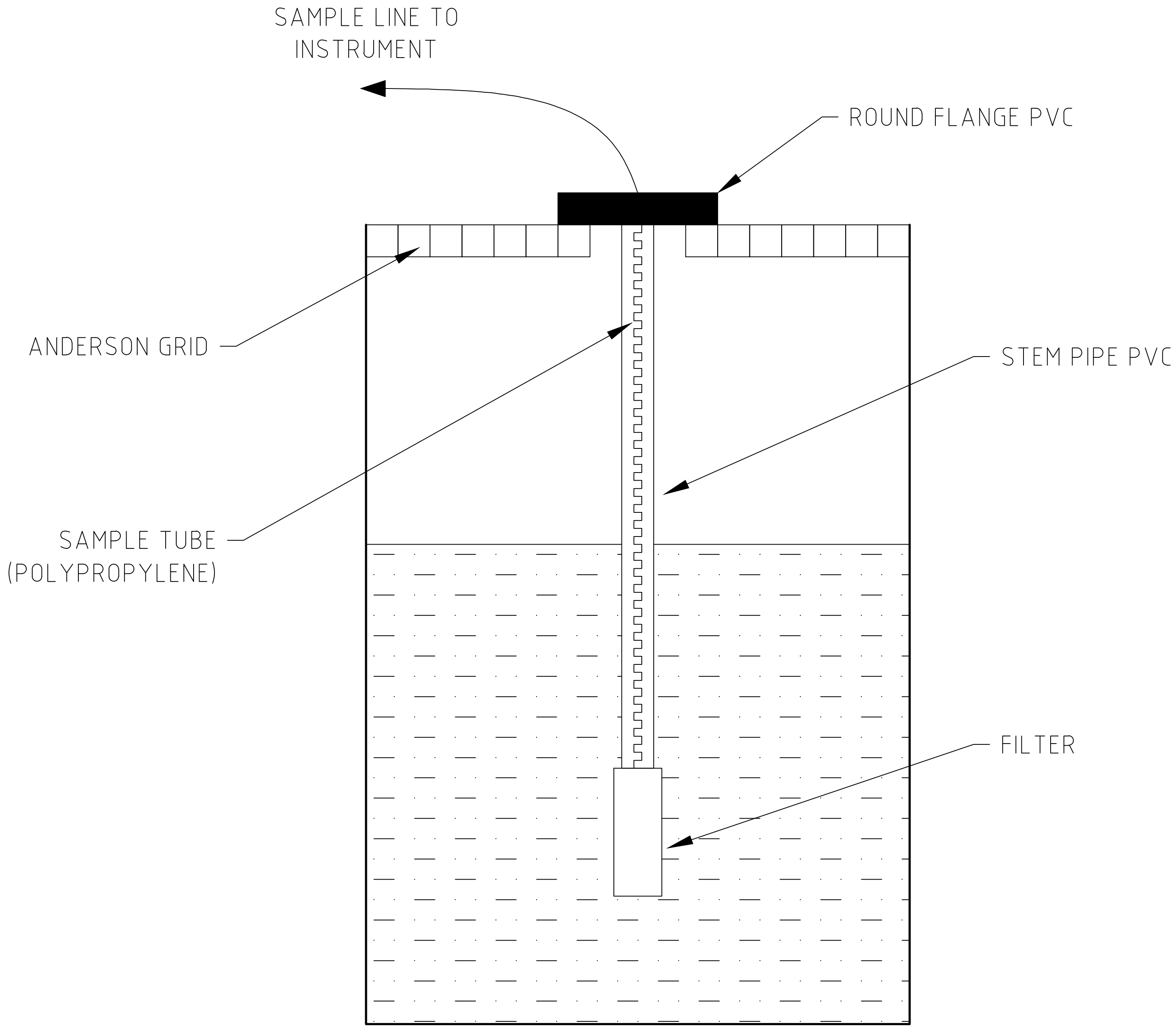
DRAWING No. SSD / SSD231

ISSUE A | SHEET No. 1

SWA1-EXT AUG 2014

NOTES:

1. SAMPLE TUBE LENGTH WILL BE SITE SPECIFIC. MAXIMUM LENGTH IS 23m PLUS LENGTH OF STEM PIPE.
2. STEM PIPE LENGTH WILL BE SITE SPECIFIC. APPROXIMATE RANGE IS 1.2m TO 3m.



DESIGNED J.BUDGEN 5.03.2021				
DRAWN A.JONES 16.06.2023				
VERIFIED S.ROSS 16.06.2023				
APPROVED D.FRUCI 16.06.2023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	16.06.23
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED S.ROSS 16.06.2023 SYDNEY WATER

ACCEPTED D.FRUCI 16.06.2023 CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL AMMONIA, NOX AND ORTHOPHOSPHATE INSTRUMENT INSTALLATION UNDER GRATE

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

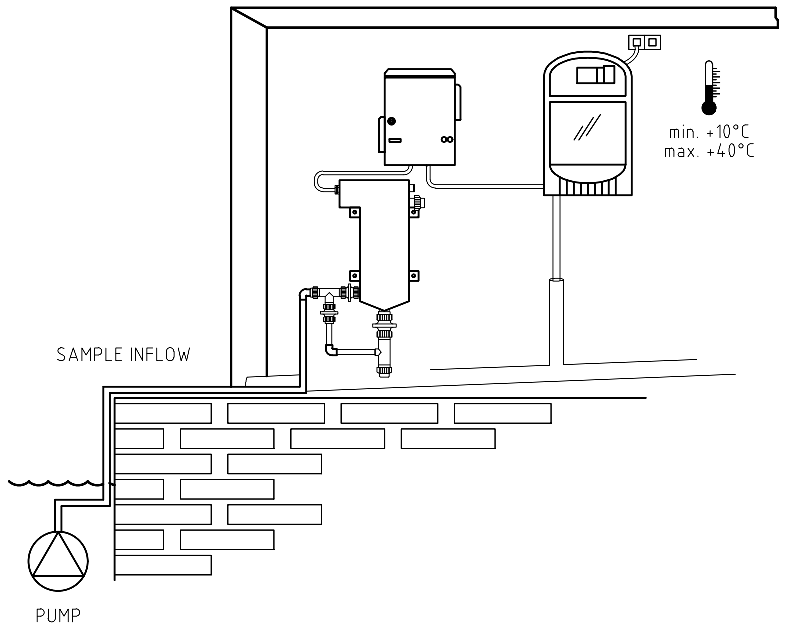
DRAWING No. SSD SSD232

ISSUE A SHEET No. 1

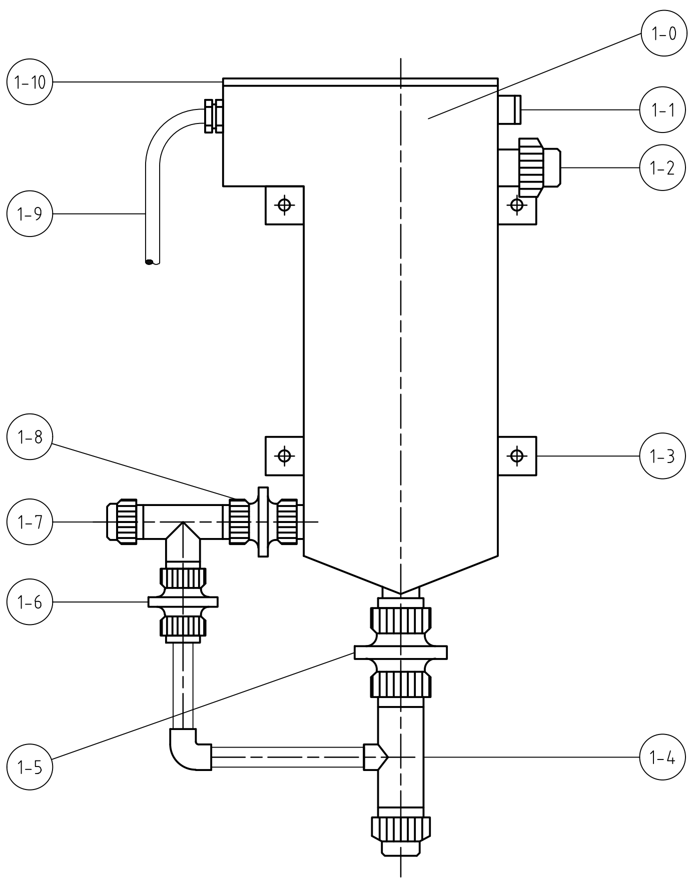
SWA1-EXT AUG 2014

FOR AMMONIA AND ORTHO-PHOSPHORUS ANALYSERS WITH THE HACH FILTRAX UNIT

THE PREFERRED SOLUTION IS TO USE A SAMPLE PUMP, WITH THE FILTERS HOUSED IN THE HACH FILTRAX OVERFLOW VESSEL. THIS REMOVES ANY MANUAL HANDLING RISK WITH REMOVING AND CLEANING THE FILTER UNIT.



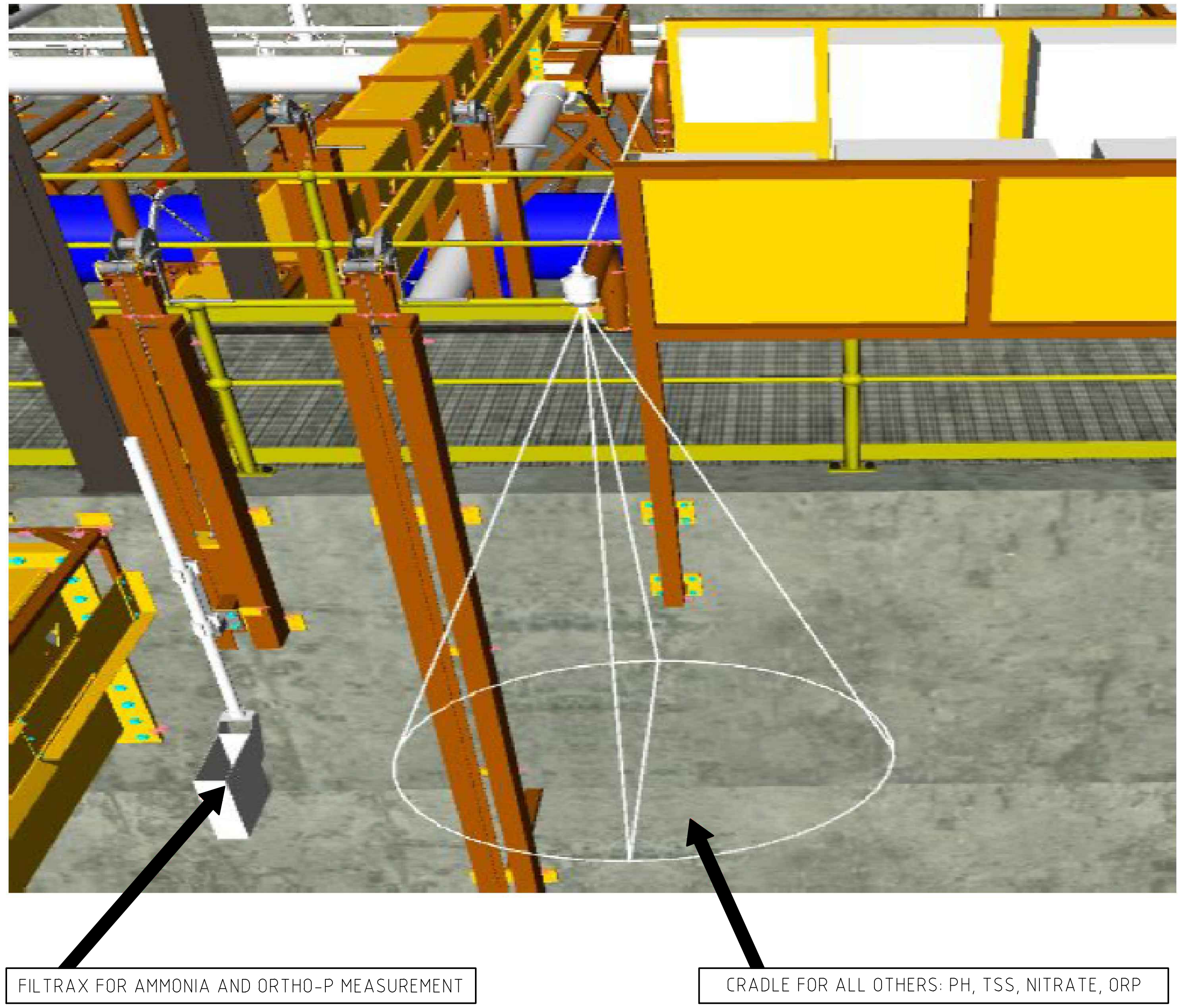
THE HACH PART NUMBER FOR THIS SETUP IS LZH100
REFERENCE SITE: ST MARYS, HOXTON PARK RWP



1-0 FILTRAX BYPASS OVERFLOW VESSEL
1-1 ADAPTOR FOR OVERFLOW PREVENTION (1" INSIDE THREAD)
1-2 SAMPLE OUTFLOW (1.5" SCREW COUPLING)
1-3 WALL MOUNTING
1-4 SLUDGE REMOVAL (1.5" SCREW COUPLING)
1-5 BALL VALVE FOR SLUDGE REMOVAL (1.5")
1-6 PUMP BYPASS VALVE (¾")
1-7 SAMPLE INFLOW (¾" SCREW COUPLING)
1-8 INFLOW REGULATING STOP VALVE (¾")
1-9 2m TUBE (FIXED CONNECTION)
1-10 LID OF FILTRAX BYPASS

HACH FILTRAX AND OTHER INSTRUMENTS ALTERNATIVE - WINCHED SYSTEM:

AT PLANTS WHERE ALL THE INSTRUMENTS ARE LOCATED IN A SINGLE PLACE e.g. IDAL, SBR, NEREDA THEN A WINCH WITH CRADLE CAN BE USED AS PER THE BELOW MODEL FROM QUAKERS HILL:



REFERENCE SITE: QUAKERS HILL WRP

DESIGNED		
DRAWN	A.JONES	25.08.2023
VERIFIED	S.ROSS	25.08.2023
APPROVED	D.FRUCI	25.08.2023

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	25.08.23

Sydney WATER

THIS DRAWING SUPERSEDES ---
RECOMMENDED 25.08.2023 S.ROSS SYDNEY WATER
ACCEPTED 25.08.2023 D.FRUCI CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL AMMONIA, NOX AND ORTHOPHOSPHATE INSTRUMENT INSTALLATION

A1 PROJ No. I&C STAND. DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD233
ISSUE A SHEET No. 1

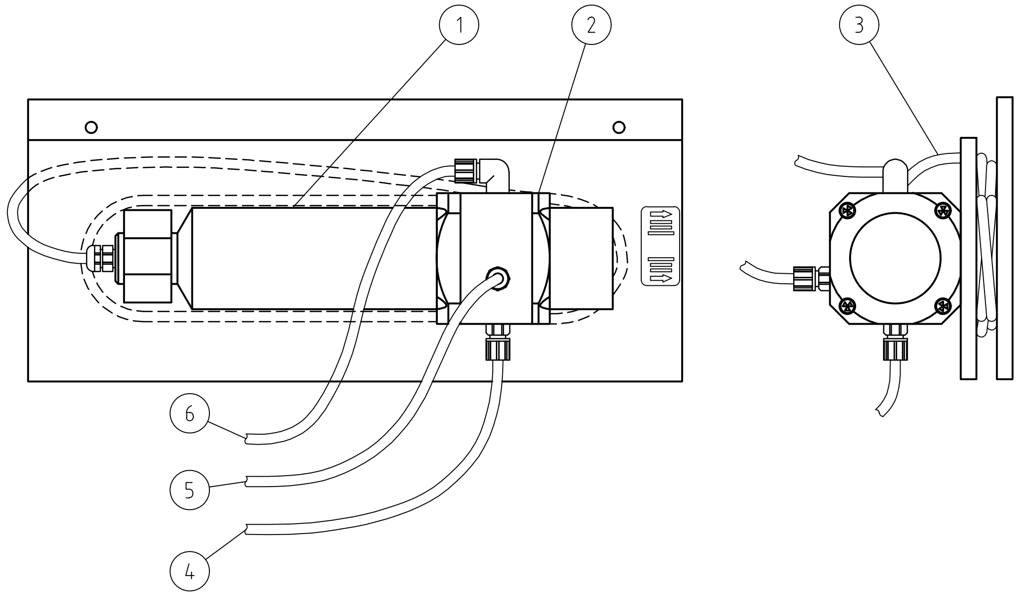
SWA1-EXT AUG 2014

HACH NITRATAX NITRATE ANALYSER

THE INSTRUMENT CAN BE INSTALLED IN TWO WAYS, IT IS ONLY ACCEPTABLE TO INSTALL DIRECTLY IN THE PROCESS FLUID IF A SLOT IS CUT OUT FROM AN ANDERSON GRID. ITS NOT ACCEPTABLE TO MOUNT IT OUTSIDE OF THE HAND RAILS AS ITS TOO HEAVY.

IF THE WALKWAY DESIGN IS NOT SUITABLE FOR THE ABOVE METHOD, THEN HACH CAN PROVIDE A FLOW THROUH CELL THAT ATTACHES TO THE ENF OF THE NITRATAX, IN THIS CONFIGURATION IT CAN BE MOUNTED ON A PANEL. NOTE A SAMPLE PUMP WOULD BE REQUIRED. SEE RIGHT FOR DETAILS.

HACH NITRATAX NITRATE ANALYSER MOUNTED ON A PANEL



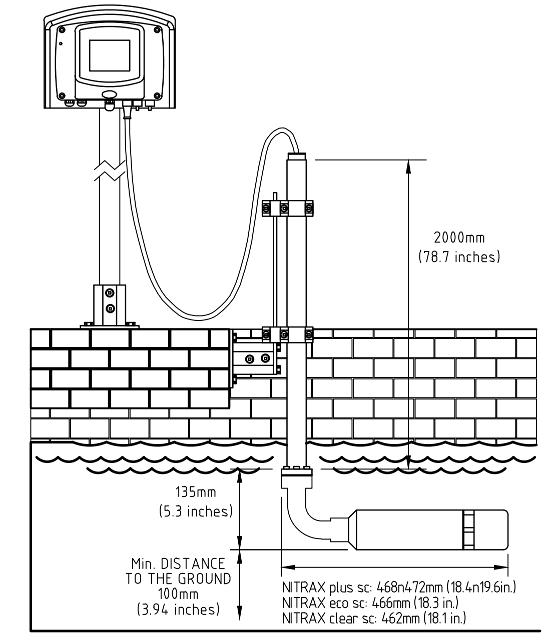
SENSOR PLUS SC/FLOW-THROUGH ASSEMBLY (OPTIONAL)

1	SC SENSOR (PARTS WILL VARY DEPENDING ON SENSOR STYLE)	4	FLOW CELL DRAIN
2	FLOW CELL (PARTS WILL VARY DEPENDING ON SENSOR STYLE)	5	SAMPLE INLET
3	SENSOR CABLE (EXTRA CABLE STORED INSIDE PANEL AS SHOWN)	6	SAMPLE DRAIN

THE BELOW HAS BEEN RECREATED FROM THE HACH MANUAL - AND IS NOT ACCEPTABLE.
THE INSTRUMENT IS TOO HEAVY TO BE INSTALLED IN THIS WAY.

INSTALLATION DIMENSIONS

INSTALLATION FOR MOUNTING NITRAX sc USING FIXED POINT INSTALLATION KIT (LZX414.00.10000).



DESIGNED				
DRAWN A.JONES 11.09.2023				
VERIFIED S.ROSS 11.09.2023				
APPROVED D.FRUCI 11.09.2023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	11.09.23
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES ---

RECOMMENDED S.ROSS 11.09.2023 SYDNEY WATER

ACCEPTED D.FRUCI 11.09.2023 CLIENT SYDNEY WATER

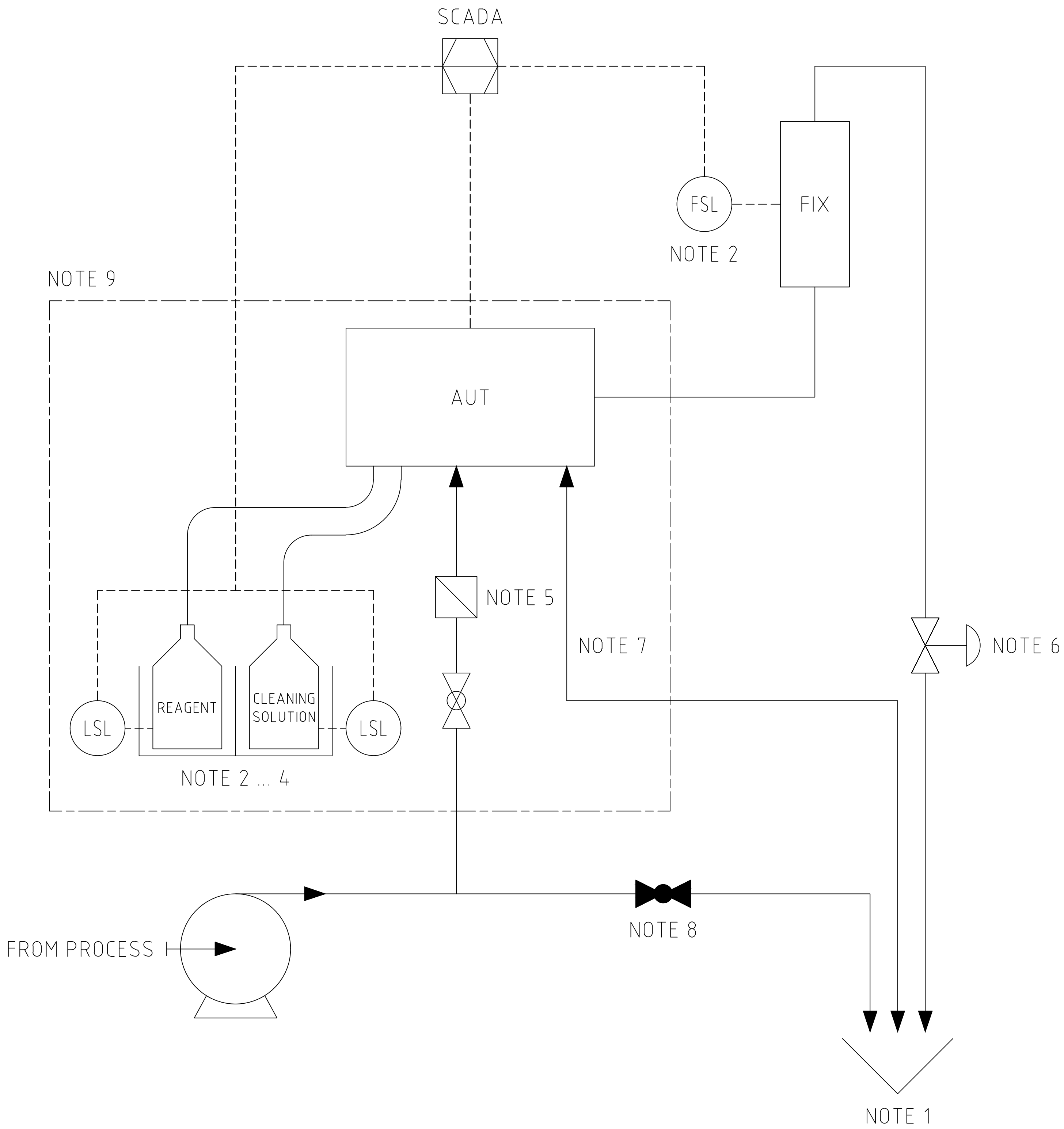
INSTRUMENT AND CONTROL STANDARDS
TYPICAL AMMONIA, NOX AND ORTHOPHOSPHATE
INSTRUMENT INSTALLATION

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD / SSD234

ISSUE A | SHEET No. 1

SWA1-EXT AUG 2014



NOTES:

1. TO DRAIN, ACCESSIBLE FOR GRAB SAMPLING
2. MAXIMUM 10 L, TRANSPARENT CONTAINERS FOR REAGENTS AND CLEANING SOLUTIONS
3. PARTITIONED BUND TO HOLD CONTAINERS
4. INDIVIDUAL LOW LEVEL SWITCHES FOR EACH REAGENT CONTAINER
5. MAXIMUM 1 MM MESH STRAINER FOR UNFILTERED SAMPLES (SECONDARY EFFLUENT)
6. DIAPHRAGM TYPE THROTTLING VALVE
7. DRAIN LINE FOR ZEROING AND CLEANING
8. BYPASS VALVE FOR ONLINE MAINTENANCE IF PUMP FEEDING MULTIPLE INSTRUMENTS
9. ENCLOSED ALUMINIUM OR STAINLESS STEEL CABINET FOR ANALYSER AND REAGENT CONTAINERS

DESIGNED C.RAYNOR 22.01.2021				
DRAWN A.JONES 21.06.2023				
VERIFIED S.ROSS 21.06.2023				
APPROVED D.FRUCI 21.06.2023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	21.06.23
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED S.ROSS 21.06.2023 SYDNEY WATER

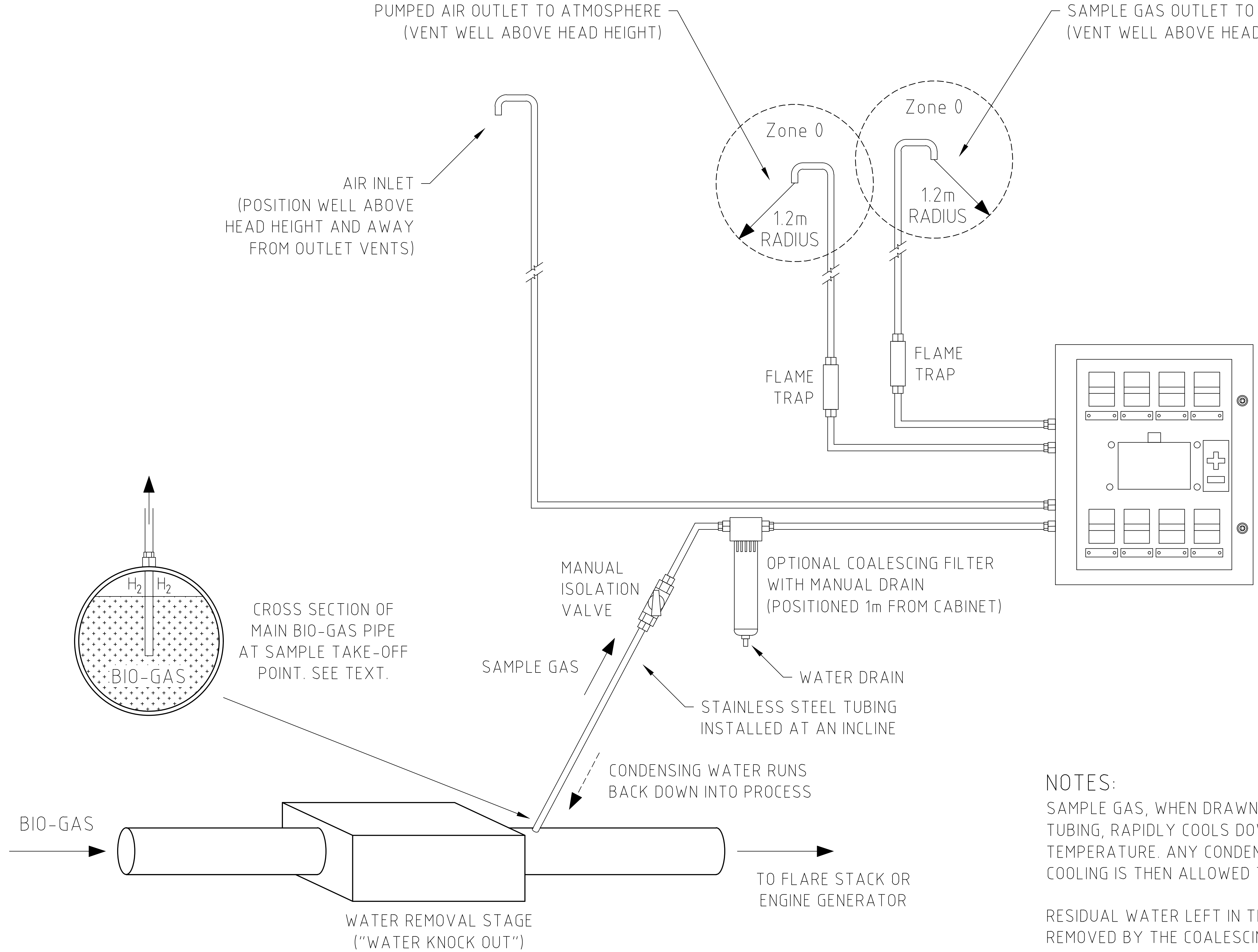
ACCEPTED D.FRUCI 21.06.2023 CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS TYPICAL ULTRAVIOLET TRANSMITTANCE (UVT) INSTRUMENT INSTALLATION

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD SSD235

ISSUE A | SHEET No. 1



NOTES:

SAMPLE GAS, WHEN DRAWN THROUGH 2m OF STAINLESS STEEL TUBING, RAPIDLY COOLS DOWN TO THE AMBIENT (AIR) TEMPERATURE. ANY CONDENSED WATER (LIQUID) PRODUCED BY COOLING IS THEN ALLOWED TO RUN BACK INTO THE PROCESS.

RESIDUAL WATER LEFT IN THE SAMPLE GAS IS THEN FURTHER REMOVED BY THE COALESCING FILTER BEFORE THE SAMPLE GAS IS HEATED WHEN ENTERING THE CABINET.

