



Instrumentation Installation

TMS1201

Standard Technical Specification



REVISION CONTROL

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DOCUMENT CONSULTATION

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1 INTRODUCTION

This specification details the minimum requirements for installation, testing and commissioning of field instrumentation installed on Queensland Urban Utilities facilities.

1.1 SCOPE

This Specification shall be read in conjunction with the General and Specific Conditions of Contract. The Contractor shall be responsible for the supply of all labour, equipment, and materials necessary to construct the works in accordance with the Project Documentation. The Contract may exclude the supply only of items specified as being supplied by QUU.

The Contractor shall be responsible for obtaining all necessary approvals, permits, licences and certificates required by Statutory Authority, Local Ordinances or other regulatory authorities covering scope of work.

1.2 DEFINITIONS

In this document, the following definitions apply:

Project Documentation	Governing technical documents for the specific item(s) for the specific works included or referenced in the Contract
Contractor	The entity bound (including sub-contractors appointed by the contractor) to execute the work having responsibility for design, manufacture and supply, installation, delivery, documentation and other functions as further defined in the documents related to the work.
Contract:	The agreement between QUU and the Contractor to which this specification pertains.

1.3 ACRONYMS AND ABBREVIATIONS

Term	Definition
BCA	Building Code of Australia
CAD	Conformity Assessment Document
DC	Direct Current
DP	Differential Pressure
ELV	Extra Low Voltage
FAT	Factory Acceptance Test
F&G	Fire and Gas
FIC	Field Installation Checksheets
EMC	Electro-Magnetic Compatibility
EWP	Elevated Work Platform

Ex	Explosion Protection
HA	Hazardous Area
HAVD	Hazardous Area Verification Dossier
HSE	Health, Safety and Environment
HVAC	Heating Ventilation and Air Conditioning
IEC	International Electro-technical Commission
I/O	Input / Output
IP	Ingress Protection
IS	Intrinsically Safe
ISO	International Standards Organisation
ITP	Inspection and Test Plan
LED	Light Emitting Diode
LV	Low Voltage
LCP	Local Control Panel
MSDA	Material Safety Data Sheet
NC	Normally Closed
NO	Normally Open
O&M	Operation and Maintenance
PLC	Programmable Logic Controller
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
RFI	Radio Frequency Interference
RTU	Remote Telemetry Unit
QA	Quality Assurance
QUU	Queensland Urban Utilities
SAT	Site Acceptance Test
SDRL	Supplier Data Requirements List
SLD	Single Line Diagram
SWA	Steel Wire Armour
UPS	Uninterruptible Power Supply
UV	Ultra-violet

1.4 REFERENCE DOCUMENTS

Document Number	Title
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CHE68	Site Inspection Checks – Cables
CHE70	Site Inspection Checks - Instruments
CHE72	Site Inspection Checks – Cable ladder/ Tray / Ducts
CHE136	Site Inspection Checks – Field Equipment
FOR893	Instrument Schedule
TEM523	Cable Schedule Template
TEM518	Hazardous Area Verification Dossier Template
TMS60	Low Voltage Switchboards - Technical Specifications
TMS62	Preferred Equipment List – Electrical and Instrumentation
TMS73	Operations and Maintenance Manuals - Technical Specifications
TMS76TMS62	Corrosion Protection for Electrical and Mechanical Equipment and Structures Preferred Equipment List – Electrical and Instrumentation
TMS1200	Electrical Installation Specification
TMS1202	Control System Implementation for Network Assets
TMS1203	General Requirements Hazardous Area Installation Specification
TMS1222	Control Panel – Technical Specification
TMS1436	Safety in Design Report Requirements
TMS1595	Pipeline and Structures Cathodic Protection – Technical Specification
TMS1639	General Mechanical Works – Technical Specification
TMS1645	Packaged Plant Electrical, Instrumentation and Control System Requirements - Technical Specification
TMS1647	Equipment Tag Naming – Technical Specification
TMS1648	Electrical, Instrumentation and Control Systems Design Criteria – Technical Specification
TMS1651	Machine Safety Implementation– Technical Specification
TMS1654	Engineering Documentation Naming Requirements
MP71	Electrical Safety Management Plan
MP183	Hazardous Area Management Plan
PRO307	Procedure Drafting Guidelines – Contract Requirements
PRO395	SEQ Water Supply and Sewerage- D&C Code Asset Information QUU Addendum
PRO450	Electrical Safety SOP
PRO521	Safety in Design SOP
SSM006	Standard Specification - Steel Protective Coating Systems
SWMS2	Safe Work Method Statement Confined Space Entry
TMS1200	Electrical Installation Specification
TMS1202	Control System Implementation for Network Assets

TMS1203	General Requirements Hazardous Area Installation Specification
TMS1222	Control Panel – Technical Specification
WI58	Arc Flash Assessment and PPE Selection
WI140	Access to Low Voltage Electrical Equipment for Visual Inspection
TMS1222	Control Panel – Technical Specification

1.5 REFERENCE TYPICAL DRAWINGS

The typical drawings are provided for information only to demonstrate minimum content and layout of information and may not represent all the requirements specified in the Project Documentation. The Contractor is responsible for the detail design.

Drawing Number	Title
QUU-STD-STP-00	Title Block
QUU-STD-STP-01	Legend
486/5/5-0171-561	Field Instrumentation Installation Details Level Probes
486/5/25-0003-342	Valve Pit Pressure Sensor Installation and Details
486/5/7-0470-024	Field Instrumentation Installation Details
486/4/7-0032-016	Water Meters General Arrangement
0005-001	PRV Facility General Arrangement
Drawing Number	Title
486/5/7-0498-024	SP302 Progress Rd #2 Sewage Pump Station - Field Instrumentation Installation Details

2 STANDARDS & REGULATIONS

All equipment and workmanship shall conform to the most recent requirements of the relevant statutory Local, State and Commonwealth Authorities and current applicable Australian Standards. Alternatively, where no Australian Standard exists, work shall conform to the most current and applicable International standard.