DESIGNED J.BUDGEN 5.03.2021				
DRAWN A.JONES 21.06.2023				
VERIFIED S.ROSS 21.06.2023				
APPROVED D.FRUCI 21.06.2023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	21.06.23
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED S.ROSS 21.06.2023 SYDNEY WATER

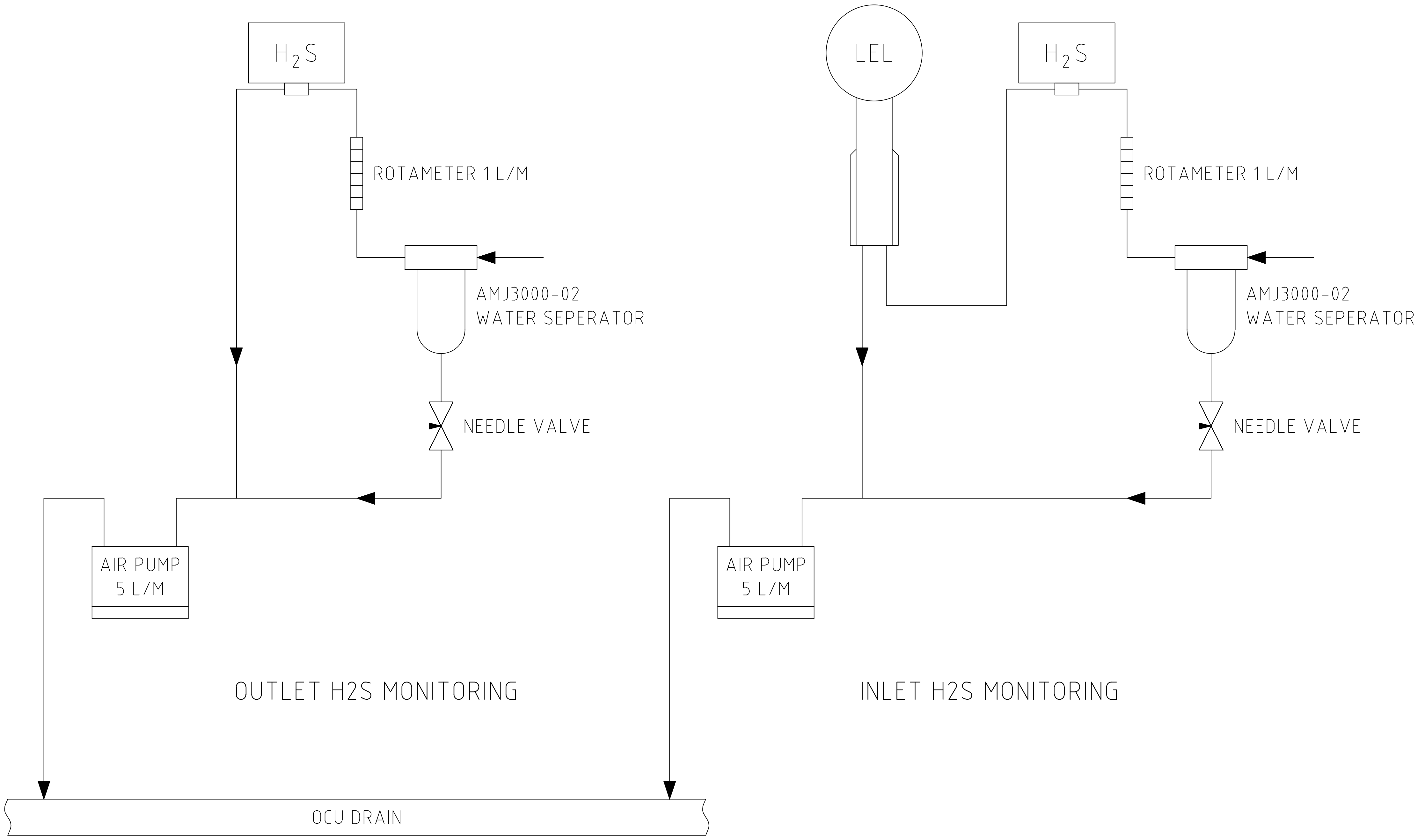
ACCEPTED D.FRUCI 21.06.2023 CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS
TYPICAL BIOGAS COMPOSITION
INSTRUMENT INSTALLATION

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD / SSD236

ISSUE A | SHEET No. 1



DESIGNED S.R. 16.07.2012				
DRAWN A.JONES 22.062023				
VERIFIED S.ROSS 22.062023				
APPROVED D.FRUCI 22.062023	A	DRAWING COPIED TO STANDARD CAD TEMPLATE	D.F	22.0623
	LETTER	DETAILS OF AMENDMENT	APP'D	DATE

Sydney WATER

THIS DRAWING SUPERSEDES

RECOMMENDED 22.062023 S.ROSS SYDNEY WATER

ACCEPTED 22.062023 D.FRUCI CLIENT SYDNEY WATER

INSTRUMENT AND CONTROL STANDARDS TYPICAL GAS DETECTION AND ALARMING INSTRUMENT INSTALLATION

A1 | PROJ No. I&C STAND. | DRAWING STATUS: I&C TYPICAL

DRAWING No. SSD / SSD237

ISSUE A | SHEET No. 1

Appendix 2 – Instrumentation Data Sheets

Appendix 2 Instrumentation Data Sheets

A2.1 Index 1: Instrumentation data sheets

DATA SHEET (PART 1)

CHLORINE RESIDUAL ANALYSER

AII.1 Part 1 User Requirements Specification

AII.2 To be completed by the specifier

AII.3 Tag No.	**AII.4 Service Description**	**Issue. A**

1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Size	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	IP Rating	
1.5	Line/vessel		4.5	Haz. Area Cert.	
1.6	Line size		4.6		
1.7	Tx. location		4.7		
1.8	Sensor location		4.8		
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0	**SAMPLING SYSTEM DETAILS** (If applicable)	
2.1	Service fluid		5.1	Sample pump	
2.2	Chl resi (mg/l)		5.2	Sample filter	
2.3	Temperature		5.3	Sample cond.	
2.4	Pressure		5.4	Sample flow	
2.5	Flow rate		5.5	Sample temp	
2.6	Flow velocity		5.6	Sample press.	
2.7	pH		5.7		
2.8	Foaming		5.8		
2.9	Contaminants		5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range (mg/l)		6.1	Auto cleaning	
3.2	Accuracy		6.2	Stand by sensor	
3.3	Resolution		6.3	Auto calibration	
3.4	Response time		6.4	Self diagnostics	
3.5	Output signal		6.5	H/W fail alarm	
3.6	Power Supply		6.6	HI/LO Alarm	
3.7	Mounting		6.7	Smart Features	
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		

ADDITIONAL INFORMATION

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 2)

CHLORINE RESIDUAL ANALYSER		
AII.5 Part 2 Supplier Information AII.6 To be completed by the supplier		
AII.7 Tag No.	**AII.8 Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Sampling equipment required	
2.2	Sample rate, temp. and pressure	
2.3	Sensor auto cleaning requirements	
2.4	Calibration equipment required	
2.5	Consumables required	
2.6	Reagents required	
2.7	Reagent storage precautions	
2.8	Reagent handling precautions	
2.9	Hazardous waste generated	
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3	Annual Cost of Reagents	
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Chlorine Residual Analyser and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

CONDUCTIVITY ANALYSER					
AII.9 Part 1 User Requirements Specification AII.10 To be completed by the specifier					
AII.11 Tag No.		**AII.12 Service Description**			**Issue. A**
1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Model	
1.2	Site		4.2	Type	
1.3	Project No.		4.3	Cell Const. (K)	
1.4	P & ID No.		4.4	Temp. comp.	
1.5	Line/vessel		4.5	Size	
1.6	Line size		4.6	Mounting	
1.7	Tx. location		4.7	IP Rating	
1.8	Sensor location		4.8	Haz. Area Cert.	
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0	**SAMPLING SYSTEM DETAILS** (If applicable)	
2.1	Service fluid		5.1	Sample pump	
2.2	Cond. (uS)		5.2	Sample filter	
2.3	Temperature		5.3	Sample cond.	
2.4	Pressure		5.4	Sample flow	
2.5	Flow rate		5.5	Sample temp	
2.6	Flow velocity		5.6	Sample press.	
2.7	Contaminants		5.7		
2.8			5.8		
2.9			5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range (uS)		6.1	Auto cleaning	
3.2	Accuracy		6.2	Stand by sensor	
3.3	Resolution		6.3	Auto calibration	
3.4	Response time		6.4	Self diagnostics	
3.5	Output signal		6.5	H/W fail alarm	
3.6	Power Supply		6.6	HI/LO Alarm	
3.7	Mounting		6.7	Smart Features	
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		
ADDITIONAL INFORMATION					
Compiled by:		Date:	Checked:		Approved:

DATA SHEET (PART 2)

CONDUCTIVITY ANALYSER		
AII.13 Part 2 Supplier Information AII.14 To be completed by the supplier		
AII.15 Tag No.	**AII.16 Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Sampling equipment required	
2.2	Sample rate, temp. and pressure	
2.3	Sensor auto cleaning requirements	
2.4	Calibration equipment required	
2.5	Consumables required	
2.6	Reagents required	
2.7	Reagent storage precautions	
2.8	Reagent handling precautions	
2.9	Hazardous waste generated	
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3	Annual Cost of Reagents	
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Conductivity Analyser and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

DISSOLVED OXYGEN ANALYSER					
AII.17 Part 1 User Requirements Specification					
AII.18 To be completed by the specifier					
AII.19 Tag No.		**AII.20 Service Description**		**Issue.A**	
1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Size	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	IP Rating	
1.5	Line/vessel		4.5	Haz. Area Cert.	
1.6	Line size		4.6		
1.7	Tx. location		4.7		
1.8	Sensor location		4.8		
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0	**SAMPLING SYSTEM DETAILS** (If applicable)	
2.1	Service fluid		5.1	Sample pump	
2.2	DO Conc-mg/l		5.2	Sample filter	
2.3	Temperature		5.3	Sample cond.	
2.4	Pressure		5.4	Sample flow	
2.5	Flow rate		5.5	Sample temp	
2.6	Flow velocity		5.6	Sample press.	
2.7	pH		5.7		
2.8	Foaming		5.8		
2.9	Contaminants		5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range (mg/l)		6.1	Auto cleaning	
3.2	Accuracy		6.2	Stand by sensor	
3.3	Resolution		6.3	Auto calibration	
3.4	Response time		6.4	Self diagnostics	
3.5	Output signal		6.5	H/W fail alarm	
3.6	Power Supply		6.6	HI/LO Alarm	
3.7	Mounting		6.7	Smart Features	
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		
ADDITIONAL INFORMATION					
Compiled by:		Date:	Checked:		Approved:

DATA SHEET (PART 2)

DISSOLVED OXYGEN ANALYSER		
AII.21 Part 2 Supplier Information AII.22 To be completed by the supplier		
AII.23 Tag No.	**AII.24 Service Description**	**Issue.A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Sampling equipment required	
2.2	Sample rate, temp. and pressure	
2.3	Sensor auto cleaning requirements	
2.4	Calibration equipment required	
2.5	Consumables required	
2.6	Reagents required	
2.7	Reagent storage precautions	
2.8	Reagent handling precautions	
2.9	Hazardous waste generated	
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3	Annual Cost of Reagents	
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Dissolved Oxygen Analyser and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

DIFF. PRESSURE FLOW TRANSMITTER			
AII.25 Part 1 User Requirements Specification AII.26 To be completed by the specifier			
AII.27 Tag No.	**AII.28 Service Description**		**Issue.A**

1.0	**APPLICATION DETAILS**		4.0	**FLOW ELEMENT DETAILS**	
1.1	Client		4.1	Flow elem. type	
1.2	Site		4.2	Flow elem. Size	
1.3	Project No.		4.3	Connection type	
1.4	P & ID No.		4.4	Flow elem. Mat.	
1.5	Pipe Ident.		4.5		
1.6	Pipe Dia.		4.6		
1.7	Tx. location		4.7		
1.8	Flow elem. loc.		4.8		
1.9	Tx-FE sep.		4.9		
2.0	**PROCESS DETAILS**		5.0		
2.1	Process fluid		5.1		
2.2	Compressibility		5.2		
2.3	Flow Rate		5.3		
2.4	Temperature		5.4		
2.5	Pressure		5.5		
2.6	Density		5.6		
2.7	Viscosity		5.7		
2.8	Corrosive		5.8		
2.9	Abrasive		5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range		6.1	Self diagnostics	
3.2	Accuracy		6.2	H/W fail alarm	
3.3	Resolution		6.3	Smart Features	
3.4	Response time		6.4		
3.5	Output signal		6.5		
3.6	Power Supply		6.6		
3.7	Mounting		6.7		
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		

ADDITIONAL INFORMATION			
Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 2)

DIFF. PRESSURE FLOW TRANSMITTER			
AII.29 Part 2 Supplier Information			
AII.30 To be completed by the supplier			
AII.31 Tag No.	**AII.32 Service Description**		**Issue.A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Calibration equipment required	
2.2	Consumables required	
2.3		
2.4		
2.5		
2.6		
2.7		
2.8		
2.9		
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3		
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Differential Pressure Flow Transmitters and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

ELECTRICAL MEASUREMENT TRANSDUCER

AII.33 Part 1 User Requirements Specification

AII.34 To be completed by the specifier

AII.35 Tag No.	**AII.36 Service Description**	**Issue.A**

1.0	**APPLICATION DETAILS**		4.0	**CT DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	No. of phases	
1.3	Project No.		4.3	Connection type	
1.4	Single line diagram No.		4.4	Transformation Ratio	
1.5	Equip. Identification		4.5	Rated burden	
1.6	Equip. Rating		4.6	Existing burden	
1.7	CT/PT loc.		4.7		
1.8	Transducer loc.		4.8		
1.9	Transducer-CT/PT sep.		4.9		
2.0	**POWER SUPPLY SYSTEM DETAILS**		5.0	**PT DETAILS**	
2.1	No. of phases		5.1	Type	
2.2	Connection type		5.2	No. of phases	
2.3	Nominal voltage		5.3	Connection type	
2.4	Nominal current		5.4	Transformation Ratio	
2.5	Nominal Power Factor		5.5	Rated burden	
2.6	Balanced/Unbalanced		5.6	Existing burden	
2.7	Harmonic distortion		5.7		
2.8	Current overload level		5.8		
2.9	Voltage overload level		5.9		
3.0	**TRANSDUCER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Measurand		6.1	Serial Interface	
3.2	Range		6.2	Self diagnostics	
3.3	Accuracy		6.3	Smart Features	
3.4	Response time		6.4		
3.5	Output signal		6.5		
3.6	Power Supply		6.6		
3.7	Mounting		6.7		
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		

ADDITIONAL INFORMATION

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 2)

ELECTRICAL MEASUREMENT TRANSDUCER		
AII.37 **Part 2 Supplier Information** AII.38 To be completed by the supplier		
AII.39 Tag No.	**AII.40 Service Description**	**Issue.A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transducer Model No.	
1.6	Measurand	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	CT/PT Burden	
2.2	Electromagnetic Interference compliance	
2.3		
2.4		
2.5		
2.6		
2.7		
2.8		
2.9		
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Calibration equipment cost	
3.3	Recommended Calibration Interval	
3.3	Recommended Calibration Time	
3.5	Guarantee Period	
3.6		
3.7		
3.8		
3.9		

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Electrical Measurement Transducers and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

ELECTROMAGNETIC FLOWMETERS					
Part 1 User Requirements Specification					
Tag No.	**Service Description**			**Issue. A**	
1.0	**APPLICATION DETAILS**		4.0	**FLOW TUBE DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Size	
1.3	Project No.		4.3	Connection type	
1.4	P & ID No.		4.4	Tube material	
1.5	Pipe Ident.		4.5	Liner material	
1.6	Pipe Dia.		4.6	Electrode material	
1.7	Tx. location		4.7	Earth ring material	
1.8	Sensor location		4.8	IP rating	
1.9	Tx -sensor cable length		4.9	Signal cable	
			4.10	Haz. Area Cert.	
2.0	**PROCESS DETAILS**		5.0	**VERIFICATOR/CALIBRATION TOOL**	
2.1	Process fluid		5.1	Uncertainity	
2.2	Conductivity		5.2	Operating temperature	
2.3	Flow velocity		5.3	Storage capacity	
2.4	Temperature		5.4	Data storage in Tx	
2.5	Pressure		5.5	Testing of electrodes	
2.6	Density		5.6	Testing of coils	
2.7	Viscosity		5.7	Testing of converter	
2.8	Corrosive		5.8	Testing of I/O	
2.9	Abrasive		5.9	Testing of cabling	
3.0	**INSTRUMENT DETAILS**		6.0	**OTHER FEATURES**	
3.1	Calibrated range		6.1	Diagnostics	
3.2	Min/Max range		6.2	H/W fail alarm	
3.3	Accuracy (system)		6.3	HI/LO Alarm(s)	
3.4	Resolution		6.4	Low flow cut off	
3.5	Response time		6.5	Flow totaliser	
3.6	Repeatability		6.6	Custody transfer	
3.7	Power Supply		6.7	In built surge protection	
3.8	Inrush current		6.8	Communications	
3.9	Display		6.9	Other	
3.10	Operating temperature (display version)		**ADDITIONAL INFORMATION**		
3.11	Flow direction				
3.12	Current output(s)				
3.13	Digital output(s)				
3.14	Pulse/frequency output(s)				
3.15	Smart features				
3.16	EMC performance				
3.17	Mounting				
3.18	IP Rating				
3.19	Haz. Area Cert.				
3.20	Cable entry/ connection				
3.21	Enclosure				
Compiled by:	Date:		Checked:	Approved:	

DATA SHEET (PART 2)

ELECTROMAGNETIC FLOWMETERS			
Part 2 Supplier Information To be completed by the supplier			
Tag No.	**Service Description**		**Issue. A**
1.0	**SUPPLIER AND MODEL DETAILS**		
1.1	Supplier		
1.2	Manufacturer		
1.3	Supplier address		
1.3	Supplier Tel/Fax		
1.5	Transmitter model No.		
1.6	Sensor/tube model No.		
1.7	Measurement range		
1.8	Weight and dimensions		
1.9	Order No.		
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**		
2.1	Calibration equipment required		
2.2	Consumables required		
2.3	Verification tools		
2.4	Calibration points		
2.5	Certification		
2.6	Guarantee period		
2.7	Training		
2.8	Finger Printing		
2.9	Resistance to compression forces		
3.0	**COST OF OWNERSHIP DETAILS**		
3.1	Instrument initial capital cost		
3.2	Annual cost of consumables		
3.3	Price for delivery to site		
3.3	Verification system (cost)		
3.4	Recommended maintenance interval		
3.5	Recommended maintenance time		
3.6	Recommended calibration Interval		
3.7	Recommended Calibration time		
3.8	Price for commissioning assistance		
3.9	Design life		
3.10	Calibration equipment/service cost		
3.11	Proposed 'Service Agreement' Attached		
COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for electromagnetic flowmeters and Part 1 of the data sheet with the following exceptions:			
Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

HAZARDOUS GAS DETECTORS					
Part 1 User Requirements Specification To be completed by the specifier					
Tag No.	**Service Description**			**Issue. A**	
1.0	**APPLICATION DETAILS**		2.0	**GAS ALARM MONITOR DETAILS**	
1.1	Client		2.1	No. of input channels	
1.2	Site		2.2	Alarm settings per inp.	
1.3	Project No.		2.3	Alarm outputs per inp.	
1.4	Sensor 1 location		2.4	Common alarm output	
1.5	Sensor 2 location		2.5	Current repeat output	
1.6	Sensor 3 location		2.6	Power Supply	
1.7	Sensor 4 location		2.7	Mounting	
1.8	Gas alarm monitor loc.		2.8	IP Rating	
1.9	Sensor-Alarm mon. sep.		2.9	Haz. Area Cert.	
3.0	**DETECTOR 1 DETAILS**		4.0	**DETECTOR 2 DETAILS**	
3.1	Monitored Gas		4.1	Monitored Gas	
3.2	Monitored conc.		4.2	Monitored conc.	
3.3	Accuracy		4.3	Accuracy	
3.4	Response time		4.4	Response time	
3.5	Output signal		4.5	Output signal	
3.6	Power supply		4.6	Power supply	
3.7	Mounting		4.7	Mounting	
3.8	IP Rating		4.8	IP Rating	
3.9	Haz. Area cert.		4.9	Haz. Area cert.	
5.0	**DETECTOR 3 DETAILS**		6.0	**DETECTOR 4 DETAILS**	
5.1	Monitored Gas		6.1	Monitored Gas	
5.2	Monitored conc.		6.2	Monitored conc.	
5.3	Accuracy		6.3	Accuracy	
5.4	Response time		6.4	Response time	
5.5	Output signal		6.5	Output signal	
5.6	Power supply		6.6	Power supply	
5.7	Mounting		6.7	Mounting	
5.8	IP Rating		6.8	IP Rating	
5.9	Haz. Area cert.		6.9	Haz. Area cert.	
ADDITIONAL INFORMATION					
Compiled by:	Date:		Checked:	Approved:	

DATA SHEET (PART 2)

HAZARDOUS GAS DETECTORS

Part 2 Supplier Information

To be completed by the supplier

Tag No.	Service Description	Issue. A

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Order No.	
1.6		
1.7		
1.8		
1.9		

		Model No.	Type	Range	Cell Life	Response time
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**					
2.1	Detector 1					
2.2	Detector 2					
2.3	Detector 3					
2.4	Detector 4					

2.5		
2.6	Alarm monitoring unit model No.	
2.7	No. of gas detector inputs	
2.8	Possible to mix flammable & toxic detectors	
2.9	Alarm unit and detector self diagnostic feature	

3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Calibration equipment cost	
3.3	Recommended Calibration Interval	
3.3	Estimated Calibration Time	
3.5	Guarantee Period	
3.6		
3.7		
3.8		
3.9		

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Flammable and Toxic Gas Detectors and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

LEVEL TRANSMITTER SUBMERSIBLE HYDROSTATIC HEAD			
Part 1 User Requirements Specification To be completed by the specifier			
Tag No.	**Service Description**		**Issue. A**

1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Body Material	
1.3	Project No.		4.3	Diaphg. material	
1.4	P & ID No.		4.4	Temp. comp.	
1.5	Vessel/Tank		4.5	IP Rating	
1.6	Level datum		4.6	Haz. Area Cert.	
1.7	Tx. location		4.7		
1.8	Sensor location		4.8		
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0		
2.1	Medium		5.1		
2.2	Temperature		5.2		
2.3	Pressure		5.3		
2.4	Density		5.4		
2.5	Corrosive		5.5		
2.6			5.6		
2.7			5.7		
2.8			5.8		
2.9			5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**ADDITIONAL FEATURES**	
3.1	Range		6.1	Smart Features	
3.2	Accuracy		6.2	Self diagnostics	
3.3	Resolution		6.3	O/ voltage prot.	
3.4	Response time		6.4	Cable length	
3.5	Output signal		6.5	Cable clamp	
3.6	Power Supply		6.6	External J/Box	
3.7	Mounting		6.7		
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		

ADDITIONAL INFORMATION			
Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 2)

LEVEL TRANSMITTER SUBMERSIBLE HYDROSTATIC HEAD		
Part 2 Supplier Information To be completed by the supplier		
AII.41 Tag No.	**Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Calibration equipment required	
2.2	Consumables required	
2.3		
2.4		
2.5		
2.6		
2.7		
2.8		
2.9		
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3		
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Submersible Hydrostatic Level Transmitter and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

AMMONIA ANALYSER					
Part 1 User Requirements Specification To be completed by the specifier					
Tag No.	**Service Description**				**Issue. A**
1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Size	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	IP Rating	
1.5	Line/vessel		4.5	Temp. Comp.	
1.6	Line size		4.6	Haz. Area Cert.	
1.7	Tx. location		4.7		
1.8	Sensor location		4.8		
1.9	Tx-sensor sep.		4.9		
2.0	**2. PROCESS DETAILS**		5.0	**SAMPLING SYSTEM DETAILS** (If applicable)	
2.1	Service fluid		5.1	Sample pump	
2.2	Tot. Ammonia (NH3-N)		5.2	Sample filter	
2.3	Temperature		5.3	Sample conditioning	
2.4	Pressure		5.4	Sample flow	
2.5	Flow rate		5.5	Sample temp	
2.6	Flow velocity		5.6	Sample press.	
2.7	pH		5.7		
2.8	Turbidity/ S/Solids		5.8		
2.9	Contaminants		5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range (mg/l) NH3-N		6.1	Auto cleaning	
3.2	Accuracy		6.2	Stand by sensor	
3.3	Resolution		6.3	Auto calibration	
3.4	Response time		6.4	Self diagnostics	
3.5	Output signal		6.5	H/W fail alarm	
3.6	Power Supply		6.6	HI/LO Alarm	
3.7	Mounting		6.7	Smart Features	
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		
ADDITIONAL INFORMATION					
Compiled by:	Date:		Checked:	Approved:	

DATA SHEET (PART 2)

AMMONIA ANALYSER		
Part 2 Supplier Information To be completed by the supplier		
AII.42 Tag No.	**Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Sampling equipment required	
2.2	Sample rate, temp. and pressure	
2.3	Sensor auto cleaning requirements	
2.4	Calibration equipment required	
2.5	Consumables required	
2.6	Reagents required	
2.7	Reagent storage precautions	
2.8	Reagent handling precautions	
2.9	Hazardous waste generated	
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3	Annual Cost of Reagents	
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Service Agreement Attached (Y/N)	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Total Ammonia Analyser and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

NITRATE ANALYSER

AII.43 Part 1 User Requirements Specification

AII.44 To be completed by the specifier

AII.45 Tag No.	**AII.46 Service Description**	**Issue. A**

1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Size	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	IP Rating	
1.5	Line/vessel		4.5	Temp. Comp.	
1.6	Line size		4.6	Haz. Area Cert.	
1.7	Tx. location		4.7		
1.8	Sensor location		4.8		
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0	**SAMPLING SYSTEM DETAILS** (If applicable)	
2.1	Service fluid		5.1	Sample pump	
2.2	Nitrates (mg/l) NO3-N		5.2	Sample filter	
2.3	Temperature		5.3	Sample conditioning	
2.4	Pressure		5.4	Sample flow	
2.5	Flow rate		5.5	Sample temp	
2.6	Flow velocity		5.6	Sample press.	
2.7	pH		5.7		
2.8	Turbidity/ S/Solids		5.8		
2.9	Contaminants		5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range (mg/l) NO3-N		6.1	Auto cleaning	
3.2	Accuracy		6.2	Stand by sensor	
3.3	Resolution		6.3	Auto calibration	
3.4	Response time		6.4	Self diagnostics	
3.5	Output signal		6.5	H/W fail alarm	
3.6	Power Supply		6.6	HI/LO Alarm	
3.7	Mounting		6.7	Smart Features	
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		

ADDITIONAL INFORMATION

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 2)

NITRATE ANALYSER		
Part 2 Supplier Information To be completed by the supplier		
Tag No.	**Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Sampling equipment required	
2.2	Sample rate, temp. and pressure	
2.3	Sensor auto cleaning requirements	
2.4	Calibration equipment required	
2.5	Consumables required	
2.6	Reagents required	
2.7	Reagent storage precautions	
2.8	Reagent handling precautions	
2.9	Hazardous waste generated	
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3	Annual Cost of Reagents	
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Service Agreement Attached (Y/N)	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Nitrate Analyser and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

OPEN CHANNEL FLOW TRANSMITTER					
AII.47 Part 1 User Requirements Specification AII.48 To be completed by the specifier					
AII.49 Tag No.	**AII.50 Service Description**			**Issue. A**	
1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Material	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	Frequency	
1.5	Channel ID		4.5	Block. distance	
1.6	Channel width		4.6	Beam angle	
1.7	Tx. location		4.7	Temp. comp.	
1.8	Sensor location		4.8	IP Rating	
1.9	Tx-sensor sep.		4.9	Haz. Area Cert.	
2.0	**PROCESS DETAILS**		5.0	**GAUGING STRUCTURE**	
2.1	Process fluid		5.1	Type	
2.2	Temperature		5.2	Size	
2.3	Flow velocity		5.3	Liquid head	
2.4	Density		5.4	Stilling well	
2.5	Foaming		5.5	Head Datum	
2.6	Corrosive		5.6		
2.7			5.7		
2.8			5.8		
2.9			5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range		6.1	Self diagnostics	
3.2	Accuracy		6.2	H/W fail alarm	
3.3	Resolution		6.3	HI/LO Alarm(s)	
3.4	Response time		6.4	Smart Features	
3.5	Output signal		6.5	Low flow cut off	
3.6	Power Supply		6.6	Flow totaliser	
3.7	Mounting		6.7		
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		
ADDITIONAL INFORMATION					
Compiled by:	Date:		Checked:	Approved:	

DATA SHEET (PART 2)

OPEN CHANNEL FLOW TRANSMITTER		
AII.51 Part 2 Supplier Information AII.52 To be completed by the supplier		
AII.53 Tag No.	**AII.54 Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Calibration equipment required	
2.2	Consumables required	
2.3		
2.4		
2.5		
2.6		
2.7		
2.8		
2.9		
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3		
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Open Channel Flow Transmitters and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

ORP ANALYSER					
AII.55 Part 1 User Requirements Specification AII.56 To be completed by the specifier					
AII.57 Tag No.	**AII.58 Service Description**				**Issue. A**
1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Size	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	Meas. Electrode	
1.5	Line/vessel		4.5	Ref. Electrode	
1.6	Line size		4.6	Temp. comp.	
1.7	Tx. location		4.7	IP Rating	
1.8	Sensor location		4.8	Haz. Area Cert.	
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0	**SAMPLING SYSTEM DETAILS** (If applicable)	
2.1	Service fluid		5.1	Sample pump	
2.2	ORP (mV)		5.2	Sample filter	
2.3	Temperature		5.3	Sample cond.	
2.4	Pressure		5.4	Sample flow	
2.5	Flow rate		5.5	Sample temp	
2.6	Flow velocity		5.6	Sample press.	
2.7	pH		5.7		
2.8	Foaming		5.8		
2.9	Contaminants		5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range (mV)		6.1	Auto cleaning	
3.2	Accuracy		6.2	Stand by sensor	
3.3	Resolution		6.3	Auto calibration	
3.4	Response time		6.4	Self diagnostics	
3.5	Output signal		6.5	H/W fail alarm	
3.6	Power Supply		6.6	HI/LO Alarm	
3.7	Mounting		6.7	Smart Features	
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		
ADDITIONAL INFORMATION					
Compiled by:	Date:		Checked:	Approved:	

DATA SHEET (PART 2)

ORP ANALYSER		
AII.59 Part 2 Supplier Information AII.60 To be completed by the supplier		
AII.61 Tag No.	**AII.62 Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Sampling equipment required	
2.2	Sample rate, temp. and pressure	
2.3	Sensor auto cleaning requirements	
2.4	Calibration equipment required	
2.5	Consumables required	
2.6	Reagents required	
2.7	Reagent storage precautions	
2.8	Reagent handling precautions	
2.9	Hazardous waste generated	
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3	Annual Cost of Reagents	
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for ORP Analyser and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

pH ANALYSER			
AII.63 Part 1 User Requirements Specification			
AII.64 To be completed by the specifier			
AII.65 Tag No.	**AII.66 Service Description**		**Issue. A**

1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Size	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	Meas. Electrode	
1.5	Line/vessel		4.5	Ref. Electrode	
1.6	Line size		4.6	Temp. comp.	
1.7	Tx. location		4.7	IP Rating	
1.8	Sensor location		4.8	Haz. Area Cert.	
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0	**SAMPLING SYSTEM DETAILS** (If applicable)	
2.1	Service fluid		5.1	Sample pump	
2.2	pH		5.2	Sample filter	
2.3	Temperature		5.3	Sample cond.	
2.4	Pressure		5.4	Sample flow	
2.5	Flow rate		5.5	Sample temp	
2.6	Flow velocity		5.6	Sample press.	
2.7	Conductivity		5.7		
2.8	Foaming		5.8		
2.9	Contaminants		5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range		6.1	Auto cleaning	
3.2	Accuracy		6.2	Stand by sensor	
3.3	Resolution		6.3	Auto calibration	
3.4	Response time		6.4	Self diagnostics	
3.5	Output signal		6.5	H/W fail alarm	
3.6	Power Supply		6.6	HI/LO Alarm	
3.7	Mounting		6.7	Smart Features	
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		

ADDITIONAL INFORMATION

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 2)

pH ANALYSER		
AII.67 Part 2 Supplier Information AII.68 To be completed by the supplier		
AII.69 Tag No.	**AII.70 Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Sampling equipment required	
2.2	Sample rate, temp. and pressure	
2.3	Sensor auto cleaning requirements	
2.4	Calibration equipment required	
2.5	Consumables required	
2.6	Reagents required	
2.7	Reagent storage precautions	
2.8	Reagent handling precautions	
2.9	Hazardous waste generated	
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3	Annual Cost of Reagents	
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for PH Analyser and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

PHOSPHATE ANALYSER					
AII.71 Part 1 User Requirements Specification AII.72 To be completed by the specifier					
AII.73 Tag No.	**AII.74 Service Description**			**Issue. A**	
1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Size	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	IP Rating	
1.5	Line/vessel		4.5	Temp. Comp.	
1.6	Line size		4.6	Haz. Area Cert.	
1.7	Tx. location		4.7		
1.8	Sensor location		4.8		
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0	**SAMPLING SYSTEM DETAILS** (If applicable)	
2.1	Service fluid		5.1	Sample pump	
2.2	Phosphates (mg/l) PO4-P		5.2	Sample filter	
2.3	Temperature		5.3	Sample conditioning	
2.4	Pressure		5.4	Sample flow	
2.5	Flow rate		5.5	Sample temp	
2.6	Flow velocity		5.6	Sample press.	
2.7	pH		5.7		
2.8	Turbidity/ S/Solids		5.8		
2.9	Contaminants		5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range (mg/l) PO4-P		6.1	Auto cleaning	
3.2	Accuracy		6.2	Stand by sensor	
3.3	Resolution		6.3	Auto calibration	
3.4	Response time		6.4	Self diagnostics	
3.5	Output signal		6.5	H/W fail alarm	
3.6	Power Supply		6.6	HI/LO Alarm	
3.7	Mounting		6.7	Smart Features	
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		
ADDITIONAL INFORMATION					
Compiled by:	Date:		Checked:	Approved:	

DATA SHEET (PART 2)

PHOSPHATE ANALYSER			
AII.75 Part 2 Supplier Information AII.76 To be completed by the supplier			
AII.77 Tag No.	**AII.78 Service Description**		**Issue. A**
1.0	**SUPPLIER AND MODEL DETAILS**		
1.1	Supplier		
1.2	Manufacturer		
1.3	Supplier Address		
1.3	Supplier Tel/Fax		
1.5	Transmitter Model No.		
1.6	Sensor Model No.		
1.7	Measurement Range		
1.8	Weight and dimensions		
1.9	Order No.		
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**		
2.1	Sampling equipment required		
2.2	Sample rate, temp. and pressure		
2.3	Sensor auto cleaning requirements		
2.4	Calibration equipment required		
2.5	Consumables required		
2.6	Reagents required		
2.7	Reagent storage precautions		
2.8	Reagent handling precautions		
2.9	Hazardous waste generated		
3.0	**COST OF OWNERSHIP DETAILS**		
3.1	Instrument Initial Capital Cost		
3.2	Annual Cost of Consumables		
3.3	Annual Cost of Reagents		
3.3	Recommended Maintenance Interval		
3.5	Recommended Maintenance Time		
3.6	Recommended Calibration Interval		
3.7	Recommended Calibration Time		
3.8	Guarantee Period		
3.9	Service Agreement Attached (Y/N)		

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Phosphate Analyser and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

GAUGE PRESSURE INSTRUMENT			
AII.80 **AII.79 Part 1 User Requirements Specification-page 1**			
AII.81 Tag No.	**AII.82 Service Description**		**Issue. A**

1.0	**APPLICATION DETAILS**		
1.1	Client		
1.2	Site		
1.3	Project No.		
1.4	P & ID No.		
1.5	Pipe Ident.		
1.6	Pipe Dia.		
1.7	Tx. location		
1.8	Sensor location		
1.9	Tx -sensor cable length		
2.0	**PROCESS DETAILS**		
2.1	Process fluid		
2.2	Conductivity		
2.3	Temperature		
2.4	Pressure		
2.5	Corrosive		
2.6	Abrasive		
3.0	**INSTRUMENT DETAILS**		
	Description	**SWC Requirements**	**Supplier's offer**
3.1	Calibrated range		
3.2	Min/Max range		
3.3	Power Supply	Loop powered 24V DC	
3.4	Current output	4-20mA	
3.5	Accuracy (system)	See technical specification	
3.6	Stability	See technical specification	
3.7	Repeatability	See accuracy	
3.8	Turn on time (warm up)	See technical specification	
3.9	Total Response time	See technical specification	
3.10	Damping	Supplier to nominate	
3.11	Zero adjustment	See technical specification	
3.12	Suppression/elevation	Yes	
3.13	Resolution	Supplier to nominate	
3.14	Display		
3.15	Turndown ratio	Supplier to nominate	
3.16	Operating temperature (display version)	See technical specification	
3.17	EMC performance	See technical specification	
3.18	Mounting		
3.19	IP Rating	See technical specification	
3.20	Haz. Area Cert.		
3.21	Cable entry/ connection	See technical specification	
3.22	Enclosure	Supplier to nominate	
3.23	Weight/dimension	Supplier to nominate	

Compiled by:	Date:	Checked:	Approved:

GAUGE PRESSURE INSTRUMENT			
AII.84	AII.83 Part 1 User Requirements Specification- page 2		
AII.85 Tag No.	AII.86 Service Description		Issue. A

	Description	SWC Requirements	Supplier's offer
4.0	3. SENSOR AND PROCESS CONNECTION DETAILS		
4.1	Type	See technical specification	
4.2	Size		
4.3	Connection type	See technical specification	
4.4	Sensor technology	Supplier to nominate	
4.5	Over pressure rating	Supplier to nominate	
4.6	Burst pressure rating	Supplier to nominate	
4.7	Venting to atmosphere (reference pressure detection method)	Supplier to nominate	
4.8	IP rating	See technical specification	
4.9	Signal cable	See technical specification	
4.10	Haz. Area Cert.		
5.0	**DEVICE MANAGEMENT/CONFIGURATION & CALIBRATION TOOL**		
5.1	Device Management Technology	Supplier to nominate (EDDL or FDT/DTM or other methods)	
5.2	Management software title		
5.3	SW/HW requirements		
5.4	Configuration functionality		
5.5	Device Parameters and setting		
5.6	Device Functions		
5.7	Diagnostic data		
5.8	Calibration		
5.9	Commissioning/simulation tools		
5.10	Maintenance tools		
5.11	Support of open system		
5.12	Backward compatibility		
5.13	Dependency on operating system		
5.14	Supported communication protocols		
5.15	Version control principle		
5.16	International Standard		
5.17	User interface style		
5.18	Presentation of device functionality		
5.19	Certification		
5.20	Licensing procedure		
5.21	Other features		
	OTHER FEATURES		
6.0	Diagnostics/failure mode	Supplier to nominate	
6.1	H/W fail alarm	Supplier to nominate	
6.2	HI/LO Alarm(s)	Supplier to nominate	
6.3	In built surge protection	Yes	
6.4	Communications	See technical specification	
6.5	Smart features	Yes	
6.6	Other		

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 2)

GAUGE PRESSURE INSTRUMENT		
AII.87 Part 2 Supplier Information AII.88 To be completed by the supplier		
AII.89 Tag No.	**AII.90 Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier address	
1.3	Supplier Tel/Fax	
1.5	Transmitter model No.	
1.6	Sensor/tube model No.	
1.7	Measurement range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Calibration equipment required	
2.2	Consumables required	
2.3	Verification tools	
2.4	Calibration points	
2.5	Certification	
2.6	Guarantee period	
2.7	Training	
2.8	Finger Printing	
2.9		
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument initial capital cost	
3.2	Annual cost of consumables	
3.3	Price for delivery to site	
3.3	Configuration/calibration system (cost)	
3.4	Configuration/calibration licensing cost	
3.5	Hand held communicator cost	
3.6	Recommended maintenance interval	
3.7	Recommended maintenance time	
3.8	Recommended calibration Interval	
3.9	Recommended Calibration time	
3.10	Price for commissioning assistance	
3.11	Design life	
3.12	Calibration equipment and service cost	
3.13	Proposed 'Service Agreement' Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for gauge pressure transmitter and Part 1 of the data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

SLUDGE BLANKET LEVEL ANALYSER

AII.91 Part 1 User Requirements Specification

AII.92 To be completed by the specifier

AII.93 Tag No.	**AII.94 Service Description**	**Issue. A**

1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Size	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	IP Rating	
1.5	Tank identif.		4.5	Haz. Area Cert.	
1.6	Tank depth		4.6		
1.7	Tx. location		4.7		
1.8	Sensor location		4.8		
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0	**SAMPLING SYSTEM DETAILS** (If applicable)	
2.1	Service fluid		5.1		
2.2	SBL range (m)		5.2		
2.3	Temperature		5.3		
2.4	Pressure		5.4		
2.5	Flow rate		5.5		
2.6	Flow velocity		5.6		
2.7	pH		5.7		
2.8	Foaming		5.8		
2.9	Contaminants		5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range (m)		6.1	Auto cleaning	
3.2	Accuracy		6.2	Stand by sensor	
3.3	Resolution		6.3	Auto calibration	
3.4	Response time		6.4	Self diagnostics	
3.5	Output signal		6.5	H/W fail alarm	
3.6	Power Supply		6.6	HI/LO Alarm	
3.7	Mounting		6.7	Smart Features	
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		

ADDITIONAL INFORMATION

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 2)

SLUDGE BLANKET LEVEL ANALYSER		
AII.95 Part 2 Supplier Information AII.96 To be completed by the supplier		
AII.97 Tag No.	**AII.98 Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Sampling equipment required	
2.2	Sample rate, temp. and pressure	
2.3	Sensor auto cleaning requirements	
2.4	Calibration equipment required	
2.5	Consumables required	
2.6	Reagents required	
2.7	Reagent storage precautions	
2.8	Reagent handling precautions	
2.9	Hazardous waste generated	
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3	Annual Cost of Reagents	
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Sludge Blanket Level Analyser and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

SLUDGE DENSITY ANALYSER					
AII.99 Part 1 User Requirements Specification					
AII.100 To be completed by the specifier					
AII.101 Tag No.	**AII.102 Service Description**				**Issue. A**
1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Size	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	IP Rating	
1.5	Line/vessel		4.5	Haz. Area Cert.	
1.6	Line size		4.6		
1.7	Tx. location		4.7		
1.8	Sensor location		4.8		
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0	**SAMPLING SYSTEM DETAILS** (If applicable))	
2.1	Service fluid		5.1	Sample pump	
2.2	S/ Density (%)		5.2	Sample filter	
2.3	Temperature		5.3	Sample cond.	
2.4	Pressure		5.4	Sample flow	
2.5	Flow rate		5.5	Sample temp	
2.6	Flow velocity		5.6	Sample press.	
2.7	pH		5.7		
2.8	Foaming		5.8		
2.9	Contaminants		5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range (%)		6.1	Auto cleaning	
3.2	Accuracy		6.2	Stand by sensor	
3.3	Resolution		6.3	Auto calibration	
3.4	Response time		6.4	Self diagnostics	
3.5	Output signal		6.5	H/W fail alarm	
3.6	Power Supply		6.6	HI/LO Alarm	
3.7	Mounting		6.7	Smart Features	
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		
ADDITIONAL INFORMATION					
Compiled by:	Date:		Checked:	Approved:	

DATA SHEET (PART 2)

SLUDGE DENSITY ANALYSER		
AII.103 Part 2 Supplier Information AII.104 To be completed by the supplier		
AII.105 Tag No.	**AII.106 Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Sampling equipment required	
2.2	Sample rate, temp. and pressure	
2.3	Sensor auto cleaning requirements	
2.4	Calibration equipment required	
2.5	Consumables required	
2.6	Reagents required	
2.7	Reagent storage precautions	
2.8	Reagent handling precautions	
2.9	Hazardous waste generated	
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3	Annual Cost of Reagents	
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Sludge Density Analyser and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

SUSPENDED SOLIDS ANALYSER					
AII.107 Part 1 User Requirements Specification					
AII.108 To be completed by the specifier					
AII.109 Tag No.		**AII.110 Service Description**		**Issue. A**	
1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Size	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	IP Rating	
1.5	Line/vessel		4.5	Haz. Area Cert.	
1.6	Line size		4.6		
1.7	Tx. location		4.7		
1.8	Sensor location		4.8		
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0	**SAMPLING SYSTEM DETAILS** (If applicable)	
2.1	Service fluid		5.1	Sample pump	
2.2	S/Solids -mg/l		5.2	Sample filter	
2.3	Temperature		5.3	Sample cond.	
2.4	Pressure		5.4	Sample flow	
2.5	Flow rate		5.5	Sample temp	
2.6	Flow velocity		5.6	Sample press.	
2.7	pH		5.7		
2.8	Foaming		5.8		
2.9	Contaminants		5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range (mg/l)		6.1	Auto cleaning	
3.2	Accuracy		6.2	Stand by sensor	
3.3	Resolution		6.3	Auto calibration	
3.4	Response time		6.4	Self diagnostics	
3.5	Output signal		6.5	H/W fail alarm	
3.6	Power Supply		6.6	HI/LO Alarm	
3.7	Mounting		6.7	Smart Features	
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		
ADDITIONAL INFORMATION					
Compiled by:		Date:	Checked:		Approved:

DATA SHEET (PART 2)

SUSPENDED SOLIDS ANALYSER		
AII.111 Part 2 Supplier Information AII.112 To be completed by the supplier		
AII.113 Tag No.	**AII.114 Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Sampling equipment required	
2.2	Sample rate, temp. and pressure	
2.3	Sensor auto cleaning requirements	
2.4	Calibration equipment required	
2.5	Consumables required	
2.6	Reagents required	
2.7	Reagent storage precautions	
2.8	Reagent handling precautions	
2.9	Hazardous waste generated	
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3	Annual Cost of Reagents	
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Suspended Solids Analyser and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

TURBIDITY ANALYSER					
AII.115 Part 1 User Requirements Specification					
AII.116 To be completed by the specifier					
AII.117 Tag No.	**AII.118 Service Description**				**Issue. A**
1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Size	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	IP Rating	
1.5	Line/vessel		4.5	Haz. Area Cert.	
1.6	Line size		4.6		
1.7	Tx. location		4.7		
1.8	Sensor location		4.8		
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0	**SAMPLING SYSTEM DETAILS** (If applicable)	
2.1	Service fluid		5.1	Sample pump	
2.2	Turbidity (FTU)		5.2	Sample filter	
2.3	Temperature		5.3	Sample bubble trap	
2.4	Pressure		5.4	Sample flow	
2.5	Flow rate		5.5	Sample temp	
2.6	Flow velocity		5.6	Sample press.	
2.7	pH		5.7		
2.8	Foam/bubbles		5.8		
2.9	Contaminants		5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range (FTU)		6.1	Auto cleaning	
3.2	Accuracy		6.2	Stand by sensor	
3.3	Resolution		6.3	Auto calibration	
3.4	Response time		6.4	Self diagnostics	
3.5	Output signal		6.5	H/W fail alarm	
3.6	Power Supply		6.6	HI/LO Alarm	
3.7	Mounting		6.7	Smart Features	
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		
ADDITIONAL INFORMATION					
Compiled by:	Date:		Checked:	Approved:	

DATA SHEET (PART 2)

TURBIDITY ANALYSER		
AII.119 Part 2 Supplier Information AII.120 To be completed by the supplier		
AII.121 Tag No.	**AII.122 Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Sampling equipment required	
2.2	Sample rate, temp. and pressure	
2.3	Sensor auto cleaning requirements	
2.4	Calibration equipment required	
2.5	Consumables required	
2.6	Reagents required	
2.7	Reagent storage precautions	
2.8	Reagent handling precautions	
2.9	Hazardous waste generated	
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3	Annual Cost of Reagents	
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Turbidity Analyser and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

TEMPERATURE TRANSMITTER		
AII.123 Part 1 User Requirements Specification AII.124 To be completed by the specifier		
AII.125 Tag No.	**AII.126 Service Description**	**Issue. A**

1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Material	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	Length	
1.5	Line/Vessel		4.5	Diameter	
1.6	Line size		4.6		
1.7	Tx. location		4.7		
1.8	Sensor location		4.8		
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0	**THERMOWELL**	
2.1	Process fluid		5.1	Mounting	
2.2	Temperature		5.2	Material	
2.3	Pressure		5.3	Length	
2.4	Flow velocity		5.4	Construction	
2.5	Corrosive		5.5		
2.6	Erosive		5.6		
2.7			5.7		
2.8			5.8		
2.9			5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range		6.1	Sensor burnout	
3.2	Accuracy		6.2	Self diagnostics	
3.3	Resolution		6.3	Smart Features	
3.4	Response time		6.4		
3.5	Output signal		6.5		
3.6	Power Supply		6.6		
3.7	Mounting		6.7		
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		

ADDITIONAL INFORMATION			
Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 2)

TEMPERATURE TRANSMITTER		
AII.127 Part 2 Supplier Information AII.128 To be completed by the supplier		
AII.129 Tag No.	**AII.130 Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Calibration equipment required	
2.2	Consumables required	
2.3		
2.4		
2.5		
2.6		
2.7		
2.8		
2.9		
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3		
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Temperature Transmitter and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

TOTAL ORGANIC CARBON ANALYSER					
AII.131 Part 1 User Requirements Specification AII.132 To be completed by the specifier					
AII.133 Tag No.	**AII.134 Service Description**			**Issue. A**	
1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Size	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	IP Rating	
1.5	Line/vessel		4.5	Temp. Comp.	
1.6	Line size		4.6	Haz. Area Cert.	
1.7	Tx. location		4.7		
1.8	Sensor location		4.8		
1.9	Tx-sensor sep.		4.9		
2.0	**PROCESS DETAILS**		5.0	**SAMPLING SYSTEM DETAILS** (If applicable)	
2.1	Service fluid		5.1	Sample pump	
2.2	Total Organic Carbon		5.2	Sample filter	
2.3	Temperature		5.3	Sample conditioning	
2.4	Pressure		5.4	Sample flow	
2.5	Flow rate		5.5	Sample temp	
2.6	Flow velocity		5.6	Sample press.	
2.7	pH		5.7		
2.8	Turbidity/ S/Solids		5.8		
2.9	Contaminants		5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**OPTIONAL FEATURES**	
3.1	Range (mg/l) TOC		6.1	Auto cleaning	
3.2	Accuracy		6.2	Stand by sensor	
3.3	Resolution		6.3	Auto calibration	
3.4	Response time		6.4	Self diagnostics	
3.5	Output signal		6.5	H/W fail alarm	
3.6	Power Supply		6.6	HI/LO Alarm	
3.7	Mounting		6.7	Smart Features	
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		
ADDITIONAL INFORMATION					
Compiled by:	Date:		Checked:	Approved:	

DATA SHEET (PART 2)

TOTAL ORGANIC CARBON ANALYSER			
AII.135 Part 2 Supplier Information AII.136 To be completed by the supplier			
AII.137 Tag No.	**AII.138 Service Description**		**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Sampling equipment required	
2.2	Sample rate, temp. and pressure	
2.3	Sensor auto cleaning requirements	
2.4	Calibration equipment required	
2.5	Consumables required	
2.6	Reagents required	
2.7	Reagent storage precautions	
2.8	Reagent handling precautions	
2.9	Hazardous waste generated	
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3	Annual Cost of Reagents	
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Service Agreement Attached (Y/N)	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Total organic Carbon Analyser and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

ULTRA-SONIC FLOW TRANSMITTER					
AII.139 **Part 1** User Requirements Specification AII.140					
AII.141 Tag No.	**Service Description**				**Issue. A**
1.0	**APPLICATION DETAILS**		4.0	**TRANSDUCERS (sensor)**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Number of sensors	
1.3	Project No.		4.3	Wetted or non-wetted	
1.4	P & ID No.		4.4	Mounting	
1.5	Pipe Ident.		4.5	Connection	
1.6	Pipe Dia.		4.6	Pressure	
1.7	Tx. location		4.7	Material	
1.8	Sensor location		4.8	Protection	
1.9	Tx-sensor sep.		4.9	Haz. Area Cert.	
2.0	**PROCESS DETAILS**		5.0	**METER TUBE AND BODY**	
2.1	Process fluid		5.1	Nominal size	
2.2	Solids Conc.		5.2	Pressure rating	
2.3	Flow velocity		5.3	Inner diameter	
2.4	Temperature		5.4	Dimension	
2.5	Pressure		5.5	Weight	
2.6	Density		5.6	Material	
2.7	Viscosity		5.7	Process connection	
2.8	Corrosive		5.8	Protective coating	
2.9	Abrasive		5.9	Mounting/Restrictions	
3.0	**INSTRUMENT DETAILS**		6.0	**OTHER FEATURES**	
3.1	Calibrated range		6.1	Diagnostics	
3.2	Min/Max range		6.2	H/W fail alarm	
3.3	Accuracy (system)		6.3	HI/LO Alarm(s)	
3.4	Resolution		6.4	Low flow cut off	
3.5	Response time		6.5	Flow totaliser	
3.6	Repeatability		6.6	Custody transfer	
3.7	Calibration /meter factor		6.7	In built surge protection	
3.8	Power Supply		6.8	Communications	
3.9	Inrush current		6.9	Other	
3.10	Display		**ADDITIONAL INFORMATION**		
3.11	Operating temperature (display version)				
3.12	Flow direction				
3.13	Current output(s)				
3.14	Digital output(s)				
3.15	Pulse/frequency output(s)				
3.16	Smart features				
3.17	Mounting				
3.18	IP Rating				
3.19	Haz. Area Cert.				
3.20	Cable entry/ connection				
3.21	Enclosure				
Compiled by:	Date:		Checked:		Approved:

DATA SHEET (PART 2)

ULTRA-SONIC FLOW TRANSMITTER		
AII.142 Part 2 Supplier Information AII.143 To be completed by the supplier		
AII.144 Tag No.	**AII.145 Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor/tube Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Calibration equipment required	
2.2	Consumables required	
2.3	Verification procedure /Tools	
2.4	Calibration points	
2.5	Certification	
2.6	Guarantee Period	
2.7	Training	
2.8	Finger Printing	
2.9	Resistance to compression forces	
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3	Price for delivery to site	
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Price for commissioning assistance	
3.9	Design life	
3.10	Calibration equipment/service cost	
3.11	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Ultrasonic Flow Transmitters and Part 1 of the data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

DATA SHEET (PART 1)

ULTRASONIC LEVEL TRANSMITTER					
AII.146 Part 1 User Requirements Specification AII.147 To be completed by the specifier					
AII.148 Tag No.		**AII.149 Service Description**			**Issue. A**
1.0	**APPLICATION DETAILS**		4.0	**SENSOR DETAILS**	
1.1	Client		4.1	Type	
1.2	Site		4.2	Material	
1.3	Project No.		4.3	Mounting	
1.4	P & ID No.		4.4	Frequency	
1.5	Vessel/Tank		4.5	Block. distance	
1.6	Level datum		4.6	Beam angle	
1.7	Tx. location		4.7	Temp. comp.	
1.8	Sensor location		4.8	IP Rating	
1.9	Tx-sensor sep.		4.9	Haz. Area Cert.	
2.0	**PROCESS DETAILS**		5.0		
2.1	Medium		5.1		
2.2	Temperature		5.2		
2.3	Pressure		5.3		
2.4	Density		5.4		
2.5	Foaming		5.5		
2.6	Bridging		5.6		
2.7	Dust/Vapour		5.7		
2.8	Corrosive		5.8		
2.9			5.9		
3.0	**TRANSMITTER DETAILS**		6.0	**ADDITIONAL FEATURES**	
3.1	Range		6.1	Self diagnostics	
3.2	Accuracy		6.2	H/W fail alarm	
3.3	Resolution		6.3	HI/LO Alarm(s)	
3.4	Response time		6.4	Smart Features	
3.5	Output signal		6.5	O/voltage Prot.	
3.6	Power Supply		6.6		
3.7	Mounting		6.7		
3.8	IP Rating		6.8		
3.9	Haz. Area Cert.		6.9		
ADDITIONAL INFORMATION					
Compiled by:		Date:	Checked:		Approved:

DATA SHEET (PART 2)

ULTRASONIC LEVEL TRANSMITTER		
AII.150 Part 2 Supplier Information AII.151 To be completed by the supplier		
AII.152 Tag No.	**AII.153 Service Description**	**Issue. A**

1.0	**SUPPLIER AND MODEL DETAILS**	
1.1	Supplier	
1.2	Manufacturer	
1.3	Supplier Address	
1.3	Supplier Tel/Fax	
1.5	Transmitter Model No.	
1.6	Sensor Model No.	
1.7	Measurement Range	
1.8	Weight and dimensions	
1.9	Order No.	
2.0	**OPERATION AND MAINTENANCE REQUIREMENTS**	
2.1	Calibration equipment required	
2.2	Consumables required	
2.3		
2.4		
2.5		
2.6		
2.7		
2.8		
2.9		
3.0	**COST OF OWNERSHIP DETAILS**	
3.1	Instrument Initial Capital Cost	
3.2	Annual Cost of Consumables	
3.3		
3.3	Recommended Maintenance Interval	
3.5	Recommended Maintenance Time	
3.6	Recommended Calibration Interval	
3.7	Recommended Calibration Time	
3.8	Guarantee Period	
3.9	Proposed Service Agreement Attached	

COMPLIANCE STATEMENT. The information given in part 2 of this data sheet (above) is correct. The proposed instrument is able to meet Sydney Water standard specifications for Ultrasonic Level Transmitters and Part 1 of data sheet with the following exceptions:

Compiled by:	Date:	Checked:	Approved:

A2.2 Index 2: OEM compliance check sheets

Check sheets	ISSUE	TITLE
1	A	Ammonia Analyser Check Sheet
2	A	Biogas Analyser Check Sheet
3	A	Conductivity Meter Check Sheet
4	A	Dissolved Oxygen Analyser Check Sheet
5	A	Fluoride Analyser Check Sheet
6	A	Free Chlorine Analyser Check Sheet
7	A	Total Chlorine Analyser Check Sheet
8	A	Gas Detection and Alarming – Methane/LEL Check Sheet
9	A	Gas Detection and Alarming – H_2S Check Sheet
10	A	Gas Detection and Alarming – Chlorine Check Sheet
11	A	Gas Detection and Alarming – Oxygen Check Sheet
12	A	Moisture Meter Check Sheet
13	A	Nitrate Analyser Check Sheet
14	A	ORP/Redox Meter Check Sheet
15	A	Orthophosphorus Analyser Check Sheet
16	A	pH Meter Check Sheet
17	A	Sludge Blanket Level Check Sheet
18	A	Sludge Density/Suspended Solids Analyser Check Sheet
19	A	Turbidity Analyser – Contact Type Check Sheet
20	A	Ultraviolet Transmittance (UVT) Analyser Check Sheet

Data Sheet			
Instrument	Ammonia analyser	**Application**	Nitrification/chloramination
		Installation	Sample take off
Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Potentiometric-Gas Selective electrode Reagent assisted multi wavelength absorbance	
6	Required Compliance	Australian Standards	
7	Digital communications	Vendor to detail what is available through HART	
8	Integrated or separate electronics	Both arrangements are acceptable	
9	Element Cleaning	Supplier to state options - automated cleaning is essential.	
10	Damping Constant	Supplier to state approach and limits	
11	Calibration - Zeroing	Supplier to state calibration method. Automatic zeroing preferred.	
12	Calibration - Span	Supplier to state calibration method	
13	Digital Output	Status condition required	
14	Operator Display	LCD display showing reading and units	
Functional Specification			
15	Operating Temperature	5 to 40^0 C (ambient)	
16	Operating Pressure	Supplier to specifiy maximum sample pressure the instrument can handle.	
17	Operating pH	4 – 9	

18	Units of Measurement	Concentration of total ammonia expressed as milligrams of NH3-N per litre of solution (mg/L)	
19	Digital low level alarm	All reagent containers will be monitored for level utilising a capacitance switch or similar. A single low level warning signal shall be made availble to SCADA	
20	Analog Output 1 (4 – 20 mA)	Wastewater: NH3-N (mg/L) range of: 0 - 10 mg/L to 0 - 100 mg/L. Supplier to provide available range options. Recycled Water: NH3-N (mg/L) range of: 0 - 5 mg/L Water: NH3-N (mg/L) range of: 0 - 0.5 mg/l to 0 - 20 mg/l	
21	Analog Output 2 (4 – 20 mA)	Are there options or can the unit be configured to monitor two streams with two separate ammonia concentration outputs	
Performance Specification			
22	Accuracy	Better than the greater of ± 10% of the reading or ± 0.5 mg/L	
23	Repeatability	Better than the greater of ± 5.0% of the reading or ± 0.2 mg/L.	
24	Response time (t_{90})	The analyser shall respond (90% of final value) to any step changes in measured parameter in the process stream within 10 minutes.	
25	Strainer and filter cleaning interval	The strainer and filter system shall be designed to require attention (cleaning, replacement) at most once per month.	
26	Regeant Replacement	All reagents and all other solutions should not require change/top-up at frequencies of less than than once monthly.	
27	Sample Preparation	Supplier to specify the sample preparation system requirements	
28	Mean time between failures (hours of operation)	Supplier to specify	
Installation Specification			
29	Cleaning system	Equipped with chemical auto cleaning. Supplier to specify chemical used.	
30	Wetted Materials	Supplier to specify	

31	Hazardous area compatibility	Supplier to specify	
32	Installation Specification	Instrument should be mounted to additional support frame (design supplied by Sydney Water) and not mounted on existing handrails. In tank sample offtake: ChemScan; sample off take and filtration unit should be suspended on a swivel arm extended into the tank. Refer to Appendix Drawing: DWG-L-01. Hach; filtration unit should be installed in the process fluid in a or cradle with a winch system or pumped to an overflow vessel attached to a support frame. Filtrax (part no: 5738901) will not be accepted. Refer to Appendix Drawing: DWG-L-03. In channel sample offtake: ChemScan; a slot should be cut out of the Anderson grid and the sample line and filtration unit insterted through the slot. Refer to Appendix Drawing: DWG-L-02. Hach: filtration unit should be installed in the process fluid in a or cradle with a winch system or pumped to an overflow vessel attached to a support frame. Filtrax (part no: 5738901) will not be accepted. Refer to Appendix Drawing: DWG-L-03. Suppliers to provide installation angles and distances from mounting surface, base of tank/channel, side walls, submersible depth, diffusion heads or any other surface that may cause interference eg flow, inconsistent bubbles, ragging or fouling. Lock to support frame of chain and/or tubing to enable stabilisation during maintenance.	
33	Sampling	In situ or via a valve located near to the sensor.	

Data Sheet			
Instrument	Biogas Analyser	**Application**	Biogas
		Installation	Anaerobic digester biogas

Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Infrared for methane and carbon dioxide. Chemical sensor for oxygen and hydrogen sulfide. The measurement shall not be adversely affected by temperature, ambient light, colour of sample or aging of sensor components	
6	Required Compliance	Vendor to state certifications	
7	Integrated or separate electronics	Vendor to detail if separate electronics available. Not generally required.	
8	Biogas Constituents	Carbon dioxide, hydrogen sulphide, methane, oxygen and condensing water vapour. Vendor to supply measurement limits and sample preparation approach	
9	Damping Constant	Vendor to state approach and limits	
10	Calibration - Zeroing	Instrument shall be capable of being zeroed for methane and hydrogen sulfide in atmospheric air	
11	Calibration - Span	Instrument shall be capable of being calibrated from a calibration standard	
12	Operator Display	LCD display showing reading, units and sampling point (if multiple sampling points possible)	
Functional Specification			
13	Operating Temperature	5 - 50 °C (ambient)	
14	Operating Pressure	Vendor to specify requirements (biogas normally 3-4 kPa above atmospheric pressure so needs to work for this)	

15	Units of Measurement	% fraction for methane, carbon dioxide and oxygen (supplier to specify mass or volume basis) and ppm for hydrogen sulphide (supplier to specify mass or volume basis)	
16	Analog Output 1 (4 – 20 mA)	Methane- % (volume or mass basis) (0-100%)	
17	Analog Output 2 (4 – 20 mA)	Carbon Dioxide- % (volume or mass basis) (0-100%)	
18	Analog Output 3 (4 – 20 mA)	Oxygen- % (volume of mass basis) (0-25%)	
19	Analog Output 4 (4 – 20 mA)	Hydrogen sulfide- ppm (volume or mass basis) (0-5000 ppm)	
20	Digital communications	Vendor to detail what is available through HART	
21	Digital Output	Status condition required	
Performance Specification			
22	Accuracy	±5% of span	
23	Repeatability	±2.5% of span	
24	Response time (t_{90})	If sampling the one location continuously: <5 min. If taken intermittent sampling: lesser of within 10 min of starting sampling from that point or maximum sample time (note this is usually a feature of sampling pipework than the instrument itself)	
25	Mean time between failures (hours of operation)	Vendor to specify	
Installation Specification			
25	Measuring element liner	Supplier to state options, sufficient to handle high hydrogen sulfide (up to 10000 ppm)	
26	Sample Preparation	Biogas is normally wet so a system to remove water if required. Vendor to specify their system and maintenance requirements.	
27	Material	Vendor to specify. Stainless steel sampling lines (usually 1/4") to bring biogas samples to the instrument	
28	Flowrate	Vendor to specify sample flow.	

29	Hazardous area compatibility	Vendor to state certifications	
30	Maintenance Specification	Analyser shall be easily accessible and gas lines to analyser easy to isolate (either through installation method or in the analyser itself). Vendor to specify maintenance requirements.	
31	Installation Specification	Sampling lines will take the sample from a biogas line to the analyser. There should be an additional valve allowing a portable meter to sample from the same location. Analyser location, electronics and sample disposal should all conform to IECEx rules. The analyser should be installed in an easy to access and maintain location. Refer to Appendix Drawing DWG-N-01.	
32	Sampling	A sample valve should be provided near to the sensor for sample collection for calibration checks.	

Data Sheet			
Instrument	Conductivity Meter	**Application**	Drinking water: membrane permeate and clean in place (CIP) Wastewater: chemical dosing for odour scrubbers, influent monitoring
		Installation	Sample offtake, in-line on wet rack
Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Torroidal or four-electrode probes. Torroidal for high conductivity applications (odour scrubbing, influent channels) or where stream contains residual organics (e.g. oil and grease). Electrode for low conductivity, contaminant free streams (e.g. membrane permeate). In both cases the measurement cells shall be provided with an integral Pt.100 automatic temperature compensation element.	
6	Required Compliance	Vendor to advise.	
7	Digital communications	Vendor to detail what is available through HART	
8	Element Cleaning	Vendor to provide details for options	
9	Damping Constant	Vendor to state approach and limits	

10	Calibration - Zeroing	Vendor to provide options for zeroing.	
11	Calibration - Span	Instrument shall be capable of being calibrated with standard solutions.	
12	Digital Output	Status condition required	
13	Operator Display	LCD display showing reading and units	
Functional Specification			
14	Operating Temperature	5 - 35 °C (ambient)	
15	Operating Pressure	Vendor to specify maximum operating pressure	
16	Operating pH	4 - 12	
17	Units of Measurement	Membrane permeate: microSiemens per centimetre (µS/cm) Odour scrubbing: milliSiemens per centimetre (mS/cm)	
18	Analog Output 1 (4 – 20 mA)	Membrane permeate - 0 - 1000 µS/cm at 25 °C Odour scrubbers - 0 - 100 mS/cm at 25 °C	
19	Analog Output 2 (4 – 20 mA)	Temperature - 0 - 100 °C	
Performance Specification			
20	Accuracy	Conductivity: ± 0.5% of span Temperature: ± 0.3 °C	
21	Repeatability	± 0.5% of span	
22	Response time (t_{90})	< 30 seconds to reach 90% of final value	
23	Mean time between failures (hours of operation)	Vendor to specify	
Installation Specification			
24	Wetted element liner	Vendor to match wetted material to application/process fluid	

25	Hazardous area compatibility	Vendor to provide the transmitter certifications	
26	Maintenance	If auto-cleaning is used, the probe construction shall enable on-line flushing of the sensor with clean water (reclaimed effluent or industrial water). Refer to Appendix Drawing DWG-A-01. For in-pipe installation, sensors must be suitable for quick installation and removal from process pipelines without the need to stop the process flow e.g. hot-tap type interface.	
27	Installation Specification	Refer to Appendix Drawing DWG-B-01. Refer to Appendix Drawing DWG-C-01 for installation within a pH/ORP/Conductivity wet rack. Refer to Appendix Drawing DWG-H-01 for installation within a water quality monitoring panel. Vendor to advise of installation options.	
28	Sampling	A sample valve should be provided near to the sensor for sample collection for calibration checks.	

Data Sheet			
Instrument	Dissolved Oxygen Analyser	**Application**	IDAL, BNR, MBR, NEREDA
		Installation	In tank/channel
Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC. Instrument requires local isolator.	
5	Measure Method	Galvanic or optical. The measurement shall not be adversely affected by temperature, ambient light, colour of sample or aging of sensor components	
6	Required Compliance	**NAMUR output sensors** are EN 60947-5-6:2000 and IEC 60947-5-6:1999. Australian Standards	
7	Digital communications	Vendor to detail what is available through HART	
8	Integrated or separate electronics	Both arrangements shall be accepted	
9	Element Cleaning	Supplier to state options - automated air cleaning essential. Sourcing the air from the plant air system is preferred. If separate compressor used, a local electrical isolation is required. If plant air is used, a local isolation valve is required.	
10	Damping Constant	Supplier to state approach and limits	
11	Calibration - Zeroing	Supplier to state	
12	Calibration - Span	Supplier to state	
13	Digital Output	Status condition required	
14	Operator Display	LCD display showing reading and units	
Functional Specification			
15	Operating Temperature	5 - 40 °C (ambient)	
16	Cleaning Air Pressure Requirements	Vendor to specify	

17	Operating pH	4 – 9	
18	Units of Measurement	Dissolved oxygen expressed as mg/L	
19	Analog Output 1 (4 – 20 mA)	For wastewater application, DO in the aeration zone is typically between 1 and 3 mg/L. Calibration range is 0-10 mg/L.	
20	Analog Output 2 (4 – 20 mA)	Temperature of process fluid in °C with calibration range 0 -100°C	
Performance Specification			
21	Accuracy	DO within ± 0.3 mg/L of true value Temperature within ± 0.2°C of true value	
22	Repeatability	±1% at constant temperature	
23	Response time (t_{90})	< 30 seconds to reach 90% of final value	
24	Mean time between failures (hours of operation)	Supplier to specify. Probe should read relatively accurate for 3 months without any additional calibrations.	
Installation Specification			
25	Measuring element liner	Supplier to state options, sufficient to handle process fluid temperature and pH. Appropriate durability for wastewater application.	
26	Cleaning system	Self cleaning mechanism required (air) built into the probe casing so that submerged components, including air hoses, are streamlined and deter rags. Refer to Appendix Drawing DWG-D-01.	
27	Material	Vendor to specify	
28	Hazardous area compatibility	Vendor to specify	
29	Maintenance	Optical probe should be lightweight, streamline, and have a pulley system to faciliate removal from process avoiding heavy lifting or awkward manoeuvers. Refer to Appendix Drawing DWG-D-01.	
30	Installation Specification	Refer to Appendix Drawing DWG-D-01.	
31	Sampling	All readings taken in situ	

Data Sheet			
Instrument	Fluoride Analyser	**Application**	Drinking water
		Installation	Sample takeoff

Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Potentiometric measurement technique for measurement of fluoride in online water applications, employing a matched pair of fluoride ion-selective electrode and reference electrode. These shall be provided with a Pt 100 temperature compensation element. The measurement shall not be adversely affected by temperature, ambient light, colour of sample or aging of sensor components. The supplier may propose instruments based on alternate principle of measurement, provided they can demonstrate the overall suitability and performance of the proposed alternative for the intended application.	
6	Required Compliance	Vendor to advise on options	
7	Digital communications	Vendor to detail what is available through HART	
8	Element Cleaning	Vendor to state options - automated cleaning preferred	
9	Damping Constant	Vendor to state approach and limits	

10	Calibration - Zeroing	The zero settings shall be user-selectable within the measurement range to cover a variety of different applications.	
11	Calibration - Span	The span settings shall be user-selectable within the measurement range to cover a variety of different applications.	
12	Digital Output	Status condition required	
13	Operator Display	LCD display showing reading and units	
Functional Specification			
14	Operating Temperature	5 - 35 °C (ambient)	
15	Operating Pressure	Vendor to specify requirements	
16	Units of Measurement	Concentration of fluoride, measured in milligrams of free fluoride ion per litre of solution (mg/L).	
17	Analog Output 1 (4 – 20 mA)	Fluoride concentration (mg/L) with a measurement range of 0 - 2 mg/L	
18	Analog Output 2 (4 – 20 mA)	Temperature (°C) - User to specify range	
Performance Specification			
19	Accuracy	± 2.0% of the reading or ± 0.02 mg/L (whichever is greater)	
20	Repeatability	± 2.0% of the reading or ± 0.02 mg/L (whichever is greater)	
21	Response time (t_{95})	For concentrations above 0.5 mg/L, 95% of final value reached in < 30 seconds	
22	Mean time between failures (hours of operation)	Vendor to specify	
Installation Specification			
23	Measuring element liner	Vendor to state options, sufficient to handle process fluid temperature and pH	
24	Cleaning system	Equipped with air or water (reclaimed effluent or industrial water) for auto cleaning, if used. Chemical supply is optional.	
25	Material	Vendor to specify. All materials must comply with AS/NZS 4020.	