Where conflict exists between different Codes, Standards or Regulations, the most onerous conditions of specification shall apply unless accepted otherwise in writing by QUU.

The Contractor shall not deviate from the provisions of the relevant standard without first obtaining agreement in writing from QUU.

Particular standards and regulations relevant to the work include but are not necessarily limited to the following:

2.1 AUSTRALIAN STANDARDS

The equipment shall be designed, manufactured and tested in accordance with the latest edition of all relevant Australian and International Standards, Codes and Regulations except where modified by this specification.

AS/ISO 1000	International System of Units (S.I.) and its Applications
AS 1020	Control of Undesirable Static Electricity
AS 1042	Direct Acting Electrical Measuring and Indicating Instruments and their Accessories
AS 1275	Metric Screw Threads for Fasteners
AS 131994	Safety Signs for the occupational environment
AS1627.4	Metal Finishing – Preparation and Pre-treatment of Surfaces – Abrasive blast cleaning of steel – all parts
AS 1660	Test methods for Electric Cables – all parts
AS1768	Lightning Protection
AS 1939	Classification of Degrees of Protection Provided by Enclosures for Electrical Equipment
AS 2053	Conduits and Fittings for Electrical Installations – all parts
AS 2857	Timber drums for insulated and bare cables
AS 2865	Safe Working in a Confined Space.
AS 3000	SAA Wiring Rules
AS 3008.1.1	Electrical Installations – Selection of Cables – Cables for Alternating Voltages up to and Including 0.6/1kV – Typical Australian Installation Conditions
AS 3100	Approval and test specification - General requirements for electrical equipment

AS 3808	Insulating and sheathing materials for electric cables
AS 3863	Galvanised mild steel wire for armouring electric cables
AS 3983	Metal drums for insulated and base electric cables
AS 3147	PVC Insulated Cables and Flexible Cords
AS 3808	Insulation and Sheathing Materials for Electric Cables
AS 4761.1	Competencies for Working with Electrical Equipment for Hazardous Areas (EEHA) - Competency Standards
AS 5000	Electric Cables- Polymeric insulated – all parts
AS 60038AS 5000	Standard Voltages Electric Cables- Polymeric insulated
AS 60079	Explosive Atmospheres – All parts
AS 60529	Degrees of Protection Provided by Enclosures (IP Code)
AS 61000	Electromagnetic Compatibility (EMC)

2.2 INTERNATIONAL STANDARDS

IEC 60050	International Electro-technical Vocabulary
IEC 60051	Recommendation for Direct Acting Indicating Analogue Electrical Measuring Instrument and their Accessories
IEC 60228	Conductors of Insulated Cables
IEC 60751IEC 60228	Industrial platinum resistance thermometers and platinum temperature sensors Conductors of Insulated Cables
IEC 62444	Cable Glands for Electrical Installations
ISO 9001	Quality Management Systems – Requirements

2.3 REGULATIONS

The current regulations and statutory requirements of the State of Queensland, Australia, shall be complied with, including:

- Queensland Electricity Act 1994
- Queensland Electricity Regulations 2006
- Queensland Work Health and Safety Act 2011
- Queensland: Environmental Protection Act – 1994
 - Environmental Protection Regulation 2008
 - Environmental Protection (Air) Policy 2008
 - Environmental Protection (Noise) Policy 2008
 - Environmental Protection (Water) Policy 2009
- National Construction Code 2016, volumes 1, 2, 3 and The Guide
- Queensland Electricity Connection and Metering Manual (QECMM) Version 11

- Australian Work Health and Safety Act 2011
- Work Health and Safety Regulations 2011
 - Work Health and Safety Codes of Practice 2015
- Queensland Electrical Safety Act 2002
 - Queensland Electrical Safety Code of Practice 2013
- Queensland Electrical Safety Regulation 2013
- Queensland Professional Engineers Act 2002
- Queensland Professional Engineers Regulation 2003
- Queensland Workers' Compensation and Rehabilitation Act 2003 and Amendment Act 2015
- Queensland Electricity Act (1994)
- Queensland Electricity Regulations (2006)
- Queensland Workplace Health and Safety Act 2011.
- Queensland Workplace Health and Safety Regulations 2011
- Queensland: Environmental Protection Act - 1994 and Amendment Act - 1997
- Building Code of Australia
- Supply Authority Conditions of Supply and Consumer Metering
- Workplace Health and Safety Regulation (2011)
- Electrical Safety Act 2002 and its latest amendments
- Electrical Safety Regulations 2013
- Professional Engineers Act 2002

2.4 UNITS AND LANGUAGE

AS/ISO 1000 (metric SI system) shall be used. All documentation and correspondence shall be in the English language.

2.5 SUB-CONTRACTORS

The Contractor shall disclose, at the tender stage, all sub-contractors they intend to use as part of the contract works. The Contractor shall not sub-contract any work to any party without the prior written consent of QUU. It shall remain the Contractors' responsibility to audit and co-ordinate the performance of their sub-contractor with results being disclosed to QUU. All requirements applicable to the Contractor are applicable to their Sub-contractors.

2.6 CONTRACTOR EXCEPTIONS

The Contractor shall be responsible to submit, together with the Tender, a list of deviations or exceptions to this Specification. In the absence of any exceptions, it will be construed that the Contractor fully complies with this Specification.

2.7 ORDER OF PRECEDENCE

In the event of any conflict arising between this Specification and other documents listed herein, refer comments to QUU for clarification before the works commences. The order of precedence that applies is as follows:-

1. Purchase Order or Contract
2. Project Data Sheets
3. This Specification
4. Project Drawings
5. Project Specifications
6. Standards, Codes and Regulations

3 GENERAL REQUIREMENTS

3.1 OPERATION AND DESIGN LIFE

The instrumentation installation and associated materials shall be designed and installed for minimum service life duration of 20 years continuous service in the environment and for the duty specified herein and in the relevant Project Documentation.

3.2 LOCATION AND ENVIRONMENTAL CONDITIONS

All instrumentation and associated equipment shall be designed and installed for the site conditions defined as follows:-

Location	South East Queensland	
Altitude	above mean sea level.	0-30150m
Ambient Temperature	Minimum	-5°C
	Maximum (dry bulb)	45°C
Relative Humidity	Minimum	26%
	Maximum	100% condensing
Solar Radiation	Black bulb design temperature - minimum mechanical design temperature for equipment exposed to solar radiation	85°C

Note: Corrosive environments are locations where H₂S gas or other corrosive chemicals and gasses can exist under normal operating conditions and can be both indoor and outdoor areas. This is applicable to all wet wells installations. All areas including inside air conditioned switch rooms at Sewerage Treatment Plants are considered corrosive environments. All materials installed shall be suitable for the environment.

3.3 UTILITY DATA

The electrical system may have the following voltage levels:

High Voltage Power Supply	33 kV AC, three phase 3 wire, 50 Hz, 11 kV AC three phase 3 wire 50 Hz, 6.6 kV AC, three phase 3 wire, 50 Hz
Low Voltage Supplies	3 ph, 4 Wire, 400 Volt +10,-6% 50 Hz ± 2%, MEN System Voltage Unbalance <5%
Single Phase Power Supplies	230 V AC, +10,-6%, 2 wire, 50Hz ± 2%,
Control Power Supplies:	UPS 230 V AC, single phase 2 wire, 50 Hz Regulated 24 V DC
Special Purpose Power Supplies	Regulated 48VDC and 110VDC

The equipment shall be designed to operate continuously under the following conditions:-

- HV Distribution: Steady State Voltage $\pm 5\%$ nominal voltage
- LV Distribution: Steady State Voltage $+10,-6\%$ nominal voltage
- Steady State Frequency $\pm 2.5\%$ nominal frequency
- Transient Voltage $\pm 20\%$ nominal voltage
- Transient Frequency $\pm 5\%$ nominal frequency
- Total harmonic voltage distortion $< 5\%$

3.4 SAFE WORKING IN CONFINED SPACES

All work in confined spaces shall be performed in accordance with the requirements of AS2865 Safe Working in a Confined Space and SWMS2 Safe Work Method Statement Confined Space Entry.

The Contractor's operatives including its employees and subcontractors and their operatives on site must be trained in confined space entry in accordance with the requirements of AS 2865.

Before commencing work on site, the Contractor shall fully assess the confined space entry requirements of the Works and provide QUU with current certificates for confined space training of all its personnel who will be undertaking confined space entry.

3.5 PERSONAL PROTECTIVE EQUIPMENT

The Contractor shall ensure all workers accessing live electrical equipment at voltages levels exceeding ELV shall comply with the minimum requirements of NFPA 70E:2015 or alternatively comply with WI58 Arc Flash Hazard Assessment and PPE Selection. Any departures from this work instruction or NFPA 70E:2015 shall only be permitted where accepted in writing by QUU. A risk assessment and supporting information shall be submitted with the request for any departures.

3.6 SITE INDUCTION TRAINING

The Contractor shall attend a Site Induction Training course managed and arranged by QUU, prior to being granted site access by QUU. Arrangements for attendance at this training by the Contractor's operatives shall be coordinated through QUU.

Attendance at the Site Induction Training will require the Contractor's operatives to firstly provide evidence of certification in relation to Lock-out/Tag-out LOTO training.

QUU shall administer the Site Induction Training course at no cost to the Contractor, unless special training sessions are requested by the Contractor at short notice. The cost of attendance at the Site Induction Training by the Contractor's operatives shall be the responsibility of the Contractor.

3.6.1 Lock-out/Tag-out (LOTO)

PRO379 Energy Lock Out Tag Out Procedure applies to all QUU employees and contractors in QUU controlled workplaces. Contractors are to adhere to the requirements of this procedure unless a contract detailing control of a workplace has nominated a principal contractor other than QUU.

Contractor's operatives accessing live electrical equipment shall undergo Lock-out/ Tag-out (LOTO) training and satisfy the requirements of this training prior to obtaining access to QUU live electrical equipment. Evidence of satisfactory completion of the training shall be provided to QUU before undertaking QUU's Site Induction Training.

3.7 WORKMANSHIP AND PERSONNEL

Personnel engaged in the installation of instrumentation shall be accredited, suitably experienced, competent and skilled in the particular field of work in which they are engaged. All works shall be completed by or under the direct supervision of fully qualified tradespeople holding trade qualifications and certificates adequate for the work and licensed under the Queensland Electricity Board regulations.

Persons employed on the work shall be directed by experienced qualified supervisors who shall be responsible for the works and for ensuring that the Contractor's personnel are conversant with and comply with QUU's Safety Rules and Regulations, particularly those rules controlling the use of work permits.

Welders shall be suitably qualified and accepted by QUU's RepresentativeQUU prior to commencing any welding works.

All trades personnel that install tubing and compression fittings shall have completed a manufacturer's training course in the correct procedure for the installation of that manufacturer's tube compression fittings and specified sealants.

QUU's RepresentativeQUU reserves the right to inspect all works and direct re-work in the case that the works are not in compliance with the project specifications or commensurate with acceptable trade practice.

3.8 RECTIFICATION OF EXISTING INSTALLATIONS

The Contractor is responsible for ensuring that the instrumentation and installation is electrically safe in accordance with AS3000 and the Queensland Electrical Safety Act.

The Contractor is responsible for safe installation of electrical equipment, circuits and installations within the Contractor's scope of works.

If the Contractor discovers out of scope equipment, circuits or electrical installations that do not meet current standards, cannot be safely energised or are otherwise electrically unsafe the Contractor shall notify QUU, describe the issue in detail, propose a solution and seek direction from QUU.

Note that QUU expects Contractors to identify potential issues early, either during initial condition assessments or construction work. Late identification of defects that were capable of

being identified earlier shall not be accepted as grounds for extension of time claims and costs.