26	Hazardous area compatibility	Not required	
27	Maintenance	If auto-cleaning is used, the probe construction shall enable on-line flushing of the sensor with clean water (reclaimed effluent or industrial water). Refer to Appendix Drawing DWG-F-01.	
28	Installation Specification	Refer to Appendix Drawing DWG-F-01. For best results, install fluoride analyser in an analyser hut or other suitable indoor location to reduce the impact of sunlight, heat and humidity on its operation. <u>Sampling system:</u> - Where necessary, use pressure and flow regulators in sample line to obtain the manufacturer recommended sample water pressure, flow and velocity - Where it is necessary to use a pump to deliver the sample to the analyser, use a flexible impeller type sample pump to minimise agitation of sample - Insulation and screening of all cables and connections between the electrodes and the transmitter should be of the highest order and ingress of moisture should be prevented in the connection chamber of the transmitter - Do not shorten the preformed electrode cable by cutting it as it compromises the insulation of the cable. Order a cable length suitable for the application	
29	Sampling	A sample valve should be provided near to the sensor for sample collection for calibration checks. Alternatively, the drain pipe should be easily accessible for collection of samples. Sampling point should be selected to ensure a representative and stable sample is available to the analyser under all operating conditions	

Data Sheet			
Instrument	Free chlorine analyser	**Application**	Free chlorine
		Installation	Sample takeoff

Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Amperometric (all applications), colorimetric and potentiometric (recycled water/wastewater applications only) are all acceptable for use on Treatment Plants. The measurement shall not be adversely affected by temperature, ambient light, colour of sample or aging of sensor components	
6	Required Compliance		
7	Digital communications	Vendor to detail what is available through HART	
8	Integrated or separate electronics	Both arrangements shall be available	
9	Element Cleaning	Supplier to state options - automated cleaning preferred	
10	Damping Constant	Supplier to state approach and limits	
11	Calibration - Zeroing	Instrument shall be capable of being zeroed locally utilizing air for free chlorine >2 mg/L and deionised water for free chlorine <2 mg/L	
12	Calibration - Span	Instrument shall be capable of being calibrated from a historic process sample	
13	Digital Output	Status condition required	
14	Operator Display	LCD display showing reading and units	
Functional Specification			
15	Operating Temperature	5 - 35 °C (ambient) process fluid	
16	Operating Pressure	Vendor to specify	

17	Operating pH	4 – 9	
18	Units of Measurement	Concentration of free chlorine, expressed in milligrams per litre (mg/L)	
19	Analog Output 1 (4 – 20 mA)	The free chlorine concentration (mg/L) with ranges as below: - Drinking water disinfection - 0 - 5 mg/L - Recycled water disinfection - 0 - 10 mg/L - Wastewater disinfection - 0 - 10 mg/L	
20	Analog Output 2 (4 – 20 mA)	Vendor to specify if available	
Performance Specification			
21	Accuracy	± 4.0% of the span or ± 0.04mg/L (whichever is greater)	
22	Repeatability	± 2.0% of the span or ± 0.02 mg/L (whichever is greater)	
23	Response time (t_{90})	< 3 minutes to reach 90% of final value	
24	Mean time between failures (hours of operation)	Vendor to specify	
Installation Specification			
25	Measuring element liner	Vendor to state options, sufficient to handle process fluid temperature and pH	
26	Cleaning system	Vendor to specify- automatic system to prevent algal growth and iron/manganese build up preferred	
27	Material	Vendor to specify	
28	Velocity	Vendor to specify	
29	Hazardous area compatibility	Not required	

30	Maintenance Specification	Refer to Appendix Drawings DWG-E-01 (amperometric), DWG-E-02 (potentiometric) and DWG-E-03 (colorimetric). If the sensor is potentiometric or amperometric then it shall not require calibration/verification more frequent than 1/month. If the sensor is colorimetric then it shall not require a change in reagents more frequent than 1/month. Sensor shall be easy to access for any maintenance requirements. Supplier maintenance frequency shall not be more frequent than 1/year.	
31	Installation Specification	Refer to Appendix Drawings DWG-E-01 (amperometric), DWG-E-02 (potentiometric) and DWG-E-03 (colorimetric). Refer to Appendix Drawing DWG-H-01 for installation within a water quality monitoring panel. For best results chlorine residual analysers should be installed in analyser huts or other suitable indoor location to reduce the impact of sunlight, heat and humidity on its operation. Sampling system: - Use small bore short run sample pipe to reduce the dead time - Where necessary, use pressure and flow regulators in sample line to obtain the manufacturer recommended sample flow and velocity - Where it is necessary to use a pump to deliver the sample to the analyser, use a flexible impeller type sample pump to minimise agitation of sample - The sample probe should be inserted into the pipe to a depth of one third of the diameter and the sample port should face downstream - Stainless steel tube should be the first choice for sample lines. Opaque nylon tubing may also be used, however clear plastic pipes should not be used as these encourage biological growth.	

32	Sampling	A sample valve should be provided near to the sensor for sample collection for calibration checks. Sampling point should be selected to ensure a representative and stable sample is available to the analyser under all operating conditions.	

Data Sheet			
Instrument	Total chlorine analyser	**Application**	Total chlorine
		Installation	Sample takeoff
Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Amperometric (all applications), colorimetric and potentiometric (recycled water/wastewater applications only) are all acceptable for use on Treatment Plants. The measurement shall not be adversely affected by temperature, ambient light, colour of sample or aging of sensor components	
6	Required Compliance		
7	Digital communications	Vendor to detail what is available through HART	
8	Integrated or separate electronics	Both arrangements shall be available	
9	Element Cleaning	Supplier to state options - automated cleaning preferred	
10	Damping Constant	Supplier to state approach and limits	
11	Calibration - Zeroing	Instrument shall be capable of being zeroed locally utilizing air for total chlorine >2 mg/L and deionised water for total chlorine <2 mg/L	
12	Calibration - Span	Instrument shall be capable of being calibrated from a historic process sample	

13	Digital Output	Status condition required	
14	Operator Display	LCD display showing reading and units	
Functional Specification			
15	Operating Temperature	5 - 35 °C (ambient) process fluid	
16	Operating Pressure	Vendor to specify	
17	Operating pH	4 – 9	
18	Units of Measurement	Concentration of total chlorine (sum of free and combined), expressed in milligrams per litre (mg/L)	
19	Analog Output 1 (4 – 20 mA)	The total chlorine concentration (mg/L) with ranges as below: - Drinking water network - 0 - 5 mg/L - Wastewater disinfection - 0 - 5 mg/L	
20	Analog Output 2 (4 – 20 mA)	Vendor to specify if available	
Performance Specification			
21	Accuracy	± 4.0% of the span or ± 0.04mg/L (whichever is greater)	
22	Repeatability	± 2.0% of the span or ± 0.02 mg/L (whichever is greater)	
23	Response time (t_{90})	< 3 minutes to reach 90% of final value	
24	Mean time between failures (hours of operation)	Vendor to specify	
Installation Specification			
25	Measuring element liner	Vendor to state options, sufficient to handle process fluid temperature and pH	
26	Cleaning system	Vendor to specify- automatic system to prevent algal growth and iron/manganese build up preferred	
27	Material	Vendor to specify	
28	Velocity	Vendor to specify	
29	Hazardous area compatibility	Not required	

30	Maintenance Specification	Refer to Appendix Drawings DWG-E-01 (amperometric), DWG-E-02 (potentiometric) and DWG-E-03 (colorimetric). If the sensor is potentiometric or amperometric then it shall not require calibration/verification more frequent than 1/month. If the sensor is colorimetric then it shall not require a change in reagents more frequent than 1/month. Sensor shall be easy to access for any maintenance requirements. Supplier maintenance frequency shall not be more frequent than 1/year.	
31	Installation Specification	Refer to Appendix Drawings DWG-E-01 (amperometric), DWG-E-02 (potentiometric) and DWG-E-03 (colorimetric). Refer to Appendix Drawing DWG-H-01 for installation within a water quality monitoring panel. For best results chlorine residual analysers should be installed in analyser huts or other suitable indoor location to reduce the impact of sunlight, heat and humidity on its operation. <u>Sampling system:</u> - Use small bore short run sample pipe to reduce the dead time - Where necessary, use pressure and flow regulators in sample line to obtain the manufacturer recommended sample flow and velocity - Where it is necessary to use a pump to deliver the sample to the analyser, use a flexible impeller type sample pump to minimise agitation of sample - The sample probe should be inserted into the pipe to a depth of one third of the diameter and the sample port should face downstream - Stainless steel tube should be the first choice for sample lines. Opaque nylon tubing may also be used, however clear plastic pipes should not be used as these encourage biological growth.	
32	Sampling	A sample valve should be provided near to the sensor for sample collection for calibration checks. Sampling point should be selected to ensure a representative and stable sample is available to the analyser under all operating conditions.	

Data Sheet			
Instrument	Gas Detection and Alarming	**Application**	Methane/LEL
		Installation	

Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Infrared absorbance technology. The appropriate gas/gas blend needs to be used to calibrate the instrument, as LEL is specific to the compound being detected, as is the IR signature. Pumped flow across sensor is preferred, The sensor shall have a long life (2 to 3 years minimum) and maintenance free component. The measuring cell shall be capable of recovering from short term signal overload without any permanent damage and within 30 minutes of return of signal to normal level.	
6	Required Electromagnetic Compliance	Vendor to state	
7	Integrated or separate electronics	Both arrangements are acceptable	
8	Element Cleaning	Supplier to state options - automated cleaning is preferred	
9	Damping Constant	Supplier to state approach and limits	
10	Calibration - Zeroing	Vendor to state zeroing procedure	
11	Calibration - Span	The gas detector design shall allow manual calibration of its sensor in a simple and convenient manner. Preference shall be given to designs that are based on pre-calibrated field replaceable sensors.	

12	Operator Display	LCD display showing reading and units	
Functional Specification			
13	Operating Temperature	5 - 50 °C (ambient)	
14	Operating Pressure	Supplier to specify pressure requirements	
15	Operating Relatibe Humidity	Needs to be able to function in air up to 100% relative humidity.	
16	Service	The specific gas detector(s) and gas alarm monitoring unit shall be used for the detection and alarming of flammable and toxic gases likely to be present inside or outside of plant installations in water and sewage treatment plants.	
17	Units of Measurement	The units of measurement shall be a percentage of lower explosive limit (%LEL).	
18	Analog Output 1 (4 – 20 mA)	The detection of the gas over the following ranges: • Methane (CH_4) 0 to 100% LEL.	
19	Analog Output 2 (4 – 20 mA)	Vendor to state options	
20	Digital communications	Vendor to detail what is available through HART	
21	Digital Output	Status condition required	
22	Alarm and Status Indication	Visual indication of the operational status of the remote gas detectors and the monitoring unit hardware. Any hardware failure shall be indicated via visual and audible alarms. In addition the unit shall provide the following voltage free contact outputs (contacts open to alarm –failsafe): • One high and one very high alarm contact output per channel • One common gas alarm contact • One common hardware failure alarm contact.	
Performance Specification			
23	Accuracy	±5% of span	
24	Repeatability	±2.5% of span	

25	Response time (t_{90})	< 30 seconds to reach 90% of final value	
26	Stability	The instrument shall meet its performance criteria continuously over a period of 6 months without the need for any manual adjustments.	
27	Availability	The instrument shall operate continuously except when it is undergoing calibration or diagnostic checking. These operations shall not significantly affect its availability. The overall availability shall be better than 99%.	
28	Mean time between failures (hours of operation)	Supplier to specify	
Installation Specification			
29	Measuring element liner	Supplier to state options	
30	Cleaning system	Vendor to state options	
31	Material	Appropriate, non-corrosive material	
32	Modularity	Modular construction and allow easy access to field replaceable components and calibration/configuration controls. The gas detectors and gas alarm moitoring units shall be self-contained and compact units suitable for indoor and outdoor installation. Multiple channel versions shall have separate alarm indications for every channel.	
33	Hazardous area compatibility	Vendor to state certifications	
34	Maintenance Specification	Vendor to specify maintenance requirements. The selected gas detector should be a robust, reliable, low maintenance and long life device in view of its plant and personnel safety function.	

35	Installation Specification	The gas detector should be selected to suit the specific gas and the gas concentration level to be monitored. Installation • Install the gas detector at locations close to the likely source of the gas. However, it should not be installed in locations where it is likely to cause unnecessary and false alarms • Install the gas detector at a location where it can be in contact with freely moving mass of air as opposed to locations where the air mass is likely to be still. • Consider installing a redundant pair of detectors requiring high reliability • The gas detectors and alarm monitoring unit should be wired and installed as self-contained independent system and powered from an un-interruptible power supply • The gas alarm monitoring unit should be located in a central location and the external common alarm contact should be wired to the plant alarm system. Commissioning Commissioning crew should verify that all detectors have been correctly located and installed. All detectors should be tested with specific gas bottles after connection to the alarm monitoring unit to verify integrity of the equipment and its installation. An ongoing test regime should also be set up to ensure that the system is functional at all times.	

Data Sheet			
Instrument	Gas Detection and Alarming	**Application**	Hydrogen sulphide (H_2S)
		Installation	

Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Measurement method is electrochemical cell for high range (>5ppmv) and chemical cassette for low range (0-5ppmv). Pumped gas flow with moisture trap is preferred. Cell shall have a long life (2 to 3 years minimum) and maintenance free component. The measuring cell shall be capable of recovering from short term signal overload without any permanent damage and within 30 minutes of return of signal to normal level.	
6	Required Electromagnetic Compliance	Vendor to state	
7	Integrated or separate electronics	Both arrangements are acceptable	
8	Element Cleaning	Supplier to state options - automated cleaning is preferred	
9	Damping Constant	Supplier to state approach and limits	
10	Calibration - Zeroing	Vendor to state zeroing procedure	
11	Calibration - Span	The gas detector design shall allow manual calibration of its sensor in a simple and convenient manner. Preference shall be given to designs that can be calibrated using a secondary standard (another sensor previously calibrated) or a standard gas bottle.	
12	Operator Display	LCD display showing reading and units	

Functional Specification			
13	Operating Temperature	5 - 50 °C (ambient)	
14	Operating Pressure	Supplier to specify pressure requirements	
15	Operating Moisture	Moisture traps and/or other moisture removal treatment essential	
16	Service	The specific gas detector(s) and gas alarm monitoring unit shall be used for odour control and for the detection and alarming of H2S inside or outside of plant installations in water and sewage treatment plants.	
17	Units of Measurement	The units of measurement shall be parts per million (ppmv)	
18	Analog Output 1 (4 – 20 mA)	The detection of the gas over the following ranges: • Hydrogen sulphide (H2S) 0 to 100 ppmv	
19	Analog Output 2 (4 – 20 mA)	Vendor to state options	
20	Digital communications	Vendor to detail what is available through HART	
21	Digital Output	Status condition required	
22	Alarm and Status Indication	Visual indication of the operational status of the remote gas detectors and the monitoring unit hardware. Any hardware failure shall be indicated via visual and audible alarms. In addition the unit shall provide the following voltage free contact outputs (contacts open to alarm –failsafe): • One high and one very high alarm contact output per channel • One common gas alarm contact • One common hardware failure alarm contact.	
Performance Specification			
23	Accuracy	±5% of span	
24	Repeatability	±2.5% of span	

25	Response time (t_{90})	< 30 seconds to reach 90% of final value	
26	Stability	The instrument shall meet its performance criteria continuously over a period of 6 months without the need for any manual adjustments.	
27	Availability	The instrument shall operate continuously except when it is undergoing calibration or diagnostic checking. These operations shall not significantly affect its availability. The overall availability shall be better than 99%.	
28	Mean time between failures (hours of operation)	Supplier to specify	
		Installation Specification	
29	Measuring element liner	Supplier to state options, sufficient to handle process fluid temperature and gas contaminants	
30	Cleaning system	Vendor to state options	
31	Material	Appropriate, non-corrosive material	
32	Modularity	Modular construction and allow easy access to field replaceable components and calibration/configuration controls. The gas detectors and gas alarm monitoring units shall be self-contained and compact units suitable for indoor and outdoor installation. Multiple channel versions shall have separate alarm indications for every channel.	
33	Hazardous area compatibility	Vendor to state certifications	
34	Maintenance Specification	Vendor to specify maintenance requirements. The selected gas detector should be a robust, reliable, low maintenance and long life device in view of its plant and personnel safety function.	

35	Installation Specification	Refer to Appendix Drawing DWG-O-01. The gas detector should be selected to suit the specific gas and the gas concentration level to be monitored. Installation • Installation of the sensor should be no more than 6m from sampling point, and sample lines should be passivated SS or Teflon. Except for underground H2S, most units installed in OCU do not need to be on UPS as power failure = no fans = nothing to monitor. • Install the gas detector at a location where it can be in contact with freely moving mass of air as opposed to locations where the air mass is likely to be still. • Consider installing a redundant pair of detectors requiring high reliability • The gas detectors and alarm monitoring unit should be wired and installed as self-contained independent system and powered from an un-interruptible power supply • The gas alarm monitoring unit should be located in a central location and the external common alarm contact should be wired to the plant alarm system. Commissioning Commissioning crew should verify that all detectors have been correctly located and installed. All detectors should be tested with specific gas bottles after connection to the alarm monitoring unit to verify integrity of the equipment and its installation. An ongoing test regime should also be set up to ensure that the system is functional at all times.	

Data Sheet			
Instrument	Gas Detection and Alarming	**Application**	Chlorine
		Installation	Wet chemical scrubber or chlorine dosing system

Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Electrochemical cell technology. The measuring cell shall be a diffusion type (no sample draw), long life (2 to 3 years minimum) and maintenance free component. The measuring cell shall be capable of recovering from short term signal overload without any permanent damage and within 30 minutes of return of signal to normal level.	
6	Required Electromagnetic Compliance	Vendor to state	
7	Integrated or separate electronics	Both arrangements are acceptable	
8	Element Cleaning	Supplier to state options - automated cleaning is preferred	
9	Damping Constant	Supplier to state approach and limits	
10	Calibration - Zeroing	Vendor to state zeroing procedure	

11	Calibration - Span	The gas detector design shall allow manual calibration of its sensor in a simple and convenient manner. Preference shall be given to designs that are based on pre-calibrated field replaceable sensors.	
12	Operator Display	LCD display showing reading and units	
Functional Specification			
13	Operating Temperature	5 - 50 °C (ambient)	
14	Operating Pressure	Supplier to specify pressure requirements	
15	Service	The specific gas detector(s) and gas alarm monitoring unit shall be used for the detection and alarming of flammable and toxic gases likely to be present inside or outside of plant installations in water and sewage treatment plants.	
16	Units of Measurement	The units of measurement shall be parts per million (ppmv)	
17	Analog Output 1 (4 – 20 mA)	The detection of the gas over the following ranges: • Chlorine (Cl_2) 0 to 10 ppmv	
18	Analog Output 2 (4 – 20 mA)	Vendor to state options	
19	Digital communications	Vendor to detail what is available through HART	
20	Digital Output	Status condition required	
21	Alarm and Status Indication	Visual indication of the operational status of the remote gas detectors and the monitoring unit hardware. Any hardware failure shall be indicated via visual and audible alarms. In addition the unit shall provide the following voltage free contact outputs (contacts open to alarm –failsafe): • One high and one very high alarm contact output per channel • One common gas alarm contact • One common hardware failure alarm contact.	

Performance Specification			
22	Accuracy	±5% of span	
23	Repeatability	±2.5% of span	
24	Response time (t_{90})	< 30 seconds to reach 90% of final value	
25	Stability	The instrument shall meet its performance criteria continuously over a period of 6 months without the need for any manual adjustments.	
26	Availability	The instrument shall operate continuously except when it is undergoing calibration or diagnostic checking. These operations shall not significantly affect its availability. The overall availability shall be better than 99%.	
27	Warm up time	Warm up time for a ‘cold-start’ (initial start-up or major repairs/overhauls) shall be less than 30 minutes. For ‘warm-start’ (short interruptions in power supply) the warm up time shall be less than 15 minutes.	
28	Mean time between failures (hours of operation)	Supplier to specify	
Installation Specification			
29	Measuring element liner	Supplier to state options, sufficient to handle process fluid temperature and gas contaminants	
30	Cleaning system	Vendor to state options	
31	Material	Appropriate, non-corrosive material	
32	Modularity	Modular construction and allow easy access to field replaceable components and calibration/configuration controls. The gas detectors and gas alarm monitoring units shall be self-contained and compact units suitable for indoor and outdoor installation. Multiple channel versions shall have separate alarm indications for every channel.	
33	Hazardous area compatibility	Vendor to state certifications	

34	Maintenance Specification	Vendor to specify maintenance requirements. The selected gas detector should be a robust, reliable, low maintenance and long life device in view of its plant and personnel safety function.	
35	Installation Specification	Refer to Appendix Drawing DWG-O-01.The gas detector should be selected to suit the specific gas and the gas concentration level to be monitored. Installation • Install the gas detector at locations close to the likely source of the gas. However, it should not be installed in locations where it is likely to cause unnecessary and false alarms • Install the gas detector at a location where it can be in contact with freely moving mass of air as opposed to locations where the air mass is likely to be still. • Consider installing a redundant pair of detectors requiring high reliability • The gas detectors and alarm monitoring unit should be wired and installed as self-contained independent system and powered from an un-interruptible power supply • The gas alarm monitoring unit should be located in a central location and the external common alarm contact should be wired to the plant alarm system. Commissioning Commissioning crew should verify that all detectors have been correctly located and installed. All detectors should be tested with specific gas bottles after connection to the alarm monitoring unit to verify integrity of the equipment and its installation. An ongoing test regime should also be set up to ensure that the system is functional at all times.	

Data Sheet			
Instrument	Gas Detection and Alarming	**Application**	Oxygen
		Installation	

Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Vendor to state options. The measuring cell shall be a diffusion type (no sample draw), long life (2 to 3 years minimum) and maintenance free component. The measuring cell shall be capable of recovering from short term signal overload without any permanent damage and within 30 minutes of return of signal to normal level.	
6	Required Electromagnetic Compliance	Vendor to state	
7	Integrated or separate electronics	Both arrangements are acceptable	
8	Element Cleaning	Supplier to state options - automated cleaning is preferred	
9	Damping Constant	Supplier to state approach and limits	
10	Calibration - Zeroing	Vendor to state zeroing procedure	
11	Calibration - Span	The gas detector design shall allow manual calibration of its sensor in a simple and convenient manner. Preference shall be given to designs that are based on pre-calibrated field replaceable sensors.	

12	Operator Display	LCD display showing reading and units	
Functional Specification			
13	Operating Temperature	5 - 50 °C (ambient)	
14	Operating Pressure	Supplier to specify pressure requirements	
15	Service	The specific gas detector(s) and gas alarm monitoring unit shall be used for the detection and alarming of flammable and toxic gases likely to be present inside or outside of plant installations in water and sewage treatment plants.	
16	Units of Measurement	The units of measurement shall be volume percentage (%vol)	
17	Analog Output 1 (4 – 20 mA)	The detection of the gas over the following ranges: • Oxygen (O2) 0 to 50 %vol	
18	Analog Output 2 (4 – 20 mA)	Vendor to state options	
19	Digital communications	Vendor to detail what is available through HART	
20	Digital Output	Status condition required	
21	Alarm and Status Indication	Visual indication of the operational status of the remote gas detectors and the monitoring unit hardware. Any hardware failure shall be indicated via visual and audible alarms. In addition the unit shall provide the following voltage free contact outputs (contacts open to alarm –failsafe): • One high and one very high alarm contact output per channel • One common gas alarm contact • One common hardware failure alarm contact.	
Performance Specification			
22	Accuracy	±5% of span	
23	Repeatability	±2.5% of span	

24	Response time (t_{90})	< 30 seconds to reach 90% of final value	
25	Stability	The instrument shall meet its performance criteria continuously over a period of 6 months without the need for any manual adjustments.	
26	Availability	The instrument shall operate continuously except when it is undergoing calibration or diagnostic checking. These operations shall not significantly affect its availability. The overall availability shall be better than 99%.	
27	Warm up time	Warm up time for a 'cold-start' (initial start-up or major repairs/overhauls) shall be less than 30 minutes. For 'warm-start' (short interruptions in power supply) the warm up time shall be less than 15 minutes.	
28	Mean time between failures (hours of operation)	Supplier to specify	
Installation Specification			
29	Measuring element liner	Supplier to state options, sufficient to handle process fluid temperature and gas contaminants	
30	Cleaning system	Vendor to state options	
31	Material	Appropriate, non-corrosive material	
32	Modularity	Modular construction and allow easy access to field replaceable components and calibration/configuration controls. The gas detectors and gas alarm monitoring units shall be self-contained and compact units suitable for indoor and outdoor installation. Multiple channel versions shall have separate alarm indications for every channel.	
33	Hazardous area compatibility	Vendor to state certifications	
34	Maintenance Specification	Vendor to specify maintenance requirements. The selected gas detector should be a robust, reliable, low maintenance and long life device in view of its plant and personnel safety function.	

35	Installation Specification	The gas detector should be selected to suit the specific gas and the gas concentration level to be monitored. Installation • Install the gas detector at locations close to the likely source of the gas. However, it should not be installed in locations where it is likely to cause unnecessary and false alarms • Install the gas detector at a location where it can be in contact with freely moving mass of air as opposed to locations where the air mass is likely to be still. • Consider installing a redundant pair of detectors requiring high reliability • The gas detectors and alarm monitoring unit should be wired and installed as self-contained independent system and powered from an un-interruptible power supply • The gas alarm monitoring unit should be located in a central location and the external common alarm contact should be wired to the plant alarm system. Commissioning Commissioning crew should verify that all detectors have been correctly located and installed. All detectors should be tested with specific gas bottles after connection to the alarm monitoring unit to verify integrity of the equipment and its installation. An ongoing test regime should also be set up to ensure that the system is functional at all times.	

Data Sheet				
Instrument	Moisture Meter		**Application**	Dewatered Biosolids
			Installation	Auger

Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Near infrared. The measurement shall not be adversely affected by temperature, ambient light, colour of sample or aging of infrared source	
6	Required Electromagnetic Compliance	Vendor to specify	
7	Integrated or separate electronics	Vendor to state options	
8	Element Cleaning	Constant flow of dry, oil-free plant air to prevent lens from coating by dust or vapours - vendor to state options	
9	Damping Constant	Supplier to state approach and limits	
10	Calibration - Zeroing	Supplier to state zeroing procedure	
11	Calibration - Span	Instrument shall be capable of being calibrated from historic process samples. Any software used for calibration shall be made available to Sydney Water.	
12	Operator Display	LCD display showing reading and units	
Functional Specification			
13	Operating Temperature	10 – 55 °C (ambient)	
14	Units of Measurement	% moisture or % solids (% solids preferred but vendor to detail)	

15	Analog Output 1 (4 – 20 mA)	% moisture/ % solids- 0-100%	
16	Digital communications	HART interface preferred	
17	Digital Output	Status condition required	
Performance Specification			
18	Accuracy	±0.5% moisture/ solids. Vendor to state actual.	
19	Repeatability	±0.01% moisture/ solids. Vendor to state actual.	
20	Response time (t_{90})	< 1 second to reach 90% of final value	
21	Mean time between failures (hours of operation)	Vendor to specify	
Installation Specification			
22	Cleaning system	Equipped with compressed air cleaning	
23	Material	Vendor to specify	
24	Hazardous area compatibility	Vendor to specify certifications	
25	Maintenance Specification	Refer to Appendix Drawing DWG-J-01.	
26	Installation Specification	Sensor is to be installed over the auger in a way that still prevents people from easily touching the auger. The light source should point at the path of the biosolids along the auger (which usually isn't in the middle). Compressed air shall be available to allow automatic cleaning of the lens. Refer to Appendix Drawing DWG-J-01.	

27	Sampling	A sample point should be avaiable from the dewatering equipment (vendor to check if already installed- if not then need to install but normally should already be there)	

Data Sheet			
Instrument	Nitrate analyser	**Application**	Denitrification
		Installation	Sample take off or Submerged
Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	UV absorption-monochromatic UV absorbtion-spectometric	
6	Required Compliance	Australian Standards	
7	Digital communications	Vendor to detail what is available through HART	
8	Integrated or separate electronics	Both arrangements shall be available	
9	Element Cleaning	Supplier to state options - automated cleaning preferred	
10	Damping Constant	Supplier to state approach and limits	
11	Calibration - Zeroing	Supplier to state calibration method	
12	Calibration - Span	Supplier to state calibration method	
13	Digital Output	Status condition required	
14	Operator Display	LCD display showing reading and units	
Functional Specification			
15	Operating Temperature	5 to 40^0 C (ambient)	
16	Operating Pressure	Supplier to specifiy requirements	
17	Operating pH	4 – 9	
18	Units of Measurement	Concentration of nitrate expressed as milligrams of NO3-N per litre of solution (mg/L)	

19	Analog Output 1 (4 – 20 mA)	NO3-N (mg/L) range of: 0-5 mg/l to 0-50 mg/l (NO3-N). Supplier to provide available range options.	
20	Analog Output 2 (4 – 20 mA)	Are there options or can the unit be configured to monitor two streams with two separate nitrate concentration outputs	
Performance Specification			
21	Accuracy	Accuracy of the analyser shall be better than the greater of ± 5.0% of the reading or ± 1.5 mg/l.	
22	Repeatability	Repeatability shall be better than the greater of ± 2.5% of the reading or ± 1.0 mg/l.	
23	Response time (t_{90})	< 10 minutes to reach 90% of final value	
24	Maintenance Specification	Sample pre-treatment filtration/strainer units should not require maintanance at intervals of less than once monthly.	
25	Mean time between failures (hours of operation)	Supplier to specify	
Installation Specification			
26	Cleaning system	Equipped with mechanical (wiper/compressed air) or chemical auto cleaning. Supplier to specify options available and chemical used.	
27	Material	Supplier to specify	
28	Hazardous area compatibility	Supplier to specify	

29	Installation Specification	Instrument should be mounted to additional support frame (design supplied by Sydney Water) and not mounted on existing handrails. In tank sample offtake: ChemScan; sample off take and filtration unit should be suspended on a swivel arm extended into the tank. Refer to Appendix Drawing: DWG-L-01. Hach; filtration unit should be installed in the process fluid in a or cradle with a winch system or pumped to an overflow vessel attached to a support frame. Filtrax (part no: 5738901) will not be accepted. Refer to Appendix Drawing: DWG-L-04. In channel sample offtake: ChemScan; a slot should be cut out of the Anderson grid and the sample line and filtration unit insterted through the slot. Refer to Appendix Drawing: DWG-L-02. Hach: filtration unit should be installed in the process fluid in a or cradle with a winch system or pumped to an overflow vessel attached to a support frame. Filtrax (part no: 5738901) will not be accepted. Refer to Appendix Drawing: DWG-L-04. Suppliers to provide installation angles and distances from mounting surface, base of tank/channel, side walls, submersible depth, diffusion heads or any other surface that may cause interference eg flow, inconsistent bubbles, ragging or fouling. Lock to support frame of chain and/or tubing to enable stabilisation during maintenance.	
30	Sampling	In situ or via a valve located near to the sensor.	