3.83.9 WEATHER AND INGRESS PROTECTION

All instrumentation shall be Ingress Protection (IP) rated as specified in the Project Documentation. All installation works shall be completed so as to ensure the ingress protection integrity of the equipment is maintained.

Instrumentation equipment that is susceptible to damage or failure due to moisture or dust ingress shall be IP rated as follows unless otherwise specified:

- For outdoor installations - minimum IP65
- For indoor installations - minimum IP42

All outdoor equipment and installations shall be suitable for un-protected exposure to the weather, direct sunlight and hose-down cleaning. Where specified in the Project Documentation weather hoods and/or sun-shades shall be provided for UV and weather protection.

Contractor shall ensure adequate protection of equipment during storage, handling, installation and post installation phases with the following additional requirements.

Control valves, relief valves, level devices, and other instruments that will be installed in pipe work or on vessels shall be protected so that foreign matter and vermin cannot enter the fittings, diaphragms, tubes, and other internal parts of the instrument. Stainless steel mesh or other QUU accepted product shall be installed.

The manufacturer's protective seals that cover openings of components or instruments such as gauges, valves, indicators, and controllers shall not be removed other than for inspection or calibration until components are ready to be connected into the system.

The components shall not be placed in a position that will allow foreign material such as sandblasting materials, metal shavings, paint spray, and rust scale to contaminate the interior or they shall be appropriately protected.

Tubing, piping, fittings, and valves used in the installation of instruments shall be kept free from moisture and foreign matter. All ends shall be kept sealed to prevent moisture and foreign matter from entering during storage.

Consumable items such as buffer solutions and other chemical shall be installed in appropriate enclosures to protect the chemicals from direct UV exposure, heat gain and excessive cold and hot temperature fluctuations.

3.93.10 CONSTRUCTION DESIGN

Construction design shall capture the final element of design required to complete the instrument installation and shall be completed by the Contractor. All such design works shall complement and not contradict or modify the intent of the design as provided in the Project Documentation.

All construction design undertaken by the Contractor shall be approved by an RPEQ and shall be reviewed and accepted by QUU's Representative QUU prior to the commencement of the installation works associated with the design.

The design shall provide a fit for purpose installation that ensures satisfactory operation of the instrumentation and facilitates future inspection, maintenance and repairs of instrument.

For instances where not specified in the Project Documentation, construction design includes but is not limited to the following:

- Final equipment mounting location;
- Final equipment mounting arrangements and brackets;
- Earthing and bonding of equipment, including earth tails and connections to structures, concrete reinforcement and earth grids where required.
- Cable ladder and conduit/pipe sizing;
- Cable ladder and conduit/pipe routing;
- Cable ladder/tray and cable/conduit support brackets;
-
- Above ground cable protection
- Cable glands and cable terminations
- Underground cable trench cross-sectional layout and dimensions;
- Underground cable trench routing (including the coordination of these works);
-
- Cable ladder/tray and conduit support brackets;
- Building penetrations and sealing;
- Junction box selection and sizing;
- Equipment stands and sunshades;
- Label types and fixing methods for cables and equipment.
- Final equipment mounting location;
- Final equipment mounting arrangements and brackets;
- Selection of instrument piping to suit the application and process conditions;
- Selection of installation methods to offer ease of calibration and dismantling;
- Process backflow prevention where applicable
- Cable ladder and conduit/pipe sizing;
- Cable ladder and conduit/pipe routing;
- Underground cable trench cross-sectional layout and dimensions;
- Underground cable trench routing (including the coordination of these works);
- Cable ladder/tray and conduit support brackets;
- Building penetrations and sealing;
- Junction box selection and sizing;

- Equipment stands and sunshades;
- Label types and fixing methods for cables and equipment.

Construction design shall comprise the provision of suitable sketches, schedules and descriptive information clearly identifying the information required for review.

3.103.11 USE OF CORRECT TOOLS

All equipment and tools to be utilised in the instrumentation installation works shall be safe, suitable for the task and in good working order. In all instances tools and equipment shall be selected to maximise safety of equipment and personnel during the execution of the works as well as providing a quality installation.

All tools and appliances furnished with installed equipment shall be maintained in good condition and handed over to QUU's RepresentativeQUU on completion of the works.

3.113.12 MOUNTING BRACKETS AND SUPPORTS

The Project Documentation may include standard bracket and support arrangements for the installation of instruments. All brackets and supports to be procured or fabricated shall be in accordance with the materials and arrangements specified in these documents unless otherwise accepted by QUU's RepresentativeQUU. For any brackets and supports that are not defined in these documents, the Contractor shall design and submit a proposed arrangement to QUU's RepresentativeQUU for acceptance. No procurement, fabrication or installation shall be completed without the receipt of acceptance from QUU's RepresentativeQUU.

Brackets and supports to be fixed to the plant steel structure shall be either welded to the steelwork or bolted through holes punched or drilled in the steelwork. Unless specifically detailed in the Project Documentation, brackets and supports shall not be clamped.

All brackets and supports shall be fabricated from hot dipped galvanised steel angle, channel or tube unless otherwise specified in the Project Documentation. All welded, cut or drilled materials shall have the exposed metal cleaned and painted with zinc enriched cold galvanising paint to the satisfaction of QUU's RepresentativeQUU.

Site fabricated steel supports and brackets shall be properly fabricated and fitted. All drillings shall be made with minimum tolerances. All sharp edges shall be de-burred and rounded corners. Under no circumstances shall any welding or fixing operations be carried out on any process plant equipment, vessels, pipelines or structures unless specifically detailed in the Project Documentation. Fixings to the above shall normally be made with purpose designed brackets provided by the plant supplier.

All mounting plates shall have sufficient space for fitting of equipment nameplates. Mounting brackets shall not be fixed to plant or steelwork that will be subject to excessive vibration during plant operation.

3.123.13 FASTENERS AND FIXINGS

All fasteners and fixings shall be zinc or cadmium plated for indoors and either hot dipped galvanised steel or 316 stainless steel for outdoors unless specified otherwise in the Project

Documentation. All mounting brackets and hardware for sensors and instrument transmitters shall be 316 stainless steel.

Spring and flat washers shall be provided under all nuts and flat washers under bolt heads. Lock nuts are an acceptable alternative to nuts and spring washers. Washers shall be the correct size for the bolt. Each bolt or stud shall have the shortest standard length which shall expose at least one full thread beyond the nut after assembly. Bolts shall be driven home (inserted) a minimum distance of 1.25 x bolt diameter.

All bolts, nuts, and stud screw threads shall be ISO metric or NPT threaded.

Fixings into masonry and concrete shall be made using expansion bolts. Fixings into concrete shall be by means of an expansion bolts or anchors suitable for the purpose.

Plastic or metal fibre expansion plugs shall only be used for light duty fixings in office buildings in line with quality commercial installation practices. Nylon mushroom anchors are not permitted in outdoor areas.

Fixings into timber or metal shall be made using zinc or cadmium plated screws driven into drilled holes sized to suit the screw.

Equipment shall generally be secured by the following methods and materials:

- Expanding masonry bolts;
- Grouted holding down bolts;
- Chemical anchors;
- Welded to structural steel;
- Bolted through holes drilled/punched in structural steelwork

3.133.14 CUTTING, DRILLING AND WELDING

All surfaces altered via cutting, drilling or chasing shall be restored to the original finish after completion of the works. . The structural integrity of concrete, steel and timer structures shall be maintained and ensure no cross contamination of dissimilar metals.

Where possible holes shall be drilled, not cut with a flame, and drilling shall be made with minimum tolerances.

All sharp edges shall be de-burred.

Structural steelwork shall not be cut, drilled or welded without acceptance from QUU's RepresentativeQUU, except as detailed in the Project Documentation.

Pre-cast concrete slabs shall not be cut or drilled without acceptance from QUU's RepresentativeQUU, except as detailed in the Project Documentation. Exposed reinforcement structural steel in concrete slabs shall be sealed with an accepted rust prevention coating system.

All welds shall comply with the appropriate welding code and shall be primed and painted on completion. All stainless steel welds shall be passivated to prevent corrosion.

Penetrations for the purpose of cables, conduits or cable ladder entries shall be installed using proprietary and purpose made jigsaws and drills. Penetrations shall be fitted with kick plates and/or flashings to provide a neat finish.

3.143.15 SEALING PENETRATIONS AND CONDUITS

All building penetrations shall be sealed after completion of the installation to:

- Match surface finishes;
- Maintain Ingress Protection rating (as required);
- Prevent vermin entry;
- Maintain fire rating (as required) with an accepted fire sealant compound;
- Comply with the requirements of hazardous area classifications (as required)
- Meet National Construction Code/BCA Regulations
- Meet BCA Regulations

Expanding foam type fillers and silicone sealants shall not be used to seal penetrations. Sealants shall be a non-deteriorating, non-setting weatherproof sealant capable of being removed at a later date for future cable installation. Cloth rags, cement grout or other alternative methods accepted to QUU can be considered.

Concrete floor penetrations shall be sealed with non-shrink grout in accordance with the Supplier's recommendations.

After the installation of cables all buried cable conduits exiting the ground shall be sealed to prevent the ingress of water or oil. A waterproof seal shall be provided by the application of a permanently plastic waterproof compound. All spare conduits shall be similarly sealed. The sealing compound shall be capable of being removed to enable additional cables to be installed if required at a later date.

After the installation of cables all outdoor surface conduits shall have both ends sealed using heat shrink tubing or a suitable sealing compound as accepted by QUU's Representative.

All penetrations in areas with a hazardous area classification shall be in accordance with the TMS1203 General Requirements Hazardous Area Installation Specification and accepted by QUU's Representative and shall be suitably certified as required and in accordance with the manufacturer's specifications.

3.153.16 SETTING OUT WORKS

The Project Documentation will include installation locations for the instruments. For instances where the exact location is not clearly defined in the Project Documentation the Contractor shall site assess the area to confirm the best location.

Following this assessment the Contractor shall submit a proposed exact installation location to QUU's Representative for acceptance.

Installation locations shall take into consideration the following:

- Relevant regulations, codes and standards;
- Accessibility of equipment for routine inspection and maintenance tasks;
- Safe access for personnel;
- Clashes with other services, plant and structures;
- Suitability for equipment to perform intended function;
- Appearance;
- Not to impede walkways and access to equipment;
- Not to impede maintenance works on nearby plant;
- Not to expose equipment to higher than normal risk of damage (vibration, material spillage, wet areas, chemical lines etc);
- Electrical clearances
- Induced voltages
- Hazardous areas
- Thermal loads and ventilation
- The design intent of the Project Documentation.
- Induced voltages
- The design intent of the Project Documentation.

3.163.17 MOUNTING

All instruments shall be installed strictly in accordance with the Supplier's instructions and the relevant Project Documentation. Where such instructions are not available, details of the proposed installation method shall be accepted by QUU's Representative QUU prior to commencement of the work.

3.173.18 COATINGS

3.17.13.18.1 Painting

Instrument enclosures and associated equipment shall be painted as specified in the Project Documentation.

The surface protection and painting shall generally be to the equipment manufacturer's standard. Where the manufacturers' standard is not accepted by QUU the paint system shall be in accordance with the SSM006 Standard Specification - Steel Protective Coating Systems TMS76 Corrosion Protection for Electrical and Mechanical Equipment and Structures - Technical Specification.

The Contractor's proposed surface protection treatment will be evaluated by QUU for acceptability.

Where an alternative painting system is proposed, the following details shall be provided:

- The surface preparation, paint process, paint type and thickness;
- A description of how the alternative paint system is equal to or superior to the specified requirements.

The Contractor's proposed surface protection treatment will be evaluated by QUU for acceptability, provided the above details are provided.