Data Sheet			
Instrument	ORP/Redox meter	**Application**	Water/wastewater Dechlorination, chemical odour scrubbers and MLSS (nitrite shunting)
		Installation	Sample takeoff, in pipe OR submerged
Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	The analyser shall be based on potentiometric measurement technique employing a matched pair of a metallic measurement electrode and a reference electrode. The supplier shall provide a choice of measurement and reference electrodes for a wide range of applications in the water and sewage treatment plants.	
6	Required Compliance	Supplier to advise.	
7	Digital communications	Vendor to detail what is available through HART FDT/DTM protocol available	
8	Element Cleaning	Vendor to state options - automated cleaning preferred	
9	Damping Constant	Vendor to state approach and limits	
11	Calibration - Span	Instrument shall be capable of being calibrated from a process sample or buffer solutions	
12	Digital Output	Status condition required	
13	Operator Display	LCD display showing reading and units	
Functional Specification			

14	Operating Temperature	5 - 35 °C (ambient)	
15	Operating Pressure	Vendor to specify operating pressure range	
16	Operating pH	0 - 14	
17	Units of Measurement	Millivolts (mV)	
18	Analog Output 1 (4 – 20 mA)	ORP with a minimum range of -1500mV to +1500mV	
19	Analog Output 2 (4 – 20 mA)	Temperature (ºC) range of 0-100°C	
Performance Specification			
20	Accuracy	± 1.0 mV over the entire measurement span	
21	Repeatability	Better then ± 0.5 mV over the entire measurement span	
22	Response time (t_{90})	< 30 seconds to reach 90% of final value	
23	Mean time between failures (hours of operation)	Vendor to specify	
Installation Specification			
24	Measuring element liner	Vendor to state options, sufficient to handle process fluid temperature and pH	
25	Cleaning system	Vendor to detail options available.	
26	Material	Vendor to specify material based on process fluid.	
27	Hazardous area compatibility	Vendor to specify	

28	Maintenance	If auto-cleaning is used, the probe construction shall enable on-line flushing of the sensor with clean water (reclaimed effluent or industrial water). Refer to Appendix Drawing DWG-A-01. For in-pipe installation, sensors must be suitable for quick installation and removal from process pipelines without the need to stop the process flow e.g. hot-tap type interface.	
29	Installation Specification	Refer to Appendix Drawing DWG-A-01. Refer to Appendix Drawing DWG-C-01 for installation within a pH/ORP/Conductivity wet rack. Refer to Appendix Drawing DWG-H-01 for installation within a water quality monitoring panel. Vendor to specify installation options.	
30	Sampling	A sample valve should be provided near to the sensor for sample collection for calibration checks.	

Data Sheet			
Instrument	Orthophosphorus Analyser	**Application**	Chemical Dosing
		Installation	Sample take off
Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Colorimetric Reagent assisted multi wavelength absorbance	
6	Required Compliance	Australian Standards	
7	Digital communications	Vendor to detail what is available through HART	
8	Integrated or separate electronics	Supplier to provide details of arrangements	
9	Element Cleaning	Supplier to state options - automated cleaning preferred	
10	Damping Constant	Supplier to state approach and limits	
11	Calibration - Zeroing	Supplier to state zeroing method	
12	Calibration - Span	Supplier to state calibration method	
13	Digital Output	Status condition required	
14	Operator Display	LCD display showing reading and units	
Functional Specification			
15	Operating Temperature	5 – 40 °C (ambient)	
16	Operating Pressure	Supplier to specifiy maximum sample pressure the instrument can handle.	
17	Operating pH	4 – 9	

18	Units of Measurement	Concentration of orthophosphate expressed as milligrams of PO_4-P per litre of solution (mg/L)	
19	Analog Output 1 (4 – 20 mA)	The PO4-P (mg/L) with ranges as below: Influent: 1 - 25 mg/L Mixed liquor/secondary effluent: 0.05 - 5 mg/L	
20	Analog Output 2 (4 – 20 mA)	Are there options or can the unit be configured to monitor two streams with two separate Ortho P concentration outputs	
Performance Specification			
21	Accuracy	Shall be better than the greater of ± 5% of the reading or ± 0.15 mg/L	
22	Repeatability	Better than the greater of ± 2.5% of the reading or ± 0.05 mg/L	
23	Stability	Supplier to state recalibration period to allow output signals to remain within above tolerance	
24	Response time (t_{90})	The analyser shall respond (90% of final value) to any step changes in measured parameter in the process stream within 15 minutes	
25	Regeant Replacement	All reagents and all other solutions should not require change/top-up at frequencies of less than than once monthly.	
26	Sample Preparation	Supplier to specify the sample preparation system requirements	
27	Mean time between failures (hours of operation)	Supplier to specify	
Installation Specification			
28	Cleaning system	Equipped with chemical auto cleaning. Supplier to specify chemical used.	
29	Material	Supplier to specify.	
30	Hazardous area compatibility	Not required	

31	Installation Specification	Installation should be mounted to additional support frame (design supplied by Sydney Water) and not mounted on existing handrails In tank sample offtake: ChemScan; sample off take and filtration unit should be suspended on a swivel arm extended into the tank. Refer to Appendix Drawing: DWG-L-01. Hach; filtration unit should be installed in the process fluid in a or cradle with a winch system or pumped to an overflow vessel attached to a support frame. Refer to Appendix Drawings: DWG-L-03. In channel sample offtake: ChemScan; a slot should be cut out of the Anderson grid and the sample line and filtration unit insterted through the slot. Refer to Appendix Drawing: DWG-L-02. Hach: filtration unit should be installed in the process fluid in a or cradle with a winch system or pumped to an overflow vessel attached to a support frame. Refer to Appendix Drawings: DWG-N-03. Suppliers to provide installation angles and distances from mounting surface, base of tank/channel, side walls, submersible depth, diffusion heads or any other surface that may cause interference eg flow, inconsistent bubbles, ragging or fouling. Lock to support frame of chain and/or tubing to enable stabilisation during maintenance.	
32	Sampling	A sample valve should be provided in the sample line for sample collection for verification checks.	

Data Sheet			
Instrument	pH meter	**Application**	Water/wastewater
		Installation	Sample takeoff, in pipe OR submerged
Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Potentiometric measurement technique employing a matched pair of a pH sensitive glass electrode and a reference electrode. The measurement electrode shall be provided with a Pt1000 temperature compensation element.	
6	Required Compliance	Supplier to advise.	
7	Digital communications	Vendor to detail what is available through HART FDT/DTM protocol available	
8	Element Cleaning	Vendor to state options - automated cleaning preferred	
9	Damping Constant	Vendor to state approach and limits	
11	Calibration - Span	Instrument shall be capable of being calibrated from a process sample or buffer solutions	
12	Digital Output	Status condition required	

13	Operator Display	LCD display showing reading and units	
Functional Specification			
14	Operating Temperature	5 - 35 °C (ambient)	
15	Operating Pressure	Vendor to specify operating pressure range	
16	Operating pH	0 - 14	
17	Units of Measurement	Power of hydrogen (pH)	
18	Analog Output 1 (4 – 20 mA)	pH with a minimum range of pH 2 to 12	
19	Analog Output 2 (4 – 20 mA)	Temperature (ºC) range of 0-100°C	
Performance Specification			
20	Accuracy	± 0.20 pH units of span	
21	Repeatability	Filtered water: ± 0.10 pH units of span Raw or coagulated raw waters: ± 0.15 pH units of span	
22	Response time (t_{95})	< 30 minutes to reach 95% of final value	
23	Mean time between failures (hours of operation)	Vendor to specify	
Installation Specification			
24	Measuring element liner	Vendor to state options, sufficient to handle process fluid temperature and pH	
25	Cleaning system	Vendor to detail options available.	
26	Material	Vendor to specify material based on process fluid.	

27	Hazardous area compatibility	Vendor to specify	
28	Maintenance	If auto-cleaning is used, the probe construction shall enable on-line flushing of the sensor with clean water (reclaimed effluent or industrial water). Refer to Appendix Drawing DWG-A-01. For in-pipe installation, sensors must be suitable for quick installation and removal from process pipelines without the need to stop the process flow e.g. hot-tap type interface.	
29	Installation Specification	Refer to Appendix Drawing DWG-A-01. Refer to Appendix Drawing DWG-C-01 for installation within a pH/ORP/Conductivity wet rack. Refer to Appendix Drawing DWG-H-01 for installation within a water quality monitoring panel. Vendor to specify installation options.	
30	Sampling	A sample valve should be provided near to the sensor for sample collection for calibration checks.	

Data Sheet			
Instrument	Sludge Blanket Level	**Application**	Sedimentation tanks, BNR, IDAL, clarifiers
		Installation	Winched IR Technology

Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Optical technology. The measurement shall not be adversely affected by temperature, ambient light, colour of sample or aging of light source.	
6	Required Electromagnetic Compliance	Vendor to state	
7	Integrated or separate electronics	Both arrangements are acceptable	
8	Element Cleaning	Supplier to state options - automated cleaning is mandatory	
9	Damping Constant	Supplier to state approach and limits	
10	Calibration - Zeroing	Vendor to state zeroing procedure	
11	Calibration - Span	Instrument shall be capable of being calibrated from a historic process sample	
12	Operator Display	LCD display showing reading and units	
Functional Specification			
13	Operating Temperature	5 - 50 °C (ambient)	
14	Operating Pressure	Supplier to specify requirements for cleaning water pressure	
15	Operating pH	4 – 9	

16	Units of Measurement	Mass of dry filterable solids in a solution, expressed as milligrams of solids per litre of solution (mg/L) and sludge blanket depth (m)	
17	Analog Output 1 (4 – 20 mA)	The suspended solids (mg/L) with range as below: • Settled sewage 0 - 20,000mg/L • MLSS 0 - 50,000 mg/L	
18	Analog Output 2 (4 – 20 mA)	Immersion depth (m), 0 -10m (at maximum depth)	
19	Digital communications	Vendor to detail what is available through HART	
20	Digital Output	Status condition required	
Performance Specification			
21	Accuracy	±1% of span	
22	Repeatability	±0.01% of span	
23	Response time (t_{90})	< 1 seconds to reach 90% of final value	
24	Mean time between failures (hours of operation)	Supplier to specify	
Installation Specification			
25	Measuring element liner	Supplier to state options, sufficient to handle process fluid temperature and pH	
26	Cleaning system	Equipped with water (reclaimed effluent or industrial water) for auto cleaning as per Appendix Drawing DWG-K-01. Chemical supply is optional.	
27	Material	Appropriate, non-corrosive material	
28	Cable Cleaning and Tensioning	Vendor to state mechanism	
29	Slack Cable Detection	Vendor to state technology	
30	Modes of Operation	Preferred modes of operation: 1. Sludge blanket and fluff detection 2. Profile 3. Sludge blanket depth tracking	

31	Maintenance Specification	Vendor to specify maintenance requirements	
32	Installation Specification	The instrument is to be installed on a false handrail at the sedimentation tank or clairifer travelling bridge. Refer to Appendix Drawing DWG-K-01.	
33	Sampling	Sample of process liquid shall be easily accessible	

Data Sheet			
Instrument	Sludge Density/Suspended Solids Analyser (Microwave)	**Application**	Primary Sludge and Anaerobic Digested Sludge
		Installation	In line

Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Microwave phase shift for online sewage applications. The measurement shall not be adversely affected by temperature, ambient light, colour of sample or aging of sensor components	
6	Required Electromagnetic Compliance	Vendor to specify	
7	Integrated or separate electronics	Vendor to provide options	
8	Element Cleaning	Vendor to provide options	
9	Damping Constant	Vendor to state approach and limits	
10	Calibration - Zeroing	Instrument shall be capable of being zeroed locally utilizing reclaimed effluent or industrial water	
11	Calibration - Span	Instrument shall be capable of being calibrated from a process sample	
12	Operator Display	LCD display showing reading and units	
Functional Specification			
13	Operating Temperature	5 - 40 °C (ambient and process temperature)	
14	Operating Pressure	Vendor to state maximum pressure	
15	Operating pH	4 – 9	
16	Units of Measurement	Mass of dry solids expressed as % of solids in solution	

17	Analog Output 1 (4 – 20 mA)	The sludge density (% or mg/L) with ranges as below: - Primary sludge 0 - 5% (0 - 50,000 mg/L) - Anaerobic digested sludge feed/output to/from thickening and dewatering 0-15%	
18	Analog Output 2 (4 – 20 mA)	Temperature of process fluid in °C. Vendor to state whether conductivity can be a second output.	
19	Digital communications	Vendor to detail what is available through HART	
20	Digital Output	Status condition required	
Performance Specification			
21	Accuracy	±1% of full span	
22	Repeatability	±0.01% of span	
23	Response time (t_{90})	Vendor to state	
24	Mean time between failures (hours of operation)	Vendor to specify	
Installation Specification			
25	Measuring element liner	Supplier to state options, sufficient to handle process fluid temperature and pH. Liner that do not coat easily with fat, oil and grease are preferred.	
26	Cleaning system	Reclaimed effluent flushing as per Appendix Drawing DWG-I-01	
27	Material	Appropriate, non-corrosive material	
28	Velocity	Supplier to specify maximum velocity	
29	Hazardous area compatibility	Vendor to state certifications	
30	Maintenance Specification	Vendor to state maintenance requirements.	
31	Installation Specification and Sampling	Refer to Appendix Drawing DWG-I-01.	

Data Sheet			
Instrument	Turbidity Meter (Contact type)	**Application(s)**	Drinking Water: filtered, treated, finished water
		Installation	Sample takeoff + wet rack

Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	IP65 (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measure Method	Nephelographic measurement technique in accordance with ISO7027 for sewage treatment, water recycling and drinking water applications. The measurement shall be compensated for the colour and absorption effects of the sample by employing ratiometric measurement technique and not be affected by ambient light. The measurement shall not be adversely affected by temperature or aging of sensor components.	
6	Required Compliance	IECEx if being installed in a hazardous area	
7	Digital communications	Vendor to detail what is available through HART	
8	Integrated or separate electronics	Vendor to specify	
9	Element Cleaning	Vendor to state options - automated interval cleaning preferred	
10	Damping Constant	Vendor to state approach and limits	
11	Calibration - Zeroing	The zero settings shall be user-selectable within the measurement range to cover a variety of different applications.	
12	Calibration - Span	The span settings shall be user-selectable within the measurement range to cover a variety of different applications.	

13	Digital Output	Status condition required	
14	Operator Display	LCD display showing reading and units	
Functional Specification			
15	Operating Temperature	5 - 35 °C (ambient)	
16	Operating Pressure	Vendor to specify requirements	
17	Flow Requirements	Minimum flow < 2.0 L/min	
18	Units of Measurement	Cloudiness of a liquid, measured relative to a standard solution of formazin & hexamethylenetetramine in pure water in Formazin Turbidity Units (FTU). 1 FTU is equal to 7.5 mg/L of silica. For low range applications (up to 100 FTU), turbidity may be measured in Nephelometric Turbidity Units (NTU) by measuring the 90 degree scatter of incident light on the sample. 1 NTU is equal to 1 FTU in this range of measurement.	
19	Analog Output 1 (4 – 20 mA)	Turbidity (in NTU) with ranges as below: - Filtered water (drinking water and wastewater): 0-1 NTU - Clarified water: 0-10 NTU	
20	Analog Output 2 (4 – 20 mA)	Vendor to specify if available	
Performance Specification			
21	Accuracy	0 – 10 NTU: Better than ± 2.0% of the span OR ± 0.008 NTU (whichever is greater)	
22	Repeatability	0 – 100 NTU: Better than ± 1.0% of the span OR ± 0.003 NTU (whichever is greater)	
23	Response time (t_{90})	90% of final value in < 3 minutes	
Installation Specification			

24	Measuring element liner	Vendor to state options, sufficient to handle process fluid temperature (item 15) and pH range of application	
25	Cleaning system	Vendor to specify - mechanical (wiper), chemical or air cleaning preferred	
26	Material	Vendor to specify	
27	Humidity	Moisture absorption system (e.g. dessicant pouch) should be included in installation to prevent any condensation buildup on measurement cell which can lead to inaccurate readings. Dessicant must not need to be replaced more frequently than every 3 months for the specific application. Note, for filtered water applications high humidity (> 80% RH) can be expected in Summer periods.	
28	Velocity	Vendor to specify. Velocity sufficient to achieve response time from sample offtake (item 23) at minimum sample flow (item 17)	
29	Installation Design and Setup Requirements	Refer to Appendix Drawing DWG-G-01 for a sample design Refer to Appendix Drawing DWG-H-01 for installation within a water quality monitoring panel.	
30	Flow Montioring and Control	When the instrument is fed from a pipework manifold feeding multiple instruments, an adjustable throttling valve will be provided to control flow at the instrument outlet. Flow indication (such as a flow switch) within the instrument is preferred, however this may be external to the instrument as per DWG-G-01. Where possible the instrument shall be equipped with a flow metering device indicating the instantaneous flowrate (in L/min or L/h) downstream of the analyser. When impossible, the drain of the instrument will be easily accessible to enable an operator to verify the flowrate.	

31	Sampling	A sample valve should be provided near to the sensor for sample collection for calibration checks. Alternatively, the drain pipe should be easily accessible for collection of samples. Locate sample line taps where air bubbles are less likely to be present. Alternatively, bubble traps should be installed in the sample line.	

Data Sheet			
Instrument	Ultraviolet Transmittance (UVT) Analyser	**Application(s)**	Recycled water - UV disinfection Drinking water - UV disinfection
		Installation	Sample offtake + wet rack

Item	Feature	Details	Conform (Y/N)
General Specification			
1	Sun Shading	Suitable sun (UV, heat radiation) protection shall be provided if required (outdoors). Display must be able to withstand continuous service without loss of LCD quality. All cabinets must have a weather shield.	
2	Ingress Protection	At least IP65 unless otherwise stated (both sensor and display)	
3	Circuit Board Protection	Tropicalisation and or resin coating required for all applications	
4	Power Supply	24 VDC	
5	Measurement Method	UV-Vis spectrophotometry at 254 nm wavelength	
6	Required Compliance	IECEx if being installed in a hazardous area	
7	Digital communications	Vendor to detail what is available through HART	
8	Integrated or separate electronics	Both arrangements shall be available	
9	Element Cleaning	Vendor to state options - non-contact should require little to zero physical cleaning either manual or automated	
10	Damping Constant	Vendor to state approach and limits	
11	Calibration - Zeroing	The zero settings shall be user-selectable within the measurement range. Manual zeroing with deionised or milli Q water is essential.	
12	Calibration - Span	The span settings shall be user-selectable within the measurement range to cover a variety of different applications.	
13	Digital Output	Status condition required	
14	Operator Display	LCD display showing reading and units	
Functional Specification			
15	Operating Temperature	5 – 35 °C (ambient)	

16	Operating Pressure	Vendor to specify requirements	
17	Operating pH	4 - 9	
18	Operating Solids & Turbidity	Maximum 150 mg/L TSS and 60 NTU	
19	Flow Requirements	Minimum flow < 2.0 L/min	
20	Units of Measurement	% transmittance of UV light at 254 nm wavelength through a sample housed in a cuvette of known path length. % transmittance (% UVT) is defined as the ratio of the intensity of the incident light which passes through the sample (I) to the incident light prior to the sample (I_o). $\% \, UVT = \frac{I}{I_0} \times 100\%$	
21	Analog Output 1 (4 – 20 mA)	0.0 - 100.0% UVT @ 254 nm	
22	Analog Output 2 (4 – 20 mA)	Vendor to specify if available (SUVA, Abs)	
Performance Specification			
23	Accuracy	± 1.0%	
24	Repeatability	± 1.0% of the span	
25	Response time (t_{90})	90% of final value in < 1 minute	
26	Light Source Lifetime	Minimum 3 years	
Installation Specification			
27	Measuring element liner	Vendor to state options, sufficient to handle process fluid temperature (item 15) and pH range of application (item 17)	
28	Cleaning system	Chemical cleaning required for applications where iron dosing is used upstream or in the network (e.g. secondary and tertiary wastewater treatment) Air or mechanical (wiper) cleaning acceptable for other applications. Check with requestor.	

29	Material	Vendor to specify	
30	Velocity	Vendor to specify. Velocity sufficient to achieve response time from sample offtake (item 23) and minimum sample flow (item 18) Pipe sizing must also be suitable for minimum at least 100 mg/L total suspended solids for non-filtered applications (e.g. secondary effluent).	
31	Installation Design and Setup Requirements	Refer to Appendix Drawing DWG-M-01 for a sample drawing Sample lines shall be large enough and maintain a sample flow velocity high enough to minimise plugging and prevent air bubble entrainment. A removable inlet strainer (e.g 2 mm mesh) shall be provided at the analyser inlet in the event of solids breakthrough or sample contamination.	
32	Reagents	Reagents (chemicals, zeroing or cleaning solutions) should be housed in maximum 10 L transparent containers to minimise manual handling hazards. Containers are to be housed in a permanent, partioned bund made of plastic or aluminium which can contain leaks. Reagent containers must be equipped with a LOW level switch (LSL) which is connected to SCADA for indication of reagent storage levels below 20%.	
33	Flow Monitoring and Control	When the instrument is fed from a pipework manifold feeding multiple instruments, an adjustable throttling valve will be provided to control flow at the instrument outlet. Flow indication (such as a flow switch) within the instrument is preferred, however this may be external to the instrument as per DWG-M-01. Where possible the instrument shall be equipped with a flow metering device indicating the instantaneous flowrate (in L/min or L/h) downstream of the analyser. When impossible, the drain of the instrument will be easily accessible to enable an operator to verify the flowrate.	
34	Sampling	A sample valve should be provided near to the sensor inlet for sample collection for calibration checks. Alternatively, the drain pipe should be easily accessible for collection of samples. Locate sample line taps where air bubbles are less likely to be present. Alternatively, bubble traps should be installed in the sample line.	

Appendix 3 – Definition of instrumentation terms

Accuracy	Conformity to an indicated standard or true value – usually expressed as a percentage (span or full scale) deviation from the indicated, standard or true value.
Ambient Temperature Range	The allowable range of the temperature of the medium (usually air) surrounding an object.
Amplification	The dimensionless ratio of output/input in a device intended by design to increase this ratio.
Amplifier	A device whose output is, by design, an enlarged reproduction of the input signal and which is energised from a source other than a signal.
Attenuation	A decrease in signal magnitude – the reciprocal of gain.
Automatic Controller	A device or combination of devices which measures the value of a variable, quantity or condition and operates so as to correct or limit deviation of this measured value from a selected setpoint reference.
Automatic Control System	An operable arrangement of one or more automatic controllers along with their associated equipment connected in closed loops with one or more processes.
Automatic Reset	A means of obtaining reset action using an electronic circuit which automatically senses that the input is not at the desired setpoint and adjusts the output at a specified rate to bring the input to setpoint.
BCD	Abbreviation of "binary coded decimal." Used to describe digital logic code for expressing decimal numbers with four logic lines.
Capacitance	The property which may be expressed as the time integral of flow rate (heat, electric current, etc.) to a form a storage divided by the associated potential change.
Cascade Control System	A control system in which the output of one controller si the input for another.

Closed Loop (Feedback Loop)	Several automatic control units connected so as to provide a signal path which includes a forward path, a feedback path and summing point. The controlled variable is constantly measured and if it deviates from that which has been prescribed, corrective action is applied to the final element in such direction as to return the controlled variable to the desired value.
Common (Mode) Noise	The AC potential that exists between the inputs of a (differential input) device and common point (usually circuit ground or earth ground).
Controlling Means	The elements in a control system which contribute to the required corrective action.
Control Point	The value at which the controlled system or process settles out or stabilises. It may or may not agree with the setpoint (instruction) applied to the controller.
Current	The movement of electrons in a conductor. The direction is opposite to the direction of flow of electrons.
Alternating Current (AC)	Refers to an electrical current which reverses its direction on a regular basis. Typically, although not necessarily, sinusoidal waveform with respect to reference or ground. Current flow from zero (average value) to maximum through zero to minimum and back to zero constitutes one cycle. The number of cycles per second (Hertz) is the frequency. Used to describe any time varying current to distinguish it form the steady state (DC) component.
Direct Current (DC)	An electrical current which flows in one direction. Used to describe any time independent (steady state) current.
Damping	Progressive reduction in the amplitude of cycling of a system – critically damped describes a system which is damped just enough to prevent overshoot following an abrupt stimulus.
Dead Band (Dead Zone)	The change through which the input to an instrument can be varied without initiating instrument response.
Dead Time	The time that elapses while the input to an instrument varies sufficiently to pass through the dead-band zone and causes the instrument to respond.
Derivative Action	Control action in which the rate of change of the error signal determines the magnitude of the corrective action to be applied. Unit is calibrated in the time units. When subjected to a ramp change the derivative output precedes the straight proportional action by this time.

Deviation	The departure from a desired value; the system deviation that exists after transients have expired is synonymous with offset.
DIN	Abbreviation for Deutsches Institute Fur Normung, A German Standard.
Direct Action Control	An increase in the process variable causes a proportional increase in the output variable. A decrease in the process variable causes a decrease in the output.
Drift	In electronics, a change in a parameter due to a temperature change.
Dynamic Behaviour	Behaviour as a function of time.
Equilibrium	When all inputs and outputs (supply and demand) have steadied down and are in balance.
Error	The difference between the actual and the true value, often expressed as a percentage of either span or full-scale value.
Feedback	Information about the status of the controlled variable which may be compared with that which is desired, in the interest iof making them coincide.
Final Control element	Component of a control system (such as a valve) which directly regulates the flow of energy or material to the process.
Frequency	Occurrence of a periodic function (with time as the independent variable), generally specified as a certain number of cycles per unit time.
Gain (Magnitude Ratio)	The ratio of change in output divided by the change in input which caused it. Both output and input must be expressed in the same units making gain a pure (dimensionless) number.
Galvanometric	A measurement which indicates relative deviation by a null-balance method.
Ground Loop	Condition which exists when two circuit points are connected by two or more paths. This allows current flow in the loop to vary the potential of the connected points.
Hunting	Oscillation or cycling that may be of appreciable amplitude caused by the system's over-zealous effort to achieve a prescribed level of control.
Hysteresis	Difference between upscale and downscale results in instrument response when subjected to same input approached from opposite directions.
Impedance	The total opposition to the flow of current (in ohms)

Indication Resolution	The smallest change that can be read with a given indication.
Inductive Load	A load which is predominantly inductive, i.e. affecting only varying or alternating currents and having low impedance for direct currents.
Input	Incoming signal to measuring instrument control unit or system.
Input Impedance	The total opposition to current flow into a device measured in ohms. If input is purely resistive, the term “input resistance” may be used.
Instability	Lack of stability.
Instrument	In process measurement and control this term is used broadly to describe any device that performs a measuring or controlling function.
Instrumentation	The application of instruments to an industrial process for the purpose of measuring or controlling its activity; the term is also applied to the instruments themselves.
Integral Control action	Action in which the controller’s output is proportional to the time integral of the error input; when used in combination with proportional action, it is often called reset action.
Lag	A delay in output with respect to a change in input.
Linearity	The nearness with which the plot of a signal or other variable plotted against a prescribed linear scale approximates a straight line.
Load	Change in level of material force, torque, energy, power or other variables applied or removed from a process or other component in the stem.
Manipulated Variable	That which is altered by the automatic control equipment so as to change the variable under control and make it conform with the desired value.
Manual Reset	A means of obtaining “reset” action by manual adjustment by the operator of an instrument
Measuring Element	The element which converts the process variable into a form or language that the controller can understand.
Measuring Means	The device used to perform the actual measurement.
Noise	Unwanted signal components that obscure the genuine signal information that is being sought.

Off-Set	The difference between what we get and what we want; that is, the difference between the point at which the process stabilises and the instruction introduced into the controller by the setpoint.
On/Off Control	A control mode in which the output is either fully on or fully off depending on whether or not the input is below or above setpoint.
Open Loop	Control without feedback; eg., an domestic fan.
Optimum	The highest obtainable proficiency of control; eg, supply equals demand and offset has been reduced to a minimum, (hopefully zero).
Output	The signal which is provided by an instrument; eg. the signal which the controller delivers to the valve operator is the controller output.
Overdamped	Damped so that overshoot cannot occur.
Potentiometric	A measurement of DC potential by a null-balance method usually in a resistance bridge.
Power Consumption	The amount of power (in watts) required by an electrical or electronic device during operation.
Process	The equipment to which supply and demand must be balanced – the system under control excluding the equipment which does the controlling.
Proportional Band	Proportional band= 100 / proportional gain. Refers to the percentage of the controller's span of measurement over which the full travel of the control valve is divided.
Proportional Control	Control action in which there is a fixed gain or attenuation between output and input.
Rate Action	That portion of controller output which is proportional to the rate of change of input. Also called derivative action.
Reference Junction Compensation	The generation of a temperature dependent voltage (of opposite polarity) to compensate for the temperature dependent voltage generated at the junction of two dissimilar metals.
Repeatability	A measure of the maximum error or deviation that can be expected when the same value is input at two different times.
Reset	Reset "action" is an electrical means of adjusting (offsetting) the output of a proportional controller to maintain the input at setpoint, by compensating for system loses or gains.

Reset Action	The control action which strives to eliminate offset; correction is made in accordance with the magnitude of the offset and the time involved. Reset is sometimes called integral as it performs an integration of the error.
Reset Time	The calibrated time on the controller reset dial which represents the time that will elapse while the open-loop controller repeats a proportional action.
Resistance	An opposition to flow which accounts for the dissipation of energy and limits flow. Flow from water tap, for example, is limited to what the available pressure can push through the tap opening.
Electrical Resistance (ohms)	Electrical resistance (Ohms) = Potential volts/Flow amperes.
Resistive Bridge	An electrical circuit consisting of four resistors connected to form a square. A potential is normally connected across one diagonal and a galvanometer across he other. Adjustment of the resistance to null reading of the galvanometer makes possible the determination of one of the resistors if the other three are known.
Resistive Load	A load which is predominantly resistive; affecting direct or alternating current with no frequency dependence.
Response	Reaction to a forcing function applied to the input; eg, the variation in measured variables which occurs as the result of step, sinusoidal, ramp or other known type known inputs.
Reverse Action Control **Ripple**	An increase in the process variable input causes a proportional decrease in the output variable. A decrease in the process variable causes an increase in the output. The variation in dc output voltage of a power supply due to the charging and discharging of the output capacitor filter circuit is known as ripple. The smaller the ripple the better the filtering. The ripple can be expressed as a percentage of the output voltage or as rms voltage.
Sample Rate (Updating)	The rate, usually expressed in number of times per second, that a device input is measured and/or an output is changed.
SCR	Abbreviation for "silicon controlled rectifier". A three terminal device which acts as a conventional rectifier to block current flow in the reverse direction and as a transistor switch in the forward direction.
Temperature Coefficient	The amount of change in a parameter due to a given temperature change. Usually expressed as percent per degree, or ppm per degree.

Sensitivity	Often described as the minimum change of input to which the system is capable of responding. This, in turn, is measured by the zero frequency gain.
Setpoint	The instruction given the automatic controller determining the point at which the controlled variable will stabilise.
Setpoint Resolution	The smallest change that is possible with a given setpoint (that will produce a change in output).
Signal	Information in the form of a pneumatic pressure, an electric current or mechanical position that carries information from one control loop component to another.
Solid State Relay	An electronic switch consisting of an isolated control input and triac or dual SCR switching element output predominantly for AC loads.
Span Point	The value of the input signal at which a span or gain adjustment is made during calibration.
SPD	Surge Protective Device.
Stability	The sought-after state where input and output are in balance and will remain so unless subjected to an external stimulus.
Step Change	A change from one level to another in supposedly zero time.
Summing Point	A point at which several signals may be algebraically added.
System	Generally refers to all control components including process, measurement, controller, operator and valve along with any other additional equipment that may contribute to its operation.
Thermocouple	A device constructed of two dissimilar metals which generates a small voltage as a function of temperature difference between a measuring and reference junction; this voltage may be measured and its magnitude used as a measure of the temperature in question.
Thermocouple Burnout Protection	Ability of a control device, which uses a T/C as its sensing element, to maintain a safe condition usually means removing power to heaters or applying power to coolers.
Time Constant	The product of resistance X capacitance which becomes the time required for a first-order system to reach 63.2% of a total change when forced by a step. In so-called higher-order systems there is a time constant for each of the first-order components.

Transducer	A device which converts information or one physical form to another physical type in its output, eg. a thermocouple converts temperature into a millivoltage.
Triac	A three terminal device which acts as a transistor switch
Unstable	Not possessing stability
Value	The level of the signal being measured or controlled.
Variable	A level, quantity or other condition which is subject to change; this may be regulated; eg. the controlled variable or simply measured; eg, a barometer measuring atmospheric pressure.
Zero	The lower end of the measuring instrument's scale, zero scale and zero may not coincide; zero error would simply exact accordance between instrument reading and true value.
Zero Point	The value of the input signal at which a zero or offset adjustment is made during calibration.
Zero Shift	Change resulting in error at the zero percent scale reading as well as a parallel error throughout the entire scale.

Technical Specification

Sydney WATER

Appendix 4 –Monitoring & Control Systems Policy (BMIS0259)

Monitoring & Control Systems Policy

1. Overview

1.1 At a glance

All Sydney Water - Monitoring and Control Systems shall be built and managed in accordance with the IICATS and SCADA Standards managed by the Operational Technology business in Digital group.

1.2 Scope

This policy applies to all staff and contractors, including RDC's and developers who are involved with the building and management of Monitoring and Control systems.

1.3 Objective

The objectives of standard Monitoring and Control systems are to:

- Support the vision, purpose and strategic outcomes of the current corporate policy
- Provide real time integrated systematic operation of our water and wastewater systems to support efficient and effective service to our customers
- Have the capability and flexibility to adapt to new technology and improved level of automation with predictive control capability
- Support more efficient and effective operations and life cycle management of our critical assets and systems via standardisation
- Support the future vision for operations and asset management
- Provide the right information at the right time that supports our people to make proactive decisions to achieve cost effective outcomes
- Ensure that these systems always remain fit for purpose and reliable through effective quality control change management
- Ensure effective cyber security and access control

2. Policy in detail

- All new and refurbished telemetry projects for water and wastewater networks must adopt current **IICATS Standards** including the **Instrumentation & Control (I&C) Standards.**
- All new SCADA projects for Water Filtration Plants and Wastewater Recycling Plants must adopt current **Automation and SCADA Standards** including the **I&C Standards**.
- All new monitoring & control systems shall comply with the Sydney Water **Information Security ICT Policy** and the Sydney Water **SCADA Security Policy**.
- Any refurbishment or expansion project for an existing SCADA system will require appropriate justification for not adopting Sydney Water **SCADA Standards**.
- Standard IICATS and SCADA solutions must be employed to avoid the cost associated with one-off solutions in design, construction, operation and maintenance.
- New technology and innovation will be encouraged through a continual improvement process that will lead to update of the Standards.
- IICATS and SCADA technology will employ 'open' system design as far as practicable to allow competitive supply arrangements and to facilitate the introduction of new technology.
- Sydney Water's **Operational Technology** business within Digital Group will be responsible for managing the IICATS and SCADA technology and standards, and for the provision of strategic direction and technical advice in these areas.
- Internet of Things (IoT) and Hydrometric monitoring systems will not be used for control systems and will maintain segregation to IICATS and SCADA control systems.

3. Definitions

Term	Definition
IICATS	**IICATS** is an acronym for: '**Integrated Instrumentation, Control, Automation and Telemetry System'** **IICATS** has been developed and is used by Sydney water to remotely monitor and control the operation of its geographically distributed water and wastewater assets on a systematic basis. It allows for the efficient collection and use of operational data. **IICATS** encompasses instrumentation, control equipment, wide area communication network, site based Remote Telemetry Units (RTU's), workstations and centralised telemetry hardware.
SCADA	**SCADA** is an acronym for: '**Supervisory Control and Data Acquisition**'. Local **SCADA** systems are used by Sydney Water to monitor and control the operation of Water Filtration Plants and Wastewater Recycling Plants. **SCADA** systems encompass instrumentation, control equipment, local and wide area communication networks, Programmable Logic Controllers (PLC's), workstations and servers. An interface is provided to integrate local **SCADA** systems into IICATS.

4. Context

4.1 Accountabilities

Position	Accountabilities
General Manager, Digital	Policy owner and approver
Head of Business, Operational Technology	Management of standards & systems Policy implementation
Head of Business WFP, Customer Delivery Head of Business WRP, Customer Delivery	Policy review and update Policy review and update
Asset Lifecycle – HoB Infra Inv & Asset Performance	Policy review and update
All staff, contractors and developers involved with Sydney Water control & monitoring assets	Policy implementation

4.2 Training and competencies

Position	Training or competency
All staff involved in life cycle management of Control & Monitoring systems	Training material available on iConnect – Digital/ Operational Technology landing page

4.3 References

Document type	Title
Policies and procedures	• Information Security ICT Policy • SCADA Security Policy
Other documents	• Instrumentation & Control (I&C) Standards • SCADA Standards

5. Ownership

Role	Title
Group	Digital
Owner	GM, Digital
Author	Craig Earl, HoB Operational Technology

5.1 Change history

Version	Issue Date	Approved by	Brief description of change and consultation
2	10-11-2022	Craig Earl, HoB Operational Technology	Updates made in Policy in detail and new corporate template
1	31-10-2014	Paul Plowman, General Manager, Liveable City Solutions	Content update to align with new corporate strategy and corporate template

Appendix 5 – Emergency stops policy

EMERGENCY STOPS POLICY (*Note 1)

Note 1: Emergency Stop Policy and aspects of electrical design are under review and confirmation of latest requirements with regard to machinery and electrical safety should be sought from SWC prior commencing detail design.

1. General

NSW WHS Regulations require that emergency stop circuits must be incapable of malfunction.

AS4024.1 defines the requirements for Safeguarding Machinery, including categories of safety circuits and a risk assessment methodology for establishing the required safety circuit.

2. Scope

This policy shall apply to the design of all new emergency stop circuits for Sydney Water and shall remain in force until amended or withdrawn.

3. Purpose

The purpose of this policy is to alert all designers to the legislative and regulatory requirements relating to emergency stops and to specify SWCs particular requirements.

4. POLICY:

- Emergency stops shall, as a minimum, comply with AS4024.1 and current NSW WHS regulations, in addition to any other regulatory or legislative requirement.
- Risk assessments shall be conducted and documented for all Sydney Water machines. Assessment templates and a detailed assessment procedure shall be produced by the designer.
- Maintenance considerations shall be taken into account in the risk assessments. Danger from machinery shall be eliminated if possible, by guarding or otherwise. Safe working procedures will be introduced where necessary (e.g. isolation, barriers, etc).
- Emergency stops shall not be used for maintenance purposes.
- Emergency stops used for personnel safety shall be designed to be incapable of malfunction.
  - They shall include red pushbuttons on a yellow background, pull to reset, non locking, with a large emergency stop label comprising black letters on a red background.
  - For Treatment Plant SCADA the circuits shall be based on SWC template circuit TE100E and the requirements of the latest issue of SWC Automation and SCADA Standards.
  - For all other assets the circuit shall be in accordance with the latest issue of the SWC I&C Manual and shall be approved by Telemetry Operations Group.

- Emergency stops that are not used for personnel safety shall be referred to as latch stops to aid distinction as to their function and avoid any confusion as to purpose with regard to NSW WHS regulations.
  - They shall include a red mushroom head button against a grey background, pull to reset, non locking, with no label.
  - For Treatment Plant SCADA the circuits shall be based on SWC template circuit TE100 and the requirements of the latest issue of SWC Automation and SCADA Standards.
  - For all other assets the circuit shall be in accordance with the latest issue of the SWC I&C Manual and shall be approved by Telemetry Operations Group.
- Where there is a conflict between this policy and relevant regulations or legislation, it is the responsibility of the designer to immediately notify the Principle upon becoming aware of such a conflict.
- For existing machines the policy stated in the addendum shall apply.

John Myliotis
Project Director, Design Services, ASD

Glyn Williams
OHS Manager, Support, AMD

Jim Pruss
A/Process Leader WWT, AMD

Greg Kane
Process Leader, Maintenance, AMD

Paul Freeman
General Manager, Asset Management Division

Date: 6/8/03

Rev. No/Date	Revision Details
1.1 - 2020	Reference to NSW OH&S Regulations 2001 updated to NSW WHS Regulations. Reference to OH&S updated to WHS.
1.0 - 2003	Initial issue.

Addendum to SWC Emergency Stops Policy for existing Machines.

1. Background

Sydney Water has approximately 7000 emergency stop circuits, only a small proportion of which are used to provide personnel safety, but all of which are capable of malfunction. A specific query to the OH&S State Coordinator, Electrical, has confirmed that these emergency stops do not meet the new legislative requirement.

OH&S 2001 reinforces the requirement that where there is danger from machinery, there is need for risk assessment, elimination of the danger if possible, by guarding or otherwise, and introduction of safe working systems. These include correct design, written procedures for work and maintenance, and training in the observance of the procedures.

With necessary guarding in place, it is anticipated that less than 5% of the total number of existing emergency stops will be found to provide a personnel safety function and will need to be retained and upgraded to eliminate the possibility of malfunction.

2. Scope

This addendum applies to all existing emergency stops within SWC at the time of signature and shall remain in place until modified or withdrawn.

3. Purpose

The purpose of this addendum is to alert all responsible Asset Management Staff to the legislative and regulatory requirements relating to emergency stops and to identify SWCs particular requirements.

4. POLICY

- In complying with OH&S 2001, priority shall be given to current and future work.
- Risk assessments need performing and documentation made readily available for all Sydney Water machines.
- Although maintenance considerations will be taken into account in the risk assessments, safe working procedures will be introduced where necessary (e.g. isolation, barriers, etc).
- Emergency stops shall not be used for maintenance purposes.
- Existing emergency stops that fulfil a personnel safety function shall be upgraded to be incapable of malfunction in order of priority with other safety work on a site by site basis.
- As international standards allow emergency stops to be used other than for personnel safety, and existing emergency stops used for purposes other than personnel safety do not present an OH&S risk, it is proposed such emergency stops remain as is.
- At SPSs, existing labels on red mushroom head buttons referring to “isolator” shall be removed. Existing drawings need not be modified. UPGs and SOPs shall remove any reference to the “isolator” button. Documentation for new installations shall refer to such buttons as latch stops but the button themselves shall not be labelled.
- Design Services will be responsible for identifying areas of need for Sydney Water compliance with OH&S 2001 requirements for guarding and emergency stops at existing installations. This shall include the development of Assessment templates and a detailed assessment procedure.
- All modified emergency stop circuits shall be in accordance with SWC Emergency Stop policy.
- Plant Managers and Asset Owners will be responsible for obtaining funds if necessary and implementing changes, including adequate risk assessment documentation, procedures, maintenance and training.

Appendix 6 – Equipment installation and conduits – IICATS sites

Appendix 6 Equipment Installation and Conduits – IICATS sites

A6.1 Equipment Installation

A6.1.1 Mounting, Supporting, and Positioning

The Contractor must supply and install all stands, supports, brackets and plates and associated fixings for the mounting and positioning of all electrical and instrumentation equipment including power outlets, switches, cubicles, field instruments, conduits, cables, cable ladder/tray and the like.

All equipment must be mounted and positioned such that it is readily accessible for operation, inspection, replacement, modification and maintenance.

All independently mounted equipment must be mounted on fixed structures, where no fixed structure is available the Contractor installer must supply and install a prior approved structure or stand for the mounting of such equipment. Stands must be bracketed off structural steel or fixed by four anchors to the floor or wall or purpose made concrete plinth.

There must be not less than 75mm clearance between a support and the nearest structure and between an instrument and the nearest structure.

All mounting stands, supports, brackets, plates and the like must be stainless steel unless specified otherwise and must be free from burrs and sharp edges, they must have all holes drilled or machined and must be suitably painted, where required, to the satisfaction of the Principal.

Cutting of holes by burning methods is not acceptable.

All mounting stands, supports, brackets, plates and the like must have space allowance, where required, for equipment identification at the top of the stand.

All panels, equipment, mounting stands, supports brackets, cable support systems, plates and the like used for the mounting of equipment must be so constructed to prevent vibration due to wind, operation of adjacent equipment or other dynamic forces likely to be present within the immediate area and must not be fastened to handrails or pipe work. The mounting position must not impede walkway or handrail access.

All screws, bolts, nuts and washers used for the mounting and fixing of electrical and instrumentation equipment must be 316 stainless steel, of correct size and length, and must be suitably isolated from contact with dissimilar metals.

Explosive or impact power tools must not be used for placing mounting studs and the like unless the use of such tools has been specifically approved in writing. by the Principal.

All electrical and instrumentation equipment must be positioned and mounted to allow bottom entry of conduits and/or cables, unless otherwise detailed in this Specification or with prior approval from SWC.

All equipment mounted along or in access ways must be positioned such that they do not present a hazard to vehicular traffic or personnel using the access way.

The Contractor must supply and install all necessary non-corrosive metal packers, shims and also grouting to ensure correct levelling and alignment of equipment must be supplied and installed. under the work of the Contract.

Precaution against galvanic corrosion must be taken whenever contact between dissimilar metals is present. Dissimilar metals must be insulated from each other by suitable plastic strips, washers or sleeves to prevent galvanic corrosion (i.e. all contact between aluminium, galvanised steel, stainless steel and other dissimilar materials must be avoided).

A6.1.2 Mechanical Protection

The Contractor must supply and install approved mechanical Mechanical protection must be provided on all electrical panels and installations, and instrument equipment under the following conditions:

- Where there is risk of electric shock
- Where there is risk of damage from impact or vandalism
- When mounted within 1.5 m above a floor or access platform.
- For protection from damage during normal plant operation and maintenance.

Conduits and very short lengths of cables requiring mechanical protection must be installed in galvanised steel water pipe or other prior approved galvanised steel metal covers.

Sheet metal covers installed to provide mechanical protection of electrical and instrumentation equipment must be constructed to withstand the shock and wind loading likely to occur in the area. Kick plates for protection within 300mm of floor level must be constructed of minimum 3 mm galvanised steel material and be painted as required by the Specification. and to the satisfaction of the Principal. All other protection must be constructed of minimum 1.5mm galvanised steel material or heavy duty rigid PVC tray cover or conduit painted as above (PVC tray cover may only be used on PVC tray and within SWC property not accessible to the public).

Sheet metal covers installed to provide mechanical protection of equipment must be constructed so as to totally enclose such equipment and associated conduits and/or cables. Covers must be bolt or screw on and must give consideration to ventilation, IP rating and vandal proofing.

Any device installed for the mechanical protection of conduits and/or cables must be free of burrs and sharp edges. Additional bushing, sleeving or other prior approved means must be provided as required to ensure adequate bending radius and to prevent conduit and/or cable damage.

A6.1.3 Sealing

The Contractor installation work must:

(a) Effectively seal all openings, ducts, trenches, cable ways and the like where made for the entry of conduits and cables through external walls of buildings, with a weatherproof concrete grout and for those through internal walls of buildings, with a weak mix concrete or by other prior approved means in both cases.
Note: Fire ratings of rooms and building must be maintained. The seal must be gas tight.

(b) Ensure that all spare conduits and ducts are effectively plugged and sealed. Gaps between conduits and gaps between conduits and cables to exclude gas, maintain fire ratings, prevent entry of rodents and liquids.

(c) Ensure that all entries to electrical panels and equipment mounted in locations exposed to the weather are made weatherproof by the installation where required additional flashing and/or rain hoods to prevent the entry of water due to wind, rain, water seepage and the like must be provided.

(d) Ensure that all conduit and cable entries to cubicles are sealed to maintain the IP rating of the cubicle and equipment.

A6.2 Conduits

A6.1.1 General

The Contractor must supply and install all conduits where necessary to complete the work of the Contract.

Conduits and fittings must comply with AS2053 “Conduits and Fittings for Electrical Installations”. Conduits smaller than 20 mm diameter must not be used. Underground conduits must not be smaller than 50mm mm diameter. All conduits, fittings and accessories must be of an approved type and manufacture. Telecommunications lead-in conduit to the BD must be minimum 32mm or as specified by the carrier.

Conduits must be in full lengths, straight, smooth, free from rags, burrs and sharp edges; off cuts must not be used to fabricate long lengths of conduit. Conduits must be set wherever possible to minimise the number of joints. Mechanical continuity must be maintained through joints.

For underground conduit only one bend of 90 degrees or less is permitted but deviations from a straight line are permitted within the flexibility of the conduit. Where more than two changes in direction are required an electrical pit must be installed at each change in direction and in any case an electrical pit must be installed at distances no greater than 50 metres. Where pits are installed one spare 50mm conduit must be installed complete with draw wire.

Exposed PVC conduit HD or LD, external to structures must be protected with a galvanised steel cover a minimum of 1.5mm in thickness and protection must start from 300 mm below ground to a height of 2 metres.

Bends must be of large radius and must be formed with approved formers. Correctly sized springs must be used to form bends in UPVC conduits. Conduits manipulated or bent must maintain true effective diameter and shape at all parts of the bend.

Conduit sets distorted or showing evidence of kinks, wrinkles, flats or having been heated must not be accepted. Wherever possible, bending of UPVC conduits should be performed by the manufacturer.

Conduits must not be buried beneath high voltage power lines or in areas where ground currents are likely to exist Lead-in communications cable in EPR zones must not have joints or terminations within a 15 metres radius from the HV transformer or HV switchyard.

A6.1.2 Heavy Duty UPVC Conduits

Heavy duty UPCV conduit must comply with AS2053 and is for underground use or for use above ground if an increased level of mechanical protection is required. If used above ground then adequate protection, to the satisfaction of the Principal, must be provided and installed by the Contractor to prevent deterioration of the conduit due to exposure to sunlight. This conduit is for both underground use and above ground use and must comply with AS2053. When used above ground the conduit must be painted to prevent deterioration of the conduit due to exposure to sunlight.

All fittings must be of the same material as the conduit and all joints must be made with an adhesive cement type recommended by the supplier.

A6.1.3 Light Duty PVC Conduits

Light duty PVC conduit must comply with AS2053 and is for use above ground in positions not exposed to mechanical damage.

All associated plastic fittings except saddles must be of the same material as for the conduits.

All conduits, plastic fittings and adhesive cement must be procured from the same manufacturer, and the manufacturer's recommended procedures must be adopted for the making of joints. All fittings must be of the same material as the conduit and all joints must be made with an adhesive cement type recommended by the supplier.

All standard size wall boxes must be of the same material as the conduits. Where special size boxes are indicated but are not obtainable in PVC, pre-fabricated metal wall box with a screwed PVC adaptor and lock nuts must be used. Metal boxes must be earthed. Metal boxes must be hot dipped galvanised with 316 stainless steel screws and covers must be fitted with 1.0 mm thick Neoprene gaskets.

PVC conduit must be fixed to a PVC wall box with a screwed PVC adaptor and circular lock nuts, unless the conduit enters the wall box via a moulded conduit entry.

A6.1.4 Steel Conduits

All steel conduits must be hot dipped galvanised with screwed joints and screwed terminations, to AS2053. End joints and terminations must be made by either screwing the conduit into the fitting or by securing the conduit to the fitting or accessory with circular hot dipped galvanised lock nuts screwed onto the conduit. In the latter case the entry hole must be close fitting to the conduit.

Steel conduits must be installed with screwed ends and screwed joints. All threads must be painted with aluminium paint. Steel conduits must be electrically and mechanically continuous.

Horizontal conduit runs which are exposed to weather, or where moisture would be retained between the conduit and the wall, must be installed using saddle spacers or other approved means of fixing clear of the surface.

Wherever steel enclosures are required for cables which are to be buried in the ground or run in concrete trenches, the enclosures must be galvanised medium quality pipe to AS1074 (generally known as galvanised water pipe). Joints must be protected against corrosion and effectively sealed against entry of water or moisture and all associated fittings must be either galvanised steel or galvanised malleable cast iron. Bends must be of large radius. The pipe run must be electrically continuous and enclosure must be earthed at both ends.

A6.1.5 Flexible Conduit

All flexible metallic or PVC conduits and fittings must be in accordance with AS2053.

Flexible conduit must be terminated with proprietary brand watertight terminations suitable for the type of flexible conduit being used.

Flexible conduit must only be used to connect items of equipment which are withdrawable, subject to vibration or adjustment, where there is no risk of mechanical damage, where intricate conduit sets are required or where a conduit system spans a building expansion joint.

Where flexible conduit is necessary its length must be limited to a maximum of 1 meter.

A6.1.6 Saddles

Saddles must be double sided hot dipped galvanised steel, fixed with 316 stainless steel screws. Zinc or cadmium plated, PVC and single sided saddles will not be acceptable. The saddles to be used must be submitted to the Principal approved for approval prior to installation commencing.

A6.1.7 Installation

Heavy duty UPVC conduit must not be installed on exterior surfaces. However short runs of heavy duty UPVC conduits and ducts from underground installations may be surface run where they enter an existing building if it is not practicable to conceal them, provided that they are suitably protected from mechanical damage and sunlight.

Jointing of conduits and fittings must be carried out strictly in accordance with the manufacturer's recommendations. Expansion joints must be installed in all conduit runs to manufacturer's recommendations.

Each power circuit/cable, originating from any distribution board, must be run in a separate conduit where the cable support system comprises conduit only.

Where conduits are exposed to direct sunlight, they must be installed in accordance with Clause 2.5.4 of AS2053.

The installation of junction boxes, inspection elbows, tees and the like are prohibited on conduits installed in inaccessible locations.

All conduits must be effectively capped during construction.

All conduits must be grouped as far as possible and all support brackets and saddles spaced to ensure that the runs remain straight and, in any case, must not exceed one (1) metre between centres.

Conduits must be securely fixed to building members and must be adequately supported during all stages of building construction. (Particular care must be taken to support PVC conduits up-stands).

Surface conduits must be made to harmonise as far as practicable with the architectural features of the building. Surface conduits must be run in vertical and horizontal planes except where it is desirable to follow the line of a constructional feature of the building, where the approval of the Principal must be obtained.

Conduits must terminate in equipment, accessories or in wall boxes and junction boxes of a type compatible with the installation.

The Contractor must supply, install, be responsible for and ensure that Aall conduits and/or boxes to be "cast in concrete" are must be supplied and installed accurately and on time. The Contractor must check aAll installed conduits and/or boxes immediately prior to and during each concrete pour must be checked to ensure that they are not damaged or dislodged.

All conduits and ducts must be cleared of foreign material and obstructions after installation and prior to draw cords or cables being drawn in. Conduit systems must be completely installed before commencing cable installation.

Appendix 7 – Motor Starters and Electrical Equipment in Starter Cubicles – IICATS sites

Appendix 7 Motor starters and electrical equipment in starter cubicles – IICATS sites

A7.1 ELECTRICAL EQUIPMENT

A7.1.1 FUSES

Fuse holders (bases and carriers) and fuse links shall comply with AS/NZS 60269. Fuse holders shall be fully shrouded.

All circuits, including starters potential and control circuits, shall be protected by HRC fuse links.

A7.1.2 CIRCUIT BREAKERS

Circuit breakers for motor starters shall be moulded case circuit breaker with adjustable fault current protection. Moulded case air circuit breakers shall fully comply with AS 2184 and shall have positive physical indication of the “tripped” position. The circuit breakers shall be of the thermal magnetic type with the quick make, quick break, trip-free toggle action and fitted with efficient arc interrupting devices of the “de-ion” type. Contactors shall be of non-welding alloys and all metal parts shall be treated to prevent corrosion.

All circuit breakers shall be fitted with provision for locking in the ‘OFF’ position using a standard padlock.

A7.1.3 PANEL METERS

Ammeters and voltmeters shall comply with AS 1042 with an accuracy class of 1.5.

Ammeters and voltmeters shall be 96mm non-flush mounting, square pattern industrial grade instruments with a 90º deflection movement. Scales shall include a red mark indication of motor full load current.

A7.1.4 CURRENT TRANSFORMERS

Current transformers shall be class ‘1’ to AS 1675. They shall have a 5Amp secondary unless otherwise specified, and a minimum burden rating of 7.5 VA for metering. The data plates of current transformers shall be readily visible from the access position. If the data plates of current transformers are not readily visible from the access platform an identical data plate shall be provided and fixed adjacent to the current transformers.

Protection current transformers shall not be used to supply metering circuits.

For multi-ratio current transformers, the class, output and burden specified shall apply to the lowest ratio.

A7.1.5 CONTACTORS

Contactors shall comply with the following:
(a) Quiet in operation;
(b) Rated duty intermittent class 01;
(c) Utilisation category "AC-3" or "DC-3" as applicable;
(d) Mechanical endurance Class 10;
(e) Contact life 1 million operations;

(f) Minimum rating of 16 A, 415 V at category ASE204;
(g) Be designed to allow for fitting of auxiliary contacts with rating of 4A at 240V a.c.
(h) Minimum of 2 N/O and 2 N/C contacts

All contactors shall be electromagnetically operated, air break and contain double break silver alloy contacts.

A7.1.6 MOTOR OVER-TEMPERATURE RELAYS

Starter modules shall be equipped with an over temperature relay(s) suitable for use with PTC thermistors supplied with motors. Equipment shall comply with AS 1023.1.

For pumping station applications, the over temperature relay shall be provided with manual reset functionality and shall trip when the temperature in the motor reaches the operating temperature.

The whole motor temperature protection system shall not latch out in case of power failure, ie. shall not prevent the starter from restarting the motor when power is restored.

A7.1.7 AUXILIARY RELAYS

Relays used in starters shall be selected from the one manufacturer's range and shall be common in regard to contact switching in any one voltage range.

The relay shall have no less than the mechanical endurance of the contactor and in any case no less than a mechanical life of 1 million operations.

Contact ratings shall be a minimum of 5 Amps at 240 V and shall be capable of carrying the inrush and hold-in current of the associated controlled device, e.g. contactor, heater, etc.

Relays shall be operable, as a minimum, over the range 192-240-264V AC.

Relays forming part of 24 V DC control circuits shall be fitted with over-voltage suppression diodes.

The Contractor’s attention is drawn to the need to consider Tthe impedance of the auxiliary relays shall be considered when long cable runs (exceeding 100m) are used for stops and field stop/start buttons. Miniaturised relays may have sufficiently high impedance for cable capacitance to induce malfunction and should there be avoided. The Contractor designer shall demonstrate to Sydney Water’s satisfaction that the design accommodates this consideration.

A7.1.8 TIMERS

All timers shall be of the electronic plug-in type, which permits removal of the timer body without disturbing the connecting wiring.

Timers forming part of 24 V DC control circuits shall be fitted with over-voltage suppression diodes.

A7.1.9 INDICATOR LIGHTS

Indicator lights shall be:

a) LED type for 240V AC and 24 V DC;

b) Illuminated when a lamp test button is operated or press to test type.

All lamps shall have Miniature Bayonet Cap (Ba 9).

A7.2 SOFT STARTERS

This section details the monitoring and control requirements for soft starters used at IICATS sites. Refer to the relevant clauses of Sydney Water Technical Specification – Electrical for power section requirements.

Soft starters, as a minimum monitoring and control requirement, must:

a) Operate on a 24VDC control voltage.

b) Provide I/O as standard with additional I/O module options with a combined minimum of 2 digital inputs, 5 relay outputs, 2 analogue inputs 4-20mA, 2 analogue outputs 4-20mA, as well as a Modbus RTU RS485 interface and Ethernet communications. I/O must be fully configurable including the ability to select the function of each input and output.

   a. The digital inputs must be configurable for run and reset functionality.

   b. The relay outputs must be configurable for fault, running and low current functionality. The low current output must be programmable with user defined logic.

   c. One of the analogue outputs must be configurable for starter instantaneous current.

   d. Drive parameters, as listed below, must be available to read from the device via a Modbus RTU RS485 interface and Ethernet Cat5/6 RJ45 interface.

c) Provide soft start, soft stop, pump start, pump stop and linear speed acceleration, linear deceleration and torque control, current limit and dual ramp operating modes with adjustable starting and stopping times.

d) Monitor phase voltage and phase current directly for each phase.

e) Monitor motor speed, motor thermal usage, board temperature and line frequency.

f) Provide real, reactive and apparent power.

g) Provide real time power factor for each phase and as a total of all three phases.

h) Monitor and record peak starting current.

i) Provide THD for voltage and current with average and three (3) phase values.

j) Provide instantaneous motor torque and motor speed (estimated % full speed) for linear speed acceleration or deceleration modes.

k) Provides elapsed time meters that calculate total accumulated run hours. One (1) must be resettable, and one (1) that cannot be reset.

l) Provide running time since last start, actual start time, and total number of starts.

m) Provide a slow speed reversing function that can be disabled and manually initiated if required.

n) Provide the ability to tune the starter to the motor using motor auto tuning, or a similar function.

o) Provide undervoltage, overvoltage, voltage imbalance, current imbalance, motor overload, stall, jam, overload and underload protection. Protection functions must have both alarm and fault conditions with the ability to enable/disable and configure alarm and fault trip points individually and individually configure alarm and fault time delays.

p) Provide a separate fault and alarm buffer to record history with real time clock time stamps. A minimum of the last 5 faults and last 100 alarms must be stored in the history log.

q) Provide an HIM with LCD screen, function keys and numeric keypad that allows full access to configure and monitor all controller parameters, option modules and option module parameters. The HIM must provide diagnostics and run time information. Options for both panel mount and remote mount HIM displays must be available.

r) Provide Programmable logic that can be used create custom logic execution, signal conditioning, event detection and alarms and connect to device inputs and drive device outputs.

s) Provide PC configuration software that allows connection to the controller.

   a. The software must provide the ability to fully configure the full set of standard and option module parameters including alarms, faults, trip points and time delays.

   b. It must provide the ability to connect to the soft starter in real-time and capture, view and analyse real-time data for all parameters, including trending, while connected to the appliance.

   c. The software must include a programmable logic editor that enables logic configuration in both function block diagrams and ladder logic.

   d. The software must allow storing and saving of individual device configurations with the ability to upload and download configurations between the device and the PC. Files must be viewable in an offline mode on the PC.

   e. The software must provide a clear, user friendly windows based GUI. The software must operate on a standard windows 10 and windows 11 operating system.

   f. The software must be free issue with no restriction on the number of users. It should be downloadable through the supplier's website. It must be regularly updated for new devices and backward compatible with legacy equipment. Updates must be available for device databases.

   g. Connection from the PC to the drive should be via standard off the shelf cables (e.g. standard ethernet or USB cables). If any proprietary configuration cables, modems or converters are required for configuration from a PC they must be supplied to Sydney Water with each soft starter.

A7.3 VARIABLE SPEED DRIVES

This section details the monitoring and control requirements for variable speed drives used at IICATS sites. Refer to the relevant clauses of Sydney Water Technical Specification – Electrical for power section requirements.

Variable speed drives, as a minimum monitoring and control requirement, must:

a) Operate on a 24VDC control voltage.

b) Provide I/O as standard with additional I/O module options with a combined minimum of 8 digital inputs, 3 relay outputs, 1 analogue input 4-20mA, 2 analogue outputs 4-20mA, as well as a Modbus RTU RS485 interface and Ethernet communications. I/O must be fully configurable including the ability to select the function of each input and output. (Note: the soft starter I/O is not applicable to variable speed drives).

   a. The digital inputs must be configurable for run forward, stop/reset, MOP up, MOP down, MOP speed select, High speed select, main contactor interlock and acceleration/deceleration ramp speed change input functionality.

   b. The relay outputs must be configurable for fault, running and low current functionality. This includes the ability to be programmable with user defined logic.

  c. The analogue input must be configurable as the reference speed and the analogue outputs must be configurable for starter speed feedback and instantaneous current.
  d. Drive parameters, as listed below, must be available to read from the device via a Modbus RTU RS485 interface and Ethernet Cat5/6 RJ45 interface.

c) Provide an active front end with harmonic mitigation ($I_{THD} \leq 5\%$) and power factor correction (typically unity total power factor).

d) Sense high line side harmonics and provide an alarm option.

e) Provide real-time predictive maintenance analytics on core components including fans, IGBTs, and capacitors based on actual use. Provide a warning/alarm feature for component percent of life remaining.

f) Utilise DC bus conditioning to minimise voltage transients.

g) Provide drive temperature monitoring and thermal management.

h) Monitor phase voltage and phase current directly for each phase.

i) Monitor motor speed, motor thermal usage, board temperature and line frequency.

j) Provide real, reactive and apparent power.

k) Provide real time power factor for each phase and as a total of all three phases.

l) Monitor and record peak starting currents.

m) Provide THD for voltage and current with average and three (3) phase values.

n) Provide instantaneous motor torque and motor speed.

o) Provides elapsed time meters that calculate total accumulated run hours. One (1) must be resettable, and one (1) that cannot be reset.

p) Provide running time since last start, actual start time, and total number of starts.

q) Provide a slow speed reversing function that can be disabled and manually initiated if required.

r) Provide the ability to tune the starter to the motor using motor auto tuning, or a similar function.

s) Provide undervoltage, overvoltage, voltage imbalance, current imbalance, motor overload, stall, jam, overload and underload protection. Protection functions must have both alarm and fault conditions with the ability to enable/disable and configure alarm and fault trip points individually and individually configure alarm and fault time delays.

t) Provide a separate fault and alarm buffer to record history with real time clock time stamps. A minimum of the last 5 faults and last 100 alarms must be stored in the history log.

u) Provide an HIM with LCD screen, function keys and numeric keypad that allows full access to configure and monitor all controller parameters, option modules and option module parameters. The HIM must provide diagnostics and run time information. Options for both panel mount and remote mount HIM displays must be available.

v) Provide Programmable logic that can be used create custom logic execution, signal conditioning, event detection and alarms and connect to device inputs and drive device outputs.

w) Provide PC configuration software that allows connection to the controller.

x) The software must provide the ability to fully configure the full set of standard and option module parameters including alarms, faults, trip points and time delays.

y) It must provide the ability to connect to the soft starter in real-time and capture, view and analyse real-time data for all parameters, including trending, while connected to the appliance.

z) The software must include a programmable logic editor that enables logic configuration in both function block diagrams and ladder logic.

a. The software must allow storing and saving of individual device configurations with the ability to upload and download configurations between the device and the PC. Files must be viewable in an offline mode on the PC.

b. The software must provide a clear, user friendly windows based GUI. The software must operate on a standard windows 10 and windows 11 operating system.

c. The software must be free issue with no restriction on the number of users. It should be downloadable through the supplier's website. It must be regularly updated for new devices and backward compatible with legacy equipment. Updates must be available for device databases.

d. Connection from the PC to the drive should be via standard off the shelf cables (e.g. standard ethernet or USB cables). If any proprietary configuration cables, modems or converters are required for configuration from a PC they must be supplied to Sydney Water with each soft starter.

Technical Specification

Sydney WATER

Appendix 8 – IICATS preassigned loop numbers

Appendix 8 IICATS preassigned loop numbers

A8.1 General

This appendix sets out the method to be followed for depicting and identifying the major machinery items (such as motors and valves) and measurement and control equipment used on SWC water and sewage sites. It follows closely the systems described in AS1101.6 and has been extended to cover machinery items. The standard provides the identification of the key functions of instruments and other equipment for use on P & I diagrams, flow diagrams, drawings, schedules, specifications etc.

For detailed cable numbering information for specific applications refer to Appendix 9 – Typical IICATS cable numbers. Where the user cannot determine which loop number to use, or a preassigned loop number does not exist for a specific device, consult the OT Standards Engineer for clarification.

A8.1.1 Outline of the identification system

The measurement and control equipment identification (or tag number) consists of functional identification and a loop identification.

A8.1.2 Functional identification

The functional identification shall consist of letters from the code letter identification table shown on Principal's Drawing GISTND/IP1200. The first letter of the functional identification shall be selected according to the measured or initiating variable in the loop.

The succeeding letter or letters shall cover the function of the individual component in the loop.

- e.g. "EA--------"

  where E = ALL Electrical Variables

  A = Alarm

A8.1.3 Loop identification

The loop identification of an instrument shall use a three digit number assigned to the loop of which the instrument is a part. Larger sites such as Sewage Treatment Plants may use four digit loop numbers.

An alpha suffix shall be used if a loop has more than one instrument with the same functional identification e.g. EA002A.

A8.1.4 Symbols

The symbols to be used for the P & I diagrams are those contained in AS1101.6 as modified by the Standard Sites P & I diagram legend on Principal's Drawing GISTND/IP1200.