3.17.23.18.2 Hot Dipped Galvanising

Steel items to be galvanised shall be as specified in the project documentation.

Hot dipped galvanising shall be in accordance with the SSM006 Standard Specification - Steel Protective Coating Systems TMS76 Corrosion Protection for Electrical and Mechanical Equipment and Structures - Technical Specification.

Minor damage to galvanised materials shall be made good by touch-up using zinc enriched cold galvanising paint. Pre-drilled hole sizes shall allow for the zinc coating thickness.

3.183.19 CARE AND MAINTENANCE

The Contractor shall ensure that all personnel within their control are fully aware of and comply with the requirements for good housekeeping on the site.

For all instrumentation installation activities safe house-keeping procedures shall be utilised for managing the necessary tools, equipment and accumulated rubbish so as to ensure a safe working environment for all personnel executing and in the vicinity of the works.

All plant areas shall be kept free of cut cable ends, cable strippings and other accumulation of rubbish. Rubbish in these areas shall be collected and disposed of in accordance with the QUU accepted site procedure on a daily basis. Materials and equipment required for immediate use only shall be stored within these particular areas.

All flammable debris shall be removed prior to working with naked flame tools, welding, cutting or grinding equipment. Equipment shall be protected from damage by grinding, drilling, swart, grit blasting etc. Where flame cutting or welding is being undertaken fire blankets shall be used to protect all electrical equipment and materials. Cable gland plates provided with equipment shall not be drilled in-situ, but shall be removed to preclude the risk of drilling debris entering the associated equipment.

Particular attention is drawn to the need for care when cutting and removing the armouring on braided cables.

All equipment not being actively worked on shall have all doors closed and all covers and gland plates firmly in position to prevent rubbish, dust and moisture entering the equipment.

Tools and loose items shall not be left or stored inside instrument enclosures.

After completion of the terminations to any instrument, panel or item of equipment, such equipment shall be thoroughly cleaned out using suction cleaners and all dust and rubbish removed. The equipment shall be inspected for internal moisture and adequately dried-out prior to energisation.

Prior to the removal of access equipment (scaffolding, EWPs and the like) from site all elevated cable pathways shall be inspected to ensure all cable pulling equipment and debris is removed and cable covers are properly installed.

3.193.20 ELECTROLYTIC CORROSION

For all instrumentation installations suitable measures as accepted by QUU's Representative QUU shall be adopted to minimise the effects of electrolytic corrosion such as:-

- Use of stand-off insulating washers when mounting equipment of dissimilar metals onto structure.
- Coatings of proprietary compounds, specially manufactured for the purpose, when mounting equipment of dissimilar metals onto structure.
- Segregation of dissimilar metals during lay-down and storage.

All works undertaken shall ensure the integrity of the Cathodic Protection system where installed, is not compromised.

3.21 ENVIRONMENTAL OBLIGATIONS

All works shall be in accordance with the Contractor's approved/accepted Construction Environmental Management Plan (CEMP).

The Contractor shall develop a CEMP in accordance with the objectives and requirements of the project environmental conditions of approval.

The Contractor's CEMP shall provide detailed information on how the Contractor will manage the site works to ensure that they are undertaken in an environmentally responsible manner, in accordance with all regulatory/project specific environmental requirements. Environmental controls should be specified for issues such as the management of soils; trenching and backfilling; erosion and sedimentation; watercourse crossings; and waste management.

In addition, the requirements of relevant approved/accepted environmental plans shall be considered by the Contractor when developing their CEMP, including (but not limited to):

- The Soil Management Plan
- The Remediation, Rehabilitation, Recovery and Monitoring Plan

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4 MATERIALS AND EQUIPMENT

4.1 SUPPLY

Materials supplied by the Contractor shall include but not be limited to instrument stands, marshalling box stands, test equipment, material necessary for fabrication of supporting brackets, nuts, bolts, washers, labels, cable identification ferrules and tags and crimps. A list of construction materials to be supplied by the Contractor shall be submitted by the Contractor to QUU for acceptance prior to placement of any orders. Material quantities shall be determined from the instrument installation contract drawings and schedules. All materials shall be new and unused, free of defects and shall be supplied with relevant certification and documentation. The defects liability period for all instruments and associated materials shall be 12 months from date of commissioning completed to QUU's satisfaction.

QUU will supply the instruments and materials defined in the Project Documentation as being supplied by QUU. The Contractor shall supply all other materials and equipment necessary to make a complete and fully functional installation in accordance with the Project Documentation. It shall be the Contractor's responsibility to define all Contractor supplied materials and equipment and to ensure the timely ordering and delivery of such to site so as to not impact on the construction schedule.

All Contractor supplied instruments and equipment shall be of manufacturer, type and model as specified in the Project Documentation. For all non-specified equipment the TMS62 Preferred Equipment List – Electrical and Instrumentation shall nominate the preferred suppliers and/or equipment. The Contractor shall not deviate from these requirements without prior written approval from QUU's Representative QUU. Where the materials are not specified the Contractor may offer standard materials suitable for the application, environment and operating/design conditions. Non-specified equipment shall be of the same type, grade and quality as similar items specified in the Project Documentation. Corresponding parts of similar equipment shall where possible be interchangeable.

The contractor shall maintain up to date inventory list of all instrument bulk materials and consumable and procure additional materials as required well in advance so as not to delay the schedule due to shortage of materials.

All instruments, materials and equipment shall be of standard manufacture and readily available from suppliers unless specified otherwise in the Project Documentation. All equipment to be supplied shall be sourced from local OEM (Original Equipment Manufacturer) Authorised Distributors within Australia.

The selected instruments shall be suitably rated for the application with particular attention given to the following:

- Process conditions
- Power rating
- Voltage rating
- Frequency rating
- Duty rating
- IP rating

- Hazardous Area zone classification

All instruments and materials shall be new and comply with the relevant specifications, regulations, codes and standards.

All instruments and materials shall be free from:

- Asbestos
- Ceramic fibre
- Chlorofluorocarbons
- Polychlorobiphenyls (PCB) and their isomers
- Radioactive materials(unless specified otherwise in Project Documentation)
- Mercury

Dangerous goods shall be labelled and identified in accordance with the project requirements. All hazardous materials shall be supplied with a material safety data sheet (MSDS).

4.2 HANDLING AND STORAGE

All instruments shall be stored, handled and preserved in accordance with the relevant Project Documentation.

The Project Documentation will define all instruments and equipment to be received and stored by the Contractor. All such equipment shall be immediately inspected by the Contractor upon receipt for damage sustained during transit. Any damage shall be notified in writing to QUU's Representative QUU and suitable action agreed with QUU's Representative QUU to minimise any work schedule delays.

The Contractor shall be responsible for the safety, security and preservation of all instruments received for the duration of the Contract. All such instruments, equipment and materials shall be stored in a suitable location and environment in accordance with the supplier's recommendations to prevent any damage, deterioration or corrosion prior to installation. As a minimum the following shall be provided for storage locations of instrumentation and associated equipment:

- Lockable fenced all weather compound;
- Adequate lighting for security and safe access;
- All weather hardstand surface;
- Suitable all weather vehicle access.

Storage locations for instruments that are susceptible to deterioration from the outdoor environment shall further comply with the following:

- shaded, dry, weather protected area;
- ambient temperatures within the range of 5°C to 45°C ;
- humidity not more than 95%.

Storage locations for instruments and equipment designed for indoor installation shall further comply with the following:-

- air conditioned and temperature controlled;
- refrigeration for consumables such as buffer reagents;
- dust free;

Storage facilities shall have provision for the safe handling and storage of potentially hazardous materials in accordance with the project safety and environmental requirements. MSDS shall be available at the site for all chemicals present at the site.

Any instruments or equipment damaged during storage by the Contractor shall be immediately brought to the attention of QUU's Representative QUU to advise suitable action to minimise any potential impact on the construction schedule.

The Contractor shall be responsible for continuous monitoring and reporting of all instruments and materials stored by the Contractor. For consumable items the used by date shall be monitored and the Contractor shall replenish stock as required. Adequate levels of Contractor supplied materials shall be maintained at all times to ensure that the installation schedule is not delayed due to material shortages. Similarly, the Contractor shall advise QUU's Representative QUU of any possible future shortages in QUU supplied materials to ensure replacement stocks can be ordered and delivered without impacting on the installation schedule.

4.3 EQUIPMENT PRESERVATION, PROTECTION AND LUBRICATION

Instrument and associated equipment shall not be left unprotected on the construction site, the instrumentation shall remain in storage until is ready to be calibrated or installed. All accessories shall be stored with the instrument to which the accessories are associated. In particular temperature instruments shall be stored together with their thermo wells.

Cables used in the installation of instrumentation shall be stored above ground level, protected from mechanical damage and all un-used cables shall be fitted with end boots to protect against moisture ingress to the cable.

Instrumentation for installation in exposed external areas shall be protected until handed over to QUU. During installation temporary provisions shall be made to protect instruments from any damage, or deterioration, which may be caused by exposure to the environment. Additional temporary protection shall be provided when necessary to guard against adverse conditions which may arise.

Instruments for installation in enclosed areas shall not be exposed to the external environment at any time after unpacking. If necessary, during installation temporary air-conditioning shall be erected in accordance with supplier's preservation requirements.

Adequate protection shall be provided for installed equipment to prevent damage from work in progress in the same or adjacent areas. All covers, caps, weather protection, etc., shall be replaced at the end of each working day.

Extreme care shall be exercised in the protection of equipment against mechanical damage during the course of erection.

Delicate instruments, protective gear and items of porcelain, glass and other material which can be easily fragmented, shall be protected by temporary wooden frames or covers until all risk of damage is removed.

All equipment is to be protected against the ingress of moisture, dust, dirt and foreign bodies during and after installation.

Care shall be taken to protect finished, painted surfaces.

4.4 SURPLUS AND SCRAP MATERIALS

Any surplus materials shall remain the property of QUU and throughout the works shall be collated, sorted and delivered to the locations as advised by QUU's RepresentativeQUU.

Any scrap materials shall remain the property of QUU unless advised otherwise in the Project Documentation. All scrap materials shall be handled in accordance with the project procedures or as agreed with QUU's RepresentativeQUU.

All waste materials shall be disposed of in accordance with the Contractor's accepted CEMP.

4.5 HAZARDOUS AREAS

For instruments installed in Hazardous Areas refer to TMS1203 General Requirements Hazardous Area Installation Specification.

5 INSTALLATION

5.1 GENERAL

All instruments and associated components shall be installed in accordance with the standard installation documentation unless otherwise accepted by QUU's Representative QUU. For any instruments that have not been defined in these documents, the Contractor shall design and submit a proposed installation arrangement to QUU's Representative QUU for approval. No procurement, fabrication or installation shall commence without the receipt of acceptance from QUU's Representative QUU.

All instruments shall have individual connections to the process unless otherwise specified.

No instrument shall be installed so that it depends for support upon:

- The impulse lines, unless so designed.
- The electrical connection.

The Contractor shall ensure that the Supplier's installation recommendations are available and reviewed prior to the commencement of any installation works. All supplier installation recommendations shall be strictly followed. Any conflict between the standard installation documentation and the supplier's recommendations shall be brought to the attention of QUU's Representative QUU for resolution. Unless otherwise specified in the Project Documentation, all brackets and fixings provided by the supplier shall be utilised.

All equipment shall be levelled, squared with building lines and adjusted for operation. Anchors, gaskets, spacers, nuts, bolts, washers, shims, packers and all other similar materials shall be used as required.

A sufficient number of brackets, supports and fixings shall be provided to solidly mount or fix the instruments in position without imposing excessive strain on the equipment or structure.

All equipment with cable entries shall be arranged so that cabling is bottom entry unless otherwise specified in the Project Documentation.