A8.2 Numbering system for standard IICATS sites

A8.2.1 General

Throughout the water and sewerage systems of Sydney Water there are sites which have common asset types and operating functions and as such are classed as standard sites.

The purpose of this part of the I & C Manual is to:

- identify those standard sites and assets applicable to the water and sewerage systems

for the I&C and IICATS projects

- define for each of the standard site types the I&C and IICATS signal provision

incorporated in the standard site operational requirements.

A8.2.2 Standard sites functional description

The detailed description of the functional requirements for each of the standard site types have been documented separately and are available from SWC OT Group.

These functional descriptions for the standard site types are provided to achieve two objectives. These objectives are as follows:

- To describe the local control and monitoring facilities to be provided for a new "green field" site and the major items of equipment necessary for the provision of the agreed I&C functionality and IICATS signals.
- To describe the local control and monitoring facilities to be provided from an existing "operational site" against which a site audit will be carried out to determine scopes of work for the provision of the agreed I&C functionality and IICATS signals.

The standard site design functional requirements includes the definition of measurements to be made to meet local I&C and IICATS requirements, definition of the RTU I/O and Process & Instrumentation diagrams for the agreed standard site type.

A8.2.3 List of standard site types

The associated volumes of the Instrumentation Standards which apply to the Standard Site Types are:

- SPS Related Standards
- Water Distribution System Related Standards
- Stand Alone Monitoring Sites Related Standards

The above individual standards are to be used in conjunction with the General Instrumentation and Control Standards.

A8.3 IICATS numbering conventions

A8.3.1 General

The information given below provides a list of pre-assigned Loop identification numbers which shall be used by all organisations. This information can be explained by the following example for power monitoring.

Example 1.

Loop code	Signal tile	Tag number	Suffix	RTU I/O type	Signal type
E002	Site PSU Power Failed	EA002	A	DI/	A

- The suffix will be A, B, C .... etc.
- The digital signal types are:
  - A – Alarm
  - C – Control
  - S - Status

The Loop Code is comprised of the first letter of the functional identification and the loop identification number. Loop identifications have been pre-assigned generally on a per asset/ per item hierarchy to cover the standard IICATS signals and equipment.

The pre-assigned loop identification numbers that follow allow for a maximum of nine similar items of equipment. Using pumps as an example, nine pumps would be allocated the numbers 010 to 090. A tenth pump should adopt the number 1010, pump eleven would be 1020 etc. Consequently, where an RTU I/O connects with a site having ten or more similar items, a fourth digit is permitted to accommodate this.

The predefined loop numbers for standard sites contained in this section must also be used for identification of corresponding field instruments. This requirement shall be relaxed, at the discretion of the superintendent, only if its implementation likely to cause conflict with existing site numbering system.

Example 2.

Refer to the details in the following example for pump unit 1 water- single speed motor.

E010- Pump Unit 1 loop code

Pump unit 1 motor failed	EA010A	DI/A
Pump unit 1 motor control disabled	EA010B	DI/A
Pump unit 1 manual selected	EB010A	DI/S
Pump unit 1 OFF selected	EB010B	DI/S
Pump unit 1 auto start/stop	EC010A	DO/C
Pump unit 1 suction safety reset	EC010D	DO/C

Loop Code	**Signal Title**	**Tag Number**		**RTU I/O Type**	**Signal Type**
		No:	suffix		
E010	Pump unit 1 motor failed	EA210	A	DI	A-Alarm
E010	Pump unit 1 motor control disabled	EA210	B	DI	A-Alarm
E010	Pump unit 1 manual selected	EB210	A	DI	S-status
E010	Pump unit 1 off selected	EB210	B	DI	S-status
E010	Pump unit 1 auto start /stop	EC210	A	DO	C-control
E010	Pump unit 1 suction safety reset	EC210	D	DO	C-control

Loop Code and Tag Number: The loop code is comprised of the first letter of the functional identification and the loop identification number. The first letter of functional identification shall be selected according to the measured or initiating variable in the loop and succeeding letter or letters shall cover the function of the individual component in the loop (e.g. 'EA_ _ _', 'EB_ __', 'EC_ __' where E= all electrical variables and A= Alarm e.g. EA210A for 'Unit 1 motor failed'; B= status e.g. EB210A for 'unit 1 manual selected'; C=Control e.g. EC210A for 'Unit 1 auto start/ stop' output).

Suffix: An alpha suffix shall be used if a loop has more than one instrument with the same functional identification (e.g. EA210A- '_ _ _ _ _ A' for 'unit 1 motor failed'; EA210B- '_ _ _ _ _ B' for 'unit 1 control disabled').

A8.3.2 Pre-assigned loop numbers

000 to 009	SITE GENERAL (WATER AND SEWAGE)
010 to 099	PUMP UNIT 1 to 9 (WATER AND SEWAGE)
100 to 109	WATER QUALITY MONITORING
110 to 119	WET WELL (OR WET WELL 1) (SEWAGE)
120 to 129	WET WELL 2 (SEWAGE)
130 to 139	OVERFLOW MONITORING (SEWAGE)
140 to 149	FLOW MONITORING (WATER AND SEWAGE)
150 to169	MISCELLANEOUS 1
170 to 179	Not Used
180 to 189	WATER HYDROPNEUMATIC STATION
190 to 199	COMMUNICATIONS
200 to 209	PRESSURE MONITORING
210 to 299	PUMP UNIT 1 to 9 (WATER – LEGACY SITES ONLY)
300 to 309	PUMP MOTOR FLOODED MONITORING (WATER AND SEWERAGE)
310 to 319	RESERVOIR (or RESERVOIR 1)
320 to 350	RESERVOIR 2 TO 5
360 to 369	RESERVOIR (OR RESERVOIR 1) REMOTE SIGNALS
370 to 400	RESERVOIRS 2 TO 5 REMOTE SIGNALS
410 to 499	VALVE 1 to VALVE 9
500 to 509	DAM
510 to 519	MULTILOOP CABLES
520 to 529	CONDUIT RUNS
530 to 539	PACKAGED PUMPING STATIONS
540 to 559	VACUUM STATIONS (SEWAGE)
560 to 569	WEATHER STATIONS
570 to 589	MISCELLANEOUS 2
590 to 599	PUMP UNIT REFLUX VALVE MONITORING (WATER AND SEWAGE)
600 to 629	Not Used
630 to 659	INTERNAL COMMUNICATIONS SERIAL AND ETHERNET
660 to 750	Not Used
751 to 799	MISCELLANEOUS 3
800 to 820	WATER QUALITY MONITORING STATION
821 to 904	Not Used
905 to 915	SURGE VESSELS & AIR COMPRESSORS

A8.3.3 000 to 009 Site general (water and sewage)

Loop code	Signal title	RTU tag no.	I/O type/signal type
E000	SITE ELECTRICITY AUTHORITY POWER FAILED-1	EA000	DI/A
E001	SITE SYDNEY WATER POWER FAILED	EA001	DI/A
E002	DISTRIBUTION BOARD SURGE PROTECTION	EA002A	DI/A
	DISTRIBUTION BOARD ENERGY MONITORING	EA002B	DI/A
O003	SITE ENTRY ACCESS CLOSED/OPEN	OB003	DI/S
004		OB004	DI/S
T005	STATION OVERTEMPERATURE	TA005	DI/A
E006	SITE ELECTRICITY AUTHORITY POWER FAILED - 400V AC (EMERGENCY SUPPLY)	EA006	DI/A
E007	SITE ELECTRICITY AUTHORITY POWER FAILED-2	EA007	DI/A
E008	STATION INHIBIT	EA008	DO/S
009			

A8.3.4 010 Pump unit 1 (Water and Sewage)

Loop code	Signal title	RTU tag no.	I/O type/signal type
E010	REFER TO E010 BREAKDOWN (FOLLOWING 3 PAGES) FOR SIGNALS AND RTU TAG NUMBERS ASSOCIATED WITH THE RESPECTIVE MOTOR SPEED TYPE. REFER BELOW FOR ADDITIONAL SIGNALS AND ASSOCIATED RTU TAG NUMBERS IF APPLICABLE.		
M011	PUMP UNIT 1 PUMP SEAL FAULT (FOR SUBMERSIBLE PUMP ONLY)	MA011	DI/A
E012	PUMP UNIT 1 TRIPPED DUE TO NO FLOW (FOR VACUUM STATIONS ONLY)	EA012	DI/A
T012	PUMP UNIT 1 MOTOR OVERTEMP		
T013	PUMP UNIT 1 PUMP OVERTEMP (FOR CONVENTIONAL PUMP ONLY)		
V014	PUMP UNIT 1 PUMP VIBRATION FAULT (FOR CONVENTIONAL PUMP ONLY)		
E015	PUMP UNIT 1 MOTOR CURRENT	EI015B	AI/-
E016	PUMP UNIT 1 MOTOR INPUT POWER	EI016B	AI/-
S017	PUMP UNIT 1 MOTOR SPEED	SI017	AI/-
S018	PUMP UNIT 1 MOTOR SPEED CONTROL	SC018A	AO/-
S018A	PUMP UNIT1 LEVEL SETPOINT	SC018B	AO/-
E019	PUMP UNIT 1 FLUSHING VALVE		

A8.3.5 010 Pump unit 1 (water and sewage) – single speed motor

Loop code	Signal title	RTU tag no.	I/O type/signal type
E010	PUMP UNIT 1 FLUSHING SELECTED	EB010A	DI/S
	PUMP UNIT 1 MANUAL SELECTED	EB010B	DI/S
	PUMP UNIT 1 OFF SELECTED	EB010C	DI/S
	PUMP UNIT 1 AUTO SELECTED	EB010D	DI/S
	PUMP UNIT 1 MOTOR RUNNING/STOPPED	EB010E	DI/S
	PUMP UNIT 1 MOTOR FAILED	EA010A	DI/A
	PUMP UNIT 1 MOTOR CONTROL DISABLED	EA010B	DI/A
	PUMP UNIT 1 SUCTION SAFETY TRIPPED	EA010C	DI/A
	PUMP UNIT 1 PUMP FAILED (FOR CONVENTIONAL PUMP ONLY)	EA010D	DI/A
	PUMP UNIT 1 REFLUX VALVE FAILED	EA010E	DI/A
	PUMP UNIT 1 AUTO START/STOP	EC010A	DO/C
	PUMP UNIT 1 AUTO INHIBITED	EO010B	DO/C
	PUMP UNIT 1 NEXT TO RUN	EC010C	DO/C
	PUMP UNIT 1 SUCTION SAFETY TRIP REMOTE RESET	EC010D	DO/C

A8.3.6 010 Pump unit 1 (water and sewage) – dual speed motor

Loop code	Signal title	RTU tag no.	I/O type/signal type
E010	PUMP UNIT 1 FLUSHING SELECTED	EB010A	DI/S
	PUMP UNIT 1 MANUAL SELECTED	EB010B	DI/S
	PUMP UNIT 1 OFF SELECTED	EB010C	DI/S
	PUMP UNIT 1 AUTO SELECTED PUMP UNIT 1 MOTOR HIGH SPEED	EB010D	DI/S
	RUNNING/STOPPED PUMP UNIT 1 MOTOR LOW SPEED	EB010E	DI/S
	RUNNING/STOPPED	EB010F	DI/S
	PUMP UNIT 1 MOTOR FAILED HIGH SPEED	EA010A	DI/A
	PUMP UNIT 1 MOTOR FAILED LOW SPEED	EA010E	DI/A
	PUMP UNIT 1 MOTOR CONTROL DISABLED	EA010B	DI/A
	PUMP UNIT 1 SUCTION SAFETY TRIPPED	EA010C	DI/A
	PUMP UNIT 1 PUMP FAILED (FOR CONVENTIONAL PUMP ONLY)	EA010D	DI/A
	PUMP UNIT 1 AUTO HIGH SPEED START/STOP	EC010A	DO/C
	PUMP UNIT 1 AUTO LOW SPEED START/STOP	EC010B	DO/C
	PUMP UNIT 1 AUTO INHIBITED	EC010C	DO/C
	PUMP UNIT 1 NEXT TO RUN	EC010D	DO/C
	PUMP UNIT 1 SUCTION SAFETY TRIP REMOTE RESET	EC010E	DO/C

A8.3.7 010 Pump unit 1 (water and sewage) – variable speed motor

Loop code	Signal title	RTU tag no.	I/O type/signal type
E010	PUMP UNIT 1 FLUSHING SELECTED	EB010A	DI/S
	PUMP UNIT 1 MANUAL SELECTED	EB010B	DI/S
	PUMP UNIT 1 OFF SELECTED	EB010C	DI/S
	PUMP UNIT 1 AUTO SELECTED	EB010D	DI/S
	PUMP UNIT 1 MOTOR RUNNING/STOPPED	EB010E	DI/S
	PUMP UNIT 1 MOTOR FAILED	EA010A	DI/A
	PUMP UNIT 1 MOTOR CONTROL DISABLED	EA010B	DI/A
	PUMP UNIT 1 SUCTION SAFETY TRIPPED	EA010C	DI/A
	PUMP UNIT 1 PUMP FAILED (FOR CONVENTIONAL PUMP ONLY) PUMP UNIT 1 VARIABLE SPEED CUBICLE	EA010D	DI/A
	COMMON FAULT	EA010E	DI/A
	PUMP UNIT 1 AUTO START/STOP	EC010A	DO/C
	PUMP UNIT 1 AUTO INHIBITED	EC010B	DO/C
	PUMP UNIT 1 NEXT TO RUN	EC010C	DO/C
	PUMP UNIT 1 SUCTION SAFETY TRIP REMOTE RESET	EC010D	DO/C
	PUMP UNIT 1 RTU SPEED CONTROL SPEED SETPOINT	EC010E	AO/C
	PUMP UNIT 1 RTU SPEED CONTROL SPEED FEEDBACK	EC010F	AI/C

A8.3.8 020 to 090 Pump unit 2 to 9 (water and sewage)

PUMP UNITS 2 TO 9 (IF APPLICABLE) SHALL USE ABOVE LOOP CODE RESPECTIVELY AND THE ASSOCIATED SIGNALS IDENTIFIED AS FOR PUMP UNIT 1 (SEWAGE) 010.

A8.3.9 100 to 109 Water Quality monitoring

Loop code	Signal title	RTU tag no.	I/O type/signal type
100			
P101	WATER QUALITY PRESSURE	PI101	AI/-
F102	WATER QUALITY FLOWRATE	FI102	AI/-
T103	WATER QUALITY TEMPERATURE	TI103	AI/-
P104	WATER QUALITY INLET PRESSURE		
P105	WATER QUALITY REDUCED PRESSURE		
A106	WATER QUALITY pH	AI106	AI/-
A107	WATER QUALITY TURBIDITY	AI107	AI/-
A108	WATER QUALITY CHLORINE RESIDUAL	AI108	AI/-
109			

A8.3.10 110 to 119 Wet well (or Wet well 1) (sewage)

Loop code	Signal title	RTU tag no.	I/O type/signal type
L110	WET WELL (1) LEVEL	LI11OB	AI/-
L111	WET WELL (1) IN SERVICE	LA111	DI/S
L112	WET WELL 1 ABOVE TOP WATER LEVEL	LA112	DI/A
L113			
L114			
L115			
116			
117			
118			
119			

A8.3.11 120 to 129 Wet well 2 (sewage)

Loop code	Signal title	RTU tag no.	I/O type/signal type
L120	WET WELL 2 LEVEL	LI120B	AI/-
L121	WET WELL 2 IN SERVICE	LA121	DI/A
L122	WET WELL 2 ABOVE TOP WATER LEVEL	LA122	DI/A
123			
124			
125			
126			
127			
128			
129			

A8.3.12 130 to 139 Overflow monitoring, collecting manhole and storage chamber (sewage)

Loop code	Signal title	RTU tag no.	I/O type/signal type
L130	OVERFLOW LEVEL-Collecting Manhole	LI130	AI/-
L131	*OVERFLOW OCCURRING	LC131	DO/C
L132	*OVERFLOW LEVEL	LC132	AO/-
L133	*OVERFLOW OCCURRING (2)	LC133	DO/C
L134	*OVERFLOW LEVEL (2)	LC134	AO/-
L135	OVERFLOW OCCURRED-Collecting Manhole	LC135	DI/A
L136	STATION ON OVERFLOW	LC136	DO/A
137			
L138	STORAGE CHAMBER FILLING	LC138	DI/A
L139	OVERFLOW LEVEL- Storage Chamber	LI139	AI/-

A8.3.13 140 to 149 Flow monitoring (water and sewage)

Loop code	Signal title	RTU tag no.	I/O type/signal type
F140	FLOWRATE (1)	FI140B	AI/-
	FLOW (1) DIRECTION FORWARD/REVERSE	FB140	DI/S
L141	FLOW METER (1) PIT FLOODED	LA141	DI/A
F142	FLOWRATE 2	FI142B	AI/-
	FLOW 2 DIRECTION FORWARD/REVERSED	FB142	DI/S
L143	FLOW METER 2 PIT FLOODED	LA143	DI/A
F144	FLOWRATE 3	FI144/B	AI/-
	FLOW 3 DIRECTION FORWARD/REVERSED	FB144	DI/S
L145	FLOWMETER 3 PIT FLOODED	LA145	DI/A
146			
147			
148			
F149	FLOWRATE (REMOTE SIGNAL)	FC149	AO/-

A8.3.14 150 to 169 Miscellaneous 1

Loop code	Signal title	RTU tag no.	I/O type/signal type
150	STATION EMERGENCY CONTROL INHIBITED (SPS ONLY)	EC150	DO/C
	STATION UNDER EMERGENCY CONTROL (SPS ONLY)	EC150A	DO/C
	STATION EMERGENCY CONTROLLER AVAILABLE (SPS ONLY)	EC150B	DI/C
151	COMMON FLUSHING VALVE (SPS ONLY)		
L152	MACHINERY WELL FLOODED	LA152	DI/A
E153	SUMP PUMP FAILED	EA153	DI/A
E154	VENTILATION FAILED	EA154	DI/A
E155	OUTDOOR ENCLOSURE	-	-
E156	RTU CUBICLE AND/OR BACKPLATE	-	-
E157	MARSHALLING CUBICLE AND/OR BACKPLATE	-	-
E158	ELECTRICITY AUTHORITY POWER SUPPLY	-	-
E159	SITE EARTH	-	-
E160	SOLAR POWER SUPPLY	-	-
E161	FLUSHING START/STOP PENDANT AND CABLE	-	-
E162	LAMP TEST	-	-
E163	INDOOR CUBICLE	-	-
L164	PIT FLOODED	LA164	DI/A
B165	FIRE/SMOKE		
B165A	OVERTEMPERATURE		
E166	REMOVE EXISTING EQUIPMENT	-	-
E167	MAIN SWITCHBOARD	-	-
E168	DISTRIBUTION SWITCHBOARD 1	-	-
E169	DISTRIBUTION SWITCHBOARD 2	-	-

A8.3.15 170 TO 179 Sewage ejector station

Loop code	Signal title	RTU tag no.	I/O type/signal type
E170	LEAD IN COMMUNICATION TRENCH/CONDUIT	-	-
E171	COMPRESSOR UNIT 1 FAILED	EA171/A	DI/A
	COMPRESSOR UNIT 1 EXCESS RUNNING TIME (WHERE TIMER EXISTS)	EA171/B	DI/A
	COMPRESSOR UNIT 1 RUNNING/STOPPED	EB171/1	DI/S
	COMPRESSOR UNIT 1 AUTO/NOT AUTO (WHERE EXISTING)	EB171/B	DI/S
E172	COMPRESSOR UNIT 2 FAILED	EA172/A	DI/A
	COMPRESSOR UNIT 2 EXCESS RUNNING TIME (WHERE TIMER EXISTS)	EA172/B	DI/A
	COMPRESSOR UNIT 2 RUNNING/STOPPED	EB172/A	DI/S
	COMPRESSOR UNIT 2 AUTO/NOT AUTO (WHERE EXISTING)	EB172/B	DI/S
E173	COMPRESSOR UNIT 1 EXCESS RUN TIME RESET	EA173	DO/C
E174	COMPRESSOR UNIT 2 EXCESS RUN TIME RESET	EA174	DO/C
175			
176			
177			
178			
179			

A8.3.16 190 TO 199 Telecommunications

Loop code	Signal title	RTU tag no.	I/O type/signal type
Y190	LEAD IN COMMUNICATION TRENCH/CONDUIT	-	-
Y191	LEAD IN COMMUNICATION CABLE	-	-
Y192	MDF	-	-
Y193	COMMUNICATION CONNECTION SOCKET	-	-
Y194	COMMUNICATION EARTH BONDING TERMINAL	-	-
Y195	COMMUNICATION LINK 1	-	-
Y196	COMMUNICATION LINK 2	-	-
Y197	COMMUNICATION LINK 3	-	-
198			
199			

A8.3.17 200 TO 209 Pressure monitoring

Loop code	Signal title	RTU tag no.	I/O type/signal type
P200	PRESSURE (1)	PI200	AI/-
P201	STATION SUCTION PRESSURE (1)	PI201	AI/-
P202	STATION DELIVERY PRESSURE (1)	PI202	AI/-
L203	PRESSURE PIT FLOODED	LA203	DI/A
P204	STATION DELIVERY PRESSURE (2)	PI204	AI/-
P205	PRESSURE (2)	PI205	AI/-
P206	STATION SUCTION PRESSURE (2)	PI206	AI/-
P207	SUSTAINING PRESSURE (1)	AI207B	AI/-
P208	SUSTAINING PRESSURE (2)	AI208B	AI/-
P209	PRESSURE (REMOTE SIGNAL)	PC209	AO/-

A8.3.18 210 TO 299 Pump Units 1 to 9 (WATER – LEGACY SITES ONLY)

Contact SWC IACS Project Engineer for guidance where these loop codes are required to be used at existing sites.

A8.3.19 300 TO 309 Pump motor flooded monitoring (LEGACY SITES ONLY)

Loop code	Signal title	RTU tag no.	I/O type/signal type
300			
L301	PUMP UNIT 1 FLOODED	LA301	DI/A
L302	PUMP UNIT 2 FLOODED	LA302	DI/A
L303	PUMP UNIT 3 FLOODED	LA303	DI/A
L304	PUMP UNIT 4 FLOODED	LA304	DI/A
305			
306			
307			
308			
309			

A8.3.20 310 to 319 Reservoir (or Reservoir 1)

Loop code	Signal title	RTU tag no.	I/O type/signal type
L310	RESERVOIR (1) LEVEL	LI310B	AI/-
L311	RESERVOIR (1) OVERFLOW IMPENDING	LA311	DI/A
L312	RESERVOIR (1) LOW LEVEL	LA312	DI/A
L313	RESERVOIR (1) TRIP IECV TO CLOSE	-	-
E314	RESERVOIR (1) MIXER FAILED	EA314	DI/A
N315	RESERVOIR (1) CATHODIC PROTECTION UNIT FAILED	NA315	DI/A
F316	RESERVOIR (1) PRV FLOW/NO FLOW	FB316	DI/S
L 317	RESERVOIR REFERENCE LEVEL	L317	LI/S
A318	RESERVOIR (1) CHLORINE RESIDUAL	AI318	AI/-
F319	RESERVOIR (1) INLET FLOW/NO FLOW	FB319	DI/S

A8.3.21 320 to 350 Reservoirs 2 to 5

RESERVOIRS 2 TO 5 (IF APPLICABLE) SHALL USE ABOVE LOOP CODES RESPECTIVELY AND THE ASSOCIATED SIGNALS IDENTIFIED AS FOR RESERVOIR (OR RESERVOIR 1) 310.

A8.3.22 360 to 369 Remote Reservoir (or Reservoir 1) signals

Loop code	Signal title	RTU tag no.	I/O type/signal type
L360	REMOTE RESERVOIR (1) LEVEL	LC360	AO/-
L361	REMOTE RESERVOIR (1) OVERFLOW IMPENDING	LC361A	DO/A
	REMOTE RESERVOIR (1) LOW LEVEL	LC361B	DO/A
	REMOTE RESERVOIR (1) SELECTED FOR CONTROL	LC361C	DO/S
362			
363			
364			
365			
366			
367			
368			
E369	REMOTE RESERVOIR (1) CONTROL SELECTED	EB369A	DI/S
	REMOTE RESERVOIR (2) CONTROL SELECTED	EB369B	DI/S

A8.3.23 370 to 409 Remote reservoirs 2 to 5 remote signals

RESERVOIRS 2 TO 5 REMOTE SIGNALS (IF APPLICABLE) SHALL USE ABOVE LOOP CODES RESPECTIVELY AND THE ASSOCIATED SIGNALS IDENTIFIED AS FOR RESERVOIR (OR RESERVOIR 1) REMOTE SIGNALS 360.

A8.3.24 410 to 419 Valve (or Valve 1)

Loop code	Signal title	RTU tag no.	I/O type/signal type
E410	REFER E410 ATTACHED FOR SIGNALS AND RTU TAG NUMBERS ASSOCIATED WITH THE RESPECTIVE VALVE ACTUATOR TYPE. REFER BELOW FOR ADDITIONAL SIGNALS AND ASSOCIATED RTU TAG NUMBERS IF APPLICABLE.		
L411	VALVE (1) PIT FLOODED	LA411	DI/A
E412	VALVE (1) OIL POWER UNIT FAILED	EA412	DI/A
E413	VALVE (1) OPEN LATCH ENGAGED	EB413	DI/S
G415	VALVE (1) POSITION	GI415B	AI/-
G416	VALVE (1) POSITION CONTROL	GC416	AO/-
E417	IECV(1) EMERGENCY REMOTE TRIP TO CLOSE (FUTURE)	EC417	DO/C
E418	VALVE BATTERY BACKED SUPPLY		
P419	VALVE EMERGENCY GAS PRESSURE LOW	PA419	DI/A

A8.3.25 410 Valve (or Valve 1) – Electric actuated with separate valve control panel

Loop code	Signal title	RTU tag no.	I/O type/signal type
E410	VALVE (1) LOCAL 1 SELECTED	EB410A	DI/S
	VALVE (1) LOCAL 2 SELECTED	EB410B	DI/S
	VALVE (1) OFF SELECTED	EB410C	DI/S
	VALVE (1) AUTO SELECTED	EB410D	DI/S
	VALVE (1) FULLY OPEN	EB410E	DI/S
	VALVE (1) FULLY CLOSED	EB410F	DI/S
	VALVE (1) OPENING	EB410G	DI/S
	VALVE (1) CLOSING	EB410H	DI/S
	VALVE (1) CONTROL DISABLED	EA410A	DI/A
	VALVE (1) FAILED	EA410B	DI/A
	VALVE (1) OPEN	EC410A	DO/C
	VALVE (1) CLOSE	EC410B	DO/C
	VALVE (1) AUTO INHIBITED	EC410C	DO/C

A8.3.26 410 Valve (or Valve 1) – Electric actuated with integral starter/controls

Loop code	Signal title	RTU tag no.	I/O type/signal type
E410	VALVE (1) LOCAL 1 SELECTED	EB410A	DI/S
	VALVE (1) LOCAL 2 SELECTED	EB410B	DI/S
	VALVE (1) OFF SELECTED	EB410C	DI/S
	VALVE (1) AUTO SELECTED	EB410D	DI/S
	VALVE (1) FULLY OPEN	EB410E	DI/S
	VALVE (1) FULLY CLOSED	EB410F	DI/S
	VALVE (1) CONTROL DISABLED	EA410A	DI/A
	VALVE (1) FAILED (if applicable)	EA410B	DI/A
	VALVE (1) OPEN	EC410A	DO/C
	VALVE (1) CLOSE	EC410B	DO/C
	VALVE (1) AUTO INHIBITED	EC410C	DO/C
	VALVE (1) % OPEN	EB410I	AI/C

A8.3.27 410 Valve (or Valve 1) – Hydraulic actuated with single pilot solenoid valve

Loop code	Signal title	RTU tag no.	I/O type/signal type
E410	VALVE (1) LOCAL 1 SELECTED	EB410A	DI/S
	VALVE (1) LOCAL 2 SELECTED	EB410B	DI/S
	VALVE (1) OFF SELECTED	EB410C	DI/S
	VALVE (1) AUTO SELECTED	EB410D	DI/S
	VALVE (1) FULLY OPEN	EB410E	DI/S
	VALVE (1) FULLY CLOSED	EB410F	DI/S
	VALVE (1) OPENING	EB410G	DI/S
	VALVE (1) CLOSING	EB410H	DI/S
	VALVE (1) CONTROL DISABLED	EA410	DI/A
	VALVE (1) OPEN/CLOSE	EC410A	DO/C
	VALVE (1) AUTO INHIBITED	EC410B	DO/C

A8.3.28 410 Valve (or Valve 1) – Hydraulic actuated with double pilot solenoid valve

Loop code	Signal title	RTU tag no.	I/O type/signal type
E410	VALVE (1) LOCAL 1 SELECTED	EB410A	DI/S
	VALVE (1) LOCAL 2 SELECTED	EB410B	DI/S
	VALVE (1) OFF SELECTED	EB410C	DI/S
	VALVE (1) AUTO SELECTED	EB410D	DI/S
	VALVE (1) FULLY OPEN	EB410E	DI/S
	VALVE (1) FULLY CLOSED	EB410F	DI/S
	VALVE (1) OPENING	EB410G	DI/S
	VALVE (1) CLOSING	EB410H	DI/S
	VALVE (1) CONTROL DISABLED	EA410	DI/A
	VALVE (1) OPEN	EC410A	DO/C
	VALVE (1) CLOSE	EC410B	DO/C
	VALVE (1) AUTO INHIBITED	EC410C	DO/C

A8.3.29 410 Valve (or Valve 1) – Hydraulic actuated with positioner

Loop code	Signal title	RTU tag no.	I/O type/signal type
E410	VALVE (1) MANUAL SELECTED	EB410A	DI/S
	VALVE (1) AUTO SELECTED	EB410B	DI/S
	VALVE (1) FULLY OPEN	EB410C	DI/S
	VALVE (1) FULLY CLOSED	EB410D	DI/S
	VALVE (1) OPENING	EB410E	DI/S
	VALVE (1) CLOSING	EB410F	DI/S
	VALVE (1) AUTO INHIBITED	EC410	DO/C

A8.3.30 410 Valve (or Valve 1) – IECV and manually operated isolation valve

Loop code	Signal title	RTU tag no.	I/O type/signal type
E410	VALVE (1) FULLY OPEN	EB410A	DI/S
	VALVE (1) FULLY CLOSED	EB410B	DI/S
	VALVE (1) LOCKED	EB410C	DI/S

A8.3.31 410 Bypass valve – Electric actuated with separate valve control panel

Loop code	Signal title	RTU tag no.	I/O type/signal type
E410	VALVE (1) LOCAL 1 SELECTED	EB410A	DI/S
	VALVE (1) LOCAL 2 SELECTED	EB410B	DI/S
	VALVE (1) OFF SELECTED	EB410C	DI/S
	VALVE (1) AUTO SELECTED	EB410D	DI/S
	VALVE (1) FULLY OPEN	EB410E	DI/S
	VALVE (1) FULLY CLOSED	EB410F	DI/S
	VALVE (1) OPENING	EB410G	DI/S
	VALVE (1) CLOSING	EB410H	DI/S
	VALVE (1) CONTROL DISABLED	EA410A	DI/A
	VALVE (1) FAILED	EA410B	DO/C
	VALVE (1) OPEN	EC410A	DO/C
	VALVE (1) CLOSE	EC410B	DO/C
	VALVE (1) AUTO INHIBITED	EC410C	DO/C
	VALVE FAILED AUTO	EC410D	DO/C

A8.3.32 420 to 499 Valves 2 to 9

VALVES 2 TO 9 (IF APPLICABLE) SHALL USE ABOVE LOOP CODES RESPECTIVELY AND THE ASSOCIATED SIGNALS IDENTIFIED AS FOR VALVE (OR VALVE 1) LOOP CODE 410.

A8.3.33 500 to 509 Dam

Loop code	Signal title	RTU tag no.	I/O type/signal type
L500	DAM LEVEL	LI500	AI/-
L501	DAM LEVEL HIGH	LA501	DI/A
502			
503			
504			
505			
M506	HYDROLOGY STATION RAINFALL	MI506	AI/-
L507	HYDROLOGY STATION RIVER LEVEL	LI507	AI/-
E508	HYDROLOGY STATION BATTERY VOLTAGE LOW	EA508	DI/A
E509	HYDROLOGY STATION DATA VALID	EB509	DI/S

A8.3.34 510 to 519 Multiloop cables

Loop code	Signal title	RTU tag no.	I/O type/signal type
E510	MULTILOOP CABLE 1 DIGITAL		
E511	MULTILOOP CABLE 2 DIGITAL		
E512	MULTILOOP CABLE 3 DIGITAL		
E513	MULTILOOP CABLE 4 DIGITAL		
E514	MULTILOOP CABLE 5 DIGITAL		
E515	MULTILOOP CABLE 6 DIGITAL		
E516	MULTILOOP CABLE 7 DIGITAL		
E517	MULTILOOP CABLE 8 DIGITAL		
E518	MULTILOOP CABLE 9 DIGITAL		
E519	MULTILOOP CABLE 10 DIGITAL		

A8.3.35 520 to 529 Conduit runs

Loop code	Signal title	RTU tag no.	I/O type/signal type
E520	CONDUIT RUN 1		
E521	CONDUIT RUN 2		
E522	CONDUIT RUN 3		
E523	CONDUIT RUN 4		
E524	CONDUIT RUN 5		
E525	CONDUIT RUN 6		
E526	CONDUIT RUN 7		
E527	CONDUIT RUN 8		
E528	CONDUIT RUN 9		
E529	CONDUIT RUN 10		

A8.3.36 530 to 539 Packaged pumping stations

Loop code	Signal title	RTU tag no.	I/O type/signal type
E530	PUMP UNIT 1 RUNNING/STOPPED	EB530/A	DI/S
	PUMP UNIT 1 AUTO/NOT AUTO (WHERE EXISTING)	EB530/B	DI/S
	PUMP UNIT 1 HEALTHY/FAILED	EA530	DI/A
531			
532			
533			
534			
535			
536			
537			
538			
539			

A8.3.37 560 to 569 Weather stations

Loop code	Signal title	RTU tag no.	I/O type/signal type
M560	RAIN GAUGE	MI560	PI/-
T561	DRY BULB TEMPERATURE		
T562	WET BULB TEMPERATURE		
S563	WIND SPEED		
G564	WIND DIRECTION		
A565	SOLAR RADIATION		
566			
567			
568			
569			

A8.3.38 570 to 589 Miscellaneous 2

Loop code	Signal title	RTU tag no.	I/O type/signal type
E570	RELOCATE EXISTING EQUIPMENT	-	-
L571	VACUUM TANK SEWAGE LEVEL (% FULL) (SEWAGE PUMPING STATION - VACUUM ONLY)	L1571	AI/-
P572	VACUUM TANK VACUUM PRESSURE (-kPA) (SEWAGE PUMPING STATION - VACUUM ONLY)	PI572	AI/-
L573	SEAL WATER SUPPLY TANK LOW LEVEL (SEWAGE PUMPING STATION - VACUUM ONLY)	LA57B	DI/A
E574	WPXXX PUMP STATION RUNNING (FROM A REMOTE WPS)	EC574	DO/C
E575	CHANGEOVER CABLING	-	
E576	HV TRIP SUPPLY UNIT (1) (COMMON FAULT OR LOW VOLTS)	EA576	DI/A
G577	REMOTE RESERVOIR VALVE (1) STATUS	GC577	DO/C
G578	REMOTE RESERVOIR VALVE (2) STATUS	GC578	DO/C
E579	INCOMING POWER SUPPLY (1) SELECTION STATUS	EB579	DI/S
E580	INCOMING POWER SUPPLY (2) SELECTION STATUS	EB580	DI/S
E581	HV TRIP SUPPLY UNIT 2	EA581	DI/A
	(COMMON FAULT OR LOW VOLTS)	EA581	DI/A
E582	REMOTE SITE INTERFACE SIGNALS		
	(INTERLOCK)	EC582	DO/C
E583	CONTROL EQUIPMENT HEALTHY/ FAILED	EA583	DI/A
P584	STATION DIFFERENTIAL SWITCH OPERATED	PA584	DI/A
E585	VALVE SUMP PUMP 1 FAILED	EA585	DI/A
E586	VALVE SUMP PUMP 2 FAILED	EA586	DI/A
E587	VALVE SUMP PUMP 3 FAILED	EA587	DI/A
E588	HV MONITORING SIGNALS (1) (DATA LINK)	EA588	
E589	HV MONITORING SIGNALS (2) (DATA LINK)	EA589	

A8.3.39 590 to 599 Pump unit reflux valve monitoring (water and sewage)

Loop code	Signal title	RTU tag no.	I/O type/signal type
590			
G591	PUMP UNIT 1 REFLUX VALVE (1A) (NO FLOW OR FAILED TO CLOSE)		
G592	G592 PUMP UNIT 2 REFLUX VALVE (2A) (NO FLOW OR FAILED TO CLOSE)		
593			
594			
595			
596			
597			
G598	G598 PUMP UNIT 1 REFLUX VALVE (1B) (NO FLOW OR FAILED TO CLOSE)		
G599	G599 PUMP UNIT 2 REFLUX VALVE (2B) (NO FLOW OR FAILED TO CLOSE)		

A8.3.40 600 to 610 Transformers

Loop code	Signal title	RTU tag no.	I/O type/signal type
600			
601			
602			
603			
E604	HV/LV TRANSFORMER 1	EA604	DI/A
E605	HV/LV TRANSFORMER 2	EA605	DI/A
E606	HV/LV TRANSFORMER 3	EA606	DI/A
E607	HV/LV TRANSFORMER 4	EA607	DI/A
608			
609			

A8.3.41 630 to 649 Internal communications serial and ethernet

Loop code	Signal title	RTU tag no.	I/O type/signal type
E630	RTU CONTROL PANEL RS485 BUS		
E631	MAS800 SERIES CONTROL BUS		
632			
633			
634			
635			
636			
637			
638			
639			
640			
641			
642			
643			
644			
645			
646			
647			
648			
649			

A8.3.42 768 to 799 Miscellaneous 3

Loop code	Signal title	RTU tag no.	I/O type/signal type
E768	PORTABLE GENERATOR SUPPLY	EB768/A	DI/S
E769	PERMANENT GENERATOR SUPPLY	EB768/A	DI/S
770			
771			
772			
773			
774			
775			
E776	SEWER GAUGE A PRESSURE 1	E776A	AI/C
	SEWER GAUGE B PRESSURE 2	E776B	AI/C
	VELOCITY	E776C	AI/C
	LEVEL	E776D	AI/C
	FLOW	E776E	
E777	BUILDING EXHAUST FAN		
E778	ODOUR CONTROL FAN 1		
E779	ODOUR CONTROL FAN 2		
E780	EVACUATION ALARM	EA780	DI/A
P781	COMPRESSOR AIR PRESSURE LOW	PA781	DI/A
E782	STATION PUMP UNIT DUTY SELECTION	EC782	DO/C
P783	PRESSURE (REMOTE SIGNAL) - DIGITAL	PC783	DO/C
P784	REMOTE PMS FOR CONTROL	PC784	DO/C
E785	DELIVERY VALVE PANEL COMMON ALARM	EA785	DI/A
E786	REMOTE PUMP MONITORING/CONTROL	EC786	DO/C
E787	REMOTE ALARM SIGNAL	EA787	DO/A
E788	REMOTE STATUS SIGNAL	ES788	DO/S
E789	UPS FAULT	EA789A	DI/A
	UPS BATTERY LOW	EA789B	DI/A
P790	(STATION) DIFFERENTIAL PRESSURE (1)	PI790	AI/C
P791	(STATION) DIFFERENTIAL PRESSURE (2)	PI791	AI/C
P792	(STATION) DIFFERENTIAL PRESSURE (3)	PI792	AI/C
E793	SUMP PUMP(S) RUNNING/STOPPED	EB793	DI/S
L794	SUMP WATER LEVEL HIGH	LA794	DI/S
E795	EMERGENCY ALARM	EA795	DI/S
E796	CARBON FILTER PRESSURE DIFFERETIAL HIGH	EA796A	DI/A
	CARBON FILTER FLOW SWITCH	EA796B	DI/A
E797	SURGE DIVERTER	EA797	DI/A
E798	MISCELLANEOUS CABLING		
E799	BULKHEAD DOOR CLOSED/OPEN	EA799	DI/I

A8.3.43 800 to 820 Water quality monitoring station

Loop code	Signal title	RTU tag no.	I/O type/signal type
800			
801			
F802	FLOW ALARM		
803			
804			
805			
A806	pH DIGITAL ALARMS		
A807	TURBIDITY (WQMS) METER ALARM		
A808	CHLORINE RESIDUAL DIGITAL ALARMS		
809			
P810	SUCTION SAFETY OPERATED		
E811	SAMPLE PUMP ALARMS		
812			
813			
814			
815			
816			
A817	PHYSIOLOGICAL ALARM		
A818	BIOLOGICAL ALARM		
A819	DECHLORINATION ALARM		
F820	INTAKE PROTECTION ALARM		

A8.3.44 905 to 915 Surge vessels and air compressors

Loop code	Signal title	RTU tag no.	I/O type/signal type
P905	SURGE VESSEL 1		
P906	SURGE VESSEL 2		
P907	SURGE VESSEL 3		
908			
909			
P910	SURGE VESSEL AIR PRESSURE (COMMON)		
911			
912			
P913	SURGE VESSEL COMPRESSOR 1		
P914	SURGE VESSEL COMPRESSOR 2		
P915	SURGE VESSEL COMPRESSOR 3		

A8.3.45 Re-chlorination plant specific asset/loop numbering

Asset	Asset title
PMP01	Transfer/mixing pump 1
PMP05	Dilution pump 1
PMP06	Dilution pump 2
PMP10	Dosing pump 1
PMP11	Dosing pump 2
PMP12	Dosing pump 3
PMP13	Dosing pump 4
VLV21	Storage tank 1 outlet valve 21
SOV22	Make up water solenoid valve 22
VLV23	Recirculation valve 23
VLV24	Dosing tank outlet valve 24
VLV25	Dosing skid 1 valve 25
VLV26	Dosing skid 2 valve 26
SOV27	Dilution water 1 solenoid valve 27
SOV28	Dilution water 2 solenoid valve 28

Instrument loops	Signal title
003	Door switch
110	Storage tank level
120	Storage tank level overflow
125	Storage tank level low
130	Process room bund high level
210	Dosing tank level
220	Dosing tank level overflow
225	Dosing tank low level
230	Dosing skid 1 leakage detection catch pot high level
231	Dosing skid 1 leakage pit high level
235	Dosing skid 2 leakage detection catch pot high level
236	Dosing skid 2 leakage detection pit high level
310	Chemical dosing skid 1 flowmeter
320	Chemical dosing skid 2 flowmeter
332	Dilution water flow switch 1
342	Dilution water flow switch 2
140	Mains water flowmeter 1 (cabling to re-chlorination system)*
141	Mains flowmeter 1 pit high (cabling to re-chlorination system)*
142	Mains water flowmeter 2 (cabling to re-chlorination system)*
143	Mains water flowmeter 2 pit high (cabling to re-chlorination system)*
370	Transfer flowmeter
372	Dilution water to dosing tank low flow detection
380	Dosing skid 1 pressure transmitter
385	Dosing skid 2 pressure transmitter
108	Chlorine analyser 1 (cabling between WQM and re-chlorination system)*
208	Chlorine analyser 2 (cabling between WQM and re-chlorination system)*

* These assets may be connected to the other IICATS RTU(s). Make sure cables and asset numbers are not duplicated with the other assets on the same set of drawings and totally independent and don't share same cable routes with the other assets other than the re-chlorination system assets. Confirm with IACS SCADA Project Engineer.

Appendix 9 – Typical IICATS cable numbers

This appendix provides typical cable identification numbers for IICATS sites based on Appendix 8 - IICATS preassigned loop numbers. This is a list of common uses and is not intended as a complete list of all possible applications. Where the user cannot determine which loop number to use, or a preassigned loop number does not exist for a specific device, consult the OT Standards Engineer for clarification.

	LVS1 Power & Controls		
	LVS1 Power		
Cable ID	Source	Destination	Comment
010-P01	Power supply Distribution Board	LVS1 Motor Starter	Cable numbering starts from the power distribution board.
010-P02	LVS1 Motor Starter	Pump Unit 1 Field Turret	
010-P03	Pump Unit 1 Field Turret	Pump Unit 1 Motor	Cable number increments at each junction.
010-P04…P0x	LVS1	Unit auxiliary power, solenoids etc	Continue numbering after last pump power cable.
	LVS1 Valve Actuator Power		
Cable ID	Source	Destination	Comment
014-P01	LVS1	Delivery Control Valve Actuator	Cable numbering starts from the power supply and increments at each junction, 014-P02, 014-P03 etc. if required. Refer to Valves section.
015-P01	LVS1	Delivery Isolation Valve 2 Actuator	Cable numbering starts from the power supply and increments at each junction, 015-P02, 015-P03 etc. if required. Refer to Valves section.
016-P01	LVS1	Suction Isolation Valve 1 Actuator	Cable numbering starts from the power supply and increments at each junction, 016-P02, 016-P03 etc. if required. Refer to Valves section.
017-P01	LVS1	Suction Isolation Valve 2 Actuator	Cable numbering starts from the power supply and increments at each junction, 017-P02, 017-P03 etc. if required. Refer to Valves section.
	LVS1 Controls - multicore cables		
Cable ID	Source	Destination	Comment
010-C01	LVS1 Motor Starter	RTU Panel ELV Digital I/O	
010-C10	LVS1 Motor Starter Control Panel	LVS1 Variable Speed Drive	Used only where control panel and drive unit are separate panels.
010-C02	LVS1 Motor Starter	Pump Flush Pendent Outlet	
010-C03	LVS1 Motor Starter - Interlock	LVS2 Motor Starter	
010-C04…C0x	LVS1	Additional LVS Interlocks and controls	
010-I01	LVS1	RTU Panel Instrumentation	
	010-I01 cores		
010-I01-01W/01BK	LVS1	RTU Pump Unit 1 Speed Control	
010-I01-02W/02BK	LVS1	RTU Pump Unit 1 Current	

010-I01-03W/03BK	LVS1	RTU Pump Unit 1 Speed	
010-I01-04W/04BK	LVS1	RTU Pump Unit 1 Power	
010-D01	RTU Panel	LVS1	Data cable from RTU to pump starter. E.g., Modbus or Ethernet. Increment at each junction.
	Multifunction/multicore pump sensor cables		
011-C01	LVS1 Motor Starter	Pump Unit 1 Field Turret/Junction	For Motor Thermistor /Bimetallic /MiniCAS/MAS Relay Interface.
011-C02	Pump Unit 1 Field Turret	Pump Unit 1 Motor	This cable is not required where pump unit is terminated directly to motor starter.
	011-C0X cores for MiniCas relay		
011-C0X-1	LVS1 Thermistor relay	Pump temperature sensors	
011-C0X-2	LVS1 Thermistor relay	Pump temperature sensors	
011-C0X-3	LVS1 MiniCAS relay	Integral pump sensors	
011-C0X-4	LVS1 MiniCAS relay	Integral pump sensors	
	MAS800 series communications cable numbers		
630-D04	RTU	MAS800 Master in RTU panel	Refer to SSD120, 121, 122
631-D01	MAS800 Master in RTU panel	MAS800 LVS1	Refer to SSD120, 121, 123
631-D02	MAS800 LVS1	MAS800 LVS2	Refer to SSD120, 121, 124
631-D03	MAS800 LVS2	MAS800 LVS3	Refer to SSD120, 121, 125
631-D04	MAS800 LVS3	MAS800 LVS4 etc.	Increment for subsequent devices. Refer to SSD120, 121, 122
	LVS1 Controls - discrete cables		
	* Individual cables for discrete pump sensors only		
*011-C01	LVS1	Oil Seal	Only if an individual cable for each pump sensor is used.
*012-C01	LVS1	Thermistor	Only if an individual cable for each pump sensor is used.
013-C01	LVS1	Unit Isolation/Field latch stop	
014-C01	LVS1	Delivery Control Valve Actuator	
015-C01	LVS1	Delivery Isolation Valve 2 Actuator	
016-C01	LVS1	Suction Isolation Valve 1 Actuator	

017-C01	LVS1	Suction Isolation Valve 2 Actuator	
018-C01	LVS1		
019-C01	LVS1		
011-C03	LVS1 Motor Starter / LVS1 Variable Speed Drive	Pump Unit 1 NRV Limit Switch / Proximity Switch	
011-C04	LVS1	Unit Stop Due to Flooding Float Switch	
015-I01	LVS1	RTU Pump Unit 1 Current	Only if an individual cable for each pump sensor is used.
016-I01	LVS1	RTU Pump Unit 1 Power	Only if an individual cable for each pump sensor is used.
017-I01	LVS1	RTU Pump Unit 1 Speed	Only if an individual cable for each pump sensor is used.
018-I01	LVS1	RTU Pump Unit 1 Speed Control	Only if an individual cable for each pump sensor is used.
	LVS2 Power & Controls		
Cable ID	Source	Destination	Comment
02X-XXX			As per LVS1 using 02X prefix.
	LVS3 Power & Controls		
Cable ID	Source	Destination	Comment
03X-XXX…09X-XXX			As per LVS1 using 03X to 09X prefix.
	Split SCA Interconnections		
Cable ID	Source	Destination	Comment
163-P01	Power Distribution	SCA Anticondensation Heaters	May loop from RTU cubicle to LVS cubicle
163-P02	Power Distribution	SCA Internal Lights	May loop from RTU cubicle to LVS cubicle
163-P03	Power Distribution	GPO in RTU Panel	From auxiliary DB Board. Use only when RTU remote from PD. Individual circuit. No RTU DB.
163-P04	Power Distribution	PSU in RTU Panel	From auxiliary DB Board. Use only when RTU remote from PD. Individual circuit. No RTU DB.
713-P01	Power Distribution	DB in RTU panel	Typical. In this instance 163-P03 & P04 will not be used.

	Sump Pump & Machinery Well		
Cable ID	Source	Destination	Comment
152-C01	RTU Panel	Machinery Well Flooded Level Switch LS 152	Machinery Well Flooded Level Switch 1
153-C01	Power Distribution	Sump Pump Starter Panel or Outlet Power Supply	Sump Pump1
153-P01	Sump Pump Starter Panel or Outlet	Sump Pump	Sump Pump1
153-C01	RTU Panel	Sump Pump Failed	Sump Pump 1 Failed
153-C02	Sump Pump Starter Panel	Sump Float Switch	Sump 1 Float Switch
252-C01	RTU Panel	Machinery Well Flooded Level Switch LS 252	Machinery Well Flooded Level Switch 2
253-C01	Power Distribution	Sump Pump Starter Panel or Outlet Power Supply	Sump Pump 2
253-P01	Sump Pump Starter Panel or Outlet	Sump Pump	Sump Pump 2
253-C01	RTU Panel	Sump Pump Failed	Sump Pump 2 Failed
253-C02	Sump Pump Starter Panel	Sump Float Switch	Sump 2 Float Switch
352-XXX, 452-XXX			Machinery Well Flooded Level Switch 3, 4, etc.
353-XXX, 453-XXX			Sump pump 3, 4, etc.
	Ventilation Fan		
Cable ID	Source	Destination	Comment
154-P02	Ventilation Fan Starter Panel	Ventilation Fan Motor	Ventilation Fan 1. Cable numbers originate from power supply.
154-P01	Power Distribution	Ventilation Fan Starter Panel Power Supply	Ventilation Fan 1
154-C01	RTU Panel	Ventilation Fan Failed	Ventilation Fan 1
154-C02	Ventilation Fan Starter Panel	Ventilation Fan Pressure Switch	Ventilation Fan 1
154-C03	Ventilation Fan Starter Panel	Ventilation Fan Remote Start Station	Ventilation Fan 1
254-P02	Ventilation Fan Starter Panel	Ventilation Fan Motor	Ventilation Fan 2
254-P01	Power Distribution	Ventilation Fan Starter Panel Power Supply	Ventilation Fan 2
254-C01	RTU Panel	Ventilation Fan Failed	Ventilation Fan 2
254-C02	Ventilation Fan Starter Panel	Ventilation Fan Pressure Switch	Ventilation Fan 2
254-C03	Ventilation Fan Starter Panel	Ventilation Fan Remote Start Station	Ventilation Fan 2
354-XXX, 454-XXX			Ventilation Fan 3, Ventilation Fan 4, etc. as required.

	Supply Authority POA & Metering		
Cable ID	Source	Destination	Comment
000-C01	Power Distribution Panel - Site Authority Power Supply No. 1 Failed	RTU panel	
001-C01	Site Sydney Water Power Failed	RTU panel	
002-C01	Distribution board surge protection/energy monitoring	RTU panel	Reserved for future
003-C01	Site entry access closed/open	RTU panel	
004-			Spare
005-C01	Station overtemperature	RTU panel	
006-C01	Site electricity authority power failed - 400VAC (Emergency Supply).	RTU panel	
007-C01	Power Distribution Panel 2 - Site Authority Power Supply No 2 Failed	RTU panel	
008-C01	Station Inhibit	RTU panel	
009-			Spare
158-P01	Power Distribution or Meter Panel	Supply Authority POA Supply No. 1	
158-P02	Power Distribution or Meter Panel	Supply Authority POA Supply No. 2	
167-P01	Power Distribution	Supply Authority Metering Supply No. 1	
167-P02	Power Distribution	Supply Authority Metering Supply No. 2	
	Earthing		
Cable ID	Source	Destination	Comment
159-E01	Power Distribution Earth Bar	Earth Stake	
159-E02	Power Distribution Earth Bar	Earth Bonding to Water Pipe	
159-E03	Power Distribution Earth Bar	Building equipotential bonding	
159-E04	RTU Panel	Remote Pressure Board Panel	May need to increment depending on number of site earths.
159-E05	RTU Panel	Pressure Board Impulse Line	May need to increment depending on number of site earths.

167-E01	Power Distribution Earth Bar	Meter Panel	
194-E01	Telecommunications BD	Telecommunications Earth Bonding Terminal	Remote Telecom BD only.
310-E01	RTU Panel	Reservoir Top Junction Box	
310-E02	RTU Panel	Reservoir Level Transmitter SPD	SPD in reservoir top junction box.
768-E01	Power Distribution Earth Bar	Temporary Generator	
769-E01	Power Distribution Earth Bar	Permanent Generator	
156-E01	Power Distribution Earth Bar	Control Panel Earth Bar	Where separate from main SCA.
156-E02	Control Panel Earth Bar	SPD DIN Rail	Dedicated instrument SPD DIN rail.
798-E02	Power Distribution Earth Bar	Cable Tray	
	Standby Generator		
Cable ID	Source	Destination	Comment
768-P01	Power Distribution or ATS	Temporary Generator Connection	
769-P01	Power Distribution or ATS	Permanent Generator Connection	
769-P02	Power Distribution	Permanent Generator Auxiliaries Supply	
769-C01	Permanent Generator Load Bank Controls	RTU Panel	
769-C02	Power Distribution ATS UA Controller	Permanent Generator Controls	
769-C03	Power Distribution ATS	Permanent Generator Load Bank Controls	
	Power distribution		
Cable ID	Source	Destination	Comment
168-P01	Power Distribution	Auxiliary Power Distribution Board 1	Separate auxiliary board.
169-P01	Power Distribution	Auxiliary Power Distribution Board 2	Separate auxiliary board.
798-P0X	Power Distribution	Local Lighting & Power Circuits	Reserve for auxiliary DB circuits. GPO and lights coming off main board.
	Wet Well Area Flooded		
Cable ID	Source	Destination	Comment
798-C01	(Wet Well) Area Flooded Level Switch - Rising	RTU Panel	Usually only used for pre-existing signals.
798-C02	(Wet Well) Area Flooded Level Switch - Falling	RTU Panel	Usually only used for pre-existing signals.

	Level Instrumentation - Sewer		Note. Instrumentation cable numbering starts from the transmitter back to the RTU panel.
Cable ID	Source	Destination	Comment
110-I01	Wet Well No.1 Level Transmitter	Turret	
110-I02	Turret	RTU Panel	
112-C01	Wet Well No.1 ATWL	Turret	
112-C02	Turret	RTU Panel	
120-I01	Wet Well No.2 Level Transmitter	Turret	
120-I02	Turret	RTU Panel	
122-C01	Wet Well No.2 ATWL	Turret	
122-C02	Turret	RTU Panel	
130-I01	CMH Level Transmitter	Turret	
130-I02	Turret	RTU Panel	
135-C01	CMH Overflow Switch	Turret	
135-C02	Turret	RTU Panel	
138-C01	ESC Filling Switch	Turret	
138-C02	Turret	RTU Panel	
139-I01	ESC Level Transmitter	Turret	
139-I02	Turret	RTU Panel	
	Level Instrumentation - Water		Note. Instrumentation cable numbering starts from the transmitter back to the RTU panel.
Cable ID	Source	Destination	Comment
310-I01	Reservoir No. 1 Level Transmitter	RTU Panel	If the does not run directly to the RTU the cable number must increment at each junction. i.e., 310-I02, 310-I03 etc.
311-C01	Reservoir No. 1 Overflow Impending	RTU Panel	As above.
312-C01	Reservoir No. 1 Low Level	RTU Panel	As above.
313-C01	Reservoir No. 1 Trip IECV To Close	RTU Panel	As above.
317-C01	Reservoir No. 1 Calibration Check	RTU Panel	As above.
320-I01	Reservoir No. 2 Level Transmitter	RTU Panel	As above.

321-C01	Reservoir No. 2 Overflow Impending	RTU Panel	As above.
322-C01	Reservoir No. 2 Low Level	RTU Panel	As above.
323-C01	Reservoir No. 2 Trip IECV To Close	RTU Panel	As above.
327-C01	Reservoir No. 2 Calibration Check	RTU Panel	As above.
33X-XXX…35X-XXX			Reservoir No. 3 to Reservoir No. 5
510-C01	Reservoir Top Junction Box	RTU Panel	As above. For combined digital signals.
	Flow Instrumentation		Note. Instrumentation cable numbering starts from the transmitter back to the RTU panel.
Cable ID	Source	Destination	Comment
140-I01	Station Delivery Flowmeter 1 Transmitter	RTU Panel	If the does not run directly to the RTU the cable number must increment at each junction.
141-C01	Flowmeter 1 Pit flooded switch	RTU Panel	As above.
142-I01	Station Delivery Flowmeter 2 Transmitter	RTU Panel	As above.
143-C01	Flowmeter 2 Pit flooded switch	RTU Panel	As above.
144-I01	Station Delivery Flowmeter 3 Transmitter	RTU Panel	As above.
145-C01	Flowmeter 3 Pit flooded switch	RTU Panel	As above.
149-I01	Remote Reservoir Indicator	RTU Panel	Analog output from RTU for remote flowmeter.
	Pressure Instrumentation		Note. Instrumentation cable numbering starts from the transmitter back to the RTU panel.
Cable ID	Source	Destination	Comment
200-I01	Pressure 1 Transmitter	RTU Panel	If the does not run directly to the RTU the cable number must increment at each junction. i.e., 200-I02, 200-I03 etc.
201-I01	Station Suction Pressure 1 Transmitter	RTU Panel	As above.
202-I01	Station Delivery Pressure 1 Transmitter	RTU Panel	As above.
203-C01	Pressure 1 Pit Flooded	RTU Panel	As above.

204-I01	Station Delivery Pressure 2 Transmitter	RTU Panel	As above.
205-I01	Pressure 2 Transmitter	RTU Panel	As above.
206-I01	Station Suction Pressure 2 Transmitter	RTU Panel	As above.
207-I01	Station Delivery Pressure 2 Transmitter	RTU Panel	As above.
208-C01	Pressure 2 Pit Flooded	RTU Panel	As above.
209-I01	Pressure (Remote Signal)	RTU Panel	As above.
	Valves		For pump delivery control and pump isolation valves refer to LVS loop codes.
	Electric Valves/AICV		
Cable ID	Source	Destination	Comment
410-P01	Power Supply Distribution Board	Valve/AICV 1 Starter	
410-P02	Valve/AICV 1 Starter	Valve/AICV 1 Isolation Switch	
410-P03	Valve/AICV 1 Isolation Switch	Valve/AICV 1	
410-C01	Valve/AICV 1 Starter	RTU Panel	
410-C02	Valve/AICV 1 Starter	Valve/AICV 1	
410-C03	Valve/AICV 1 Starter	Valve/AICV 1 Isolation Switch	
411-C01	Valve/AICV 1 Starter	Valve/AICV 1 Pit Flooded	
415-I01	RTU Panel	Valve/AICV 1 Starter	
415-I02	Valve/AICV 1 Starter	Valve/AICV 1	
420-P01	Power Supply Distribution Board	Valve/AICV 2 Starter	
420-P02	Valve/AICV 2 Starter	Valve/AICV 2 Isolation Switch	
420-P03	Valve/AICV 2 Isolation Switch	Valve/AICV 2	
420-C01	Valve/AICV 2 Starter	RTU Panel	
420-C02	Valve/AICV 2 Starter	Valve/AICV 2	
420-C03	Valve/AICV 2 Starter	Valve/AICV 2 Isolation Switch	
421-C01	Valve/AICV 2 Starter	Valve/AICV 2 Pit Flooded	
425-I01	RTU Panel	Valve/AICV 2 Starter	
425-I02	Valve/AICV 2 Starter	Valve/AICV 2	
43X-XXX…49X-XXX			Valve/AICV 3 to 9

	Hydraulic Valves/AICV		
Cable ID	Source	Destination	Comment
410-C01	Valve/AICV 1 L2 Station	Valve/AICV 1 Open Limit Switch	
410-C02	Valve/AICV 1 L2 Station	Valve/AICV 1 Closed Limit Switch	
410-C03	Valve/AICV 1 L2 Station	Valve/AICV 1 L1 Station	
410-C04	Valve/AICV 1 L2 Station	RTU Panel	
420-C01	Valve/AICV 2 L2 Station	Valve/AICV 2 Open Limit Switch	
420-C02	Valve/AICV 1 L2 Station	Valve/AICV 2 Closed Limit Switch	
420-C03	Valve/AICV 1 L2 Station	Valve/AICV 2 L1 Station	
420-C04	Valve/AICV 1 L2 Station	RTU Panel	
43X-XXX…49X-XXX			Valve/AICV 3 to 9
	PRV Valves		
Cable ID	Source	Destination	Comment
200-I01	Upstream Pressure	RTU Panel	
205-I01	Downstream Pressure	RTU Panel	
203-C01	PRV Pit Flooded	RTU Panel	At pressure monitoring sites only.
	Water Quality Monitoring		
Cable ID	Source	Destination	Comment
106-I01	pH	RTU Panel	Individual analyser. 806-I01 for combined WQM analyser station.
107-I01	Turbidity	RTU Panel	Individual analyser. 807-I01 for combined WQM analyser station.
108-I01	Chlorine Residual	RTU Panel	Individual analyser. 808-I01 for combined WQM analyser station.
811-P01	WQMS Sample Pump Power Supply	RTU Panel	
811-C01	WQMS Sample Pump Failed	RTU Panel	
	Communications		
Cable ID	Source	Destination	Comment
191-T01	Telstra DM Pit	Building Distributor	Lead in communications cable.
193-T01	Building Distributor	RTU Panel	Communications connection socket. Remote BD only.
194-E01	Telecommunications BD	Telecommunications Earth Bonding Terminal	Remote BD only.

	Mixers		Note. Instrumentation cable numbering starts from the transmitter back to the RTU panel.
Cable ID	Source	Destination	Comment
314-P01	Distribution Board	Mixer 1 Starter	
314-P02	Mixer 1 Starter	Mixer 1 Motor	
314-C01	Mixer 1 Failed	RTU Panel	
324-P01	Distribution Board	Mixer 2 Starter	
324-P02	Mixer 2 Starter	Mixer 2 Motor	
324-C01	Mixer 2 Failed	RTU Panel	
334-XXX…354-XXX			Mixers for Reservoir No. 3 to Reservoir No. 5.
	Cathodic Protection		Note. Instrumentation cable numbering starts from the transmitter back to the RTU panel.
Cable ID	Source	Destination	Comment
315-P01	Distribution Board	Cathodic Protection Unit	
315-C01	Cathodic Protection Failed	RTU Panel	
	Air Compressors		Note. Instrumentation cable numbering starts from the transmitter back to the RTU panel.
Cable ID	Source	Destination	Comment
781-C01	Air compressor	RTU panel	Compressor air pressure low
913-I0x	Air compressor surge vessel 1 pressure	RTU panel	913 - Air compressor 1 for surge vessel/s
914-I0x	Air compressor surge vessel 2 pressure	RTU panel	914 - Air compressor 2 for surge vessel/s
915-I0x	Air compressor surge vessel 3 pressure	RTU panel	915 - Air compressor 3 for surge vessel/s
	Surge Vessels		Note. Instrumentation cable numbering starts from the transmitter back to the RTU panel.
Cable ID	Source	Destination	Comment
905-I0x	Surge vessel 1 differential pressure transmitter	RTU panel	905 - Surge vessel 1

906-I0x	Surge vessel 2 differential pressure transmitter	RTU panel	906 - Surge vessel 2
907-I0x	Surge vessel 3 differential pressure transmitter	RTU panel	907 - Surge vessel 3
910-I0x	Surge vessel air pressure	RTU panel	910 - Surge vessel common air pressure
	Pump Unit Differential Pressure		
Cable ID	Source	Destination	Comment
010-IO4	Pump unit 1 pressure board	RTU panel	No junctions.
020-IO4	Pump unit 2 pressure board	RTU panel	No junctions.
030-IO4	Pump unit 3 pressure board	RTU panel	No junctions.
040-IO4…090-IO4	Pump unit 4 pressure board to Pump unit 9 pressure board	RTU panel	No junctions.
	Modbus RTU serial communications - primary bus in RTU panel		
Cable ID	Source	Destination	Comment
630-D01	RTU serial port	Device 1	Refer SSD120, 121, 122
630-D02	Device 1	Device 2	Refer SSD120, 121, 122
630-D03	Device 2	Device 3	Refer SSD120, 121, 122
630-D04	Device 3	Device 4	Refer SSD120, 121, 122
	High Voltage Monitoring - Hard wired signals		Note. Instrumentation cable numbering starts from the field device back to the RTU panel.
Cable ID	Source	Destination	Comment
576-C01	HV Trip Supply 1 (Battery Charger)	IICATS HV Marshalling Panel	HV battery charger 1 major and minor alarms.
576-C02	IICATS HV Marshalling Panel	RTU panel	Should be run in dedicated cable. No multiloop cables.
581-C01	HV Trip Supply 2 (Battery Charger)	IICATS HV Marshalling Panel	HV battery charger 1 major and minor alarms.
581-C02	IICATS HV Marshalling Panel	RTU panel	Should be run in dedicated cable. No multiloop cables.
604-C01	HV/LV Transformer 1	IICATS HV Marshalling Panel	
604-C02	IICATS HV Marshalling Panel	RTU panel	Should be run in dedicated cable. No multiloop cables.
605-C01	HV/LV Transformer 2	IICATS HV Marshalling Panel	

605-C02	IICATS HV Marshalling Panel	RTU panel	Should be run in dedicated cable. No multiloop cables.
588-D01	HV station controller/interface device 1	RTU panel	For comms based HV monitoring.
589-D01	HV station controller/interface device 2	RTU panel	For comms based HV monitoring.