5.2 LOCATION

Instruments shall be located to facilitate ease of operation, inspection and maintenance. The instrument locations shall be in the approximate positions shown on instrument layout drawings. The Contractor shall determine the final position based on the approximate position. Consultation over the final positioning of instruments or if a conflict arises shall be agreed with QUU Representative QUU. Where the existing tapping point is not suitable for the instrument the Contractor shall modify existing tapping point or install a new point.

Unless otherwise specified, remote mounted instruments shall be accessible for maintenance or removal. The operator shall be able to observe the display gauges whilst adjusting the related instruments. Where no permanent access has been provided, temporary or mobile access platforms shall be provided as required. Instrumentation shall be serviceable and replaceable without the aid of a ladder or scaffolding, unless accepted by QUU.

The location of instrument tube runs and cable trays shall not obstruct escape routes, walkways or access to plant or equipment which may require regular attention.

If the adjustment of one locally mounted instrument device affects the operation of another (such as local controllers and control valves), the devices should, where practical, be mounted so that both devices can be seen at the same time.

Instruments shall not be located outside the site perimeter boundary.

All indicating instruments shall be mounted so that their indications are clearly visible with no parallax error. Dial thermometers and pressure gauges shall be plainly visible and accessible from the ground or a platform.

Instruments shall be mounted with a clearance of at least 600mm per 40°C, for equipment with surface temperatures in excess of 90°C.

A minimum of 100mm clearance shall be provided around an instrument installation and any surrounding structure or equipment.

The mounting of instruments and field devices to building cladding is not permitted.

5.3 ERGONOMICS

The instrument and its associated stand shall be installed in an upright position. It shall be as close as practical to the process that it is servicing.

Due consideration shall be given to the following:

- Positioning of equipment does not constitute a safety hazard.
- Equipment does not conflict with any existing or proposed underground services.
- Visibility and accessibility for both maintenance and operations purposes.
- Ease of access for lifting heavy items of equipment such as valves.
- All instruments and valves should be free from vibration with the exception of those specifically designed for vibration measurement.
- Instruments shall be mounted / connected so as not to stress vessel nozzles.

The instruments shall be fitted such that a single person can remove them, where size and weight permits.

5.4 MOUNTING OF INSTRUMENTS

All equipment and accessories shall be installed according to the drawings and information provided and in the Project Documentation. Written approval shall be obtained before implementing any deviation from project drawings.

In-line instruments or equipment and level instrumentation mounted on bridles such as radar /magnetostrictive level transmitters and level gauges, will be installed by the Mechanical/Piping Contractor. The Contractor shall check this type of equipment for correct installation once the Mechanical/Piping Contractor has completed the installation, and install all Electrical and Instrumentation as per the Hook-Up drawings to make the installation mechanically complete.

Field instrumentation shall be mounted on instrument stands using appropriate brackets or shall be bracketed to suitable firm steelwork. Handrails or process pipework shall not be used for support unless otherwise directed in writing by QUU Representative QUU. Field-mounted instruments shall generally be mounted on instrument stands in accordance with the Standard Installation Drawings and as shown on the Instrument Location Drawings.

Field instruments should normally be mounted 1.5 metres from the floor or platform level and generally between 0.7 and 1.6 metres.

Where the stands are to be bolted to concrete footings a gap of at least 20mm shall be created to allow levelling. The gap shall be filled with grout and finished neatly. Where the stand is mounted on steel plate or grid flooring, it shall be levelled by shimming and then welded or bolted in place. Bolting to grating is not accepted.

All instrument stands, brackets, stanchions and stand mounting plates shall be hot dipped galvanised in accordance with SSM006 Standard Specification - Steel Protective Coating Systems TMS76 Corrosion Protection for Electrical and Mechanical Equipment and Structures - Technical Specification. Stand assemblies shall be all welded construction. Weld gas vents, galvanising vents and drain holes shall be provided in the lowest part of the stand. All bolt holes shall be drilled prior to coating with an allowance of 0.5mm for the galvanising and paint finish.

Non galvanised members where specified in Project Documentation shall be painted after fabrication in accordance with SSM006 Standard Specification - Steel Protective Coating Systems TMS76 Corrosion Protection for Electrical and Mechanical Equipment and Structures - Technical Specification. The Contractor may nominate alternative paint systems, however will only be accepted by QUU where evaluated as a considered superior specification to TMS76SSM006. Contractor must obtain written acceptance from QUU for any alternative paint systems proposed.

Typical support brackets for pipe clamp-type mountings are shown in the Instrument Installation Hook-Up Drawings but can be modified as necessary to carry mounting plates for solenoid valves, pressure gauges, etc. as required.

Wherever possible, instruments shall be located so that they are protected from damage by passing or falling objects. A clearance of at least 75mm from any handrail shall be provided.

Wherever possible, instruments shall not be exposed to dripping process materials. Where this is unavoidable, a suitable cover shall be placed over them. Instruments shall not be installed on walkways and safety routes so as not to obstruct personnel movement.

Local indicators mounted directly in lines or on vessels shall be mounted so as to be visible and accessible for operation and maintenance, from grade or a nearby platform. Local indicators not mounted directly in lines or vessels shall be suitably mounted at a height of 1500mm above the floor or platform in a position accessible for operation and maintenance.

Instrument supports and brackets shall be located such that the instruments shall be as close as possible to the primary process connection and be consistent with instrument accessibility requirements for installation, operation and maintenance.

Instruments and instrument supports shall not be mounted on nor attached to equipment or structures subject to vibration.

Instruments or stands shall not be attached to any support structure nor shall they be supported off any handrail, grating or guard system without QUU's prior acceptance.

Where instrument support stands are not located on paved areas, a concrete plinth typically 300 mm square by 400 mm deep, shall be cast in the ground with no more than 100 mm projecting above the grade level and the stand bolted to this. Loxins or dynabolts may be used for securing stands to the concrete pavement.

Column mounted stands shall be clamped. Welding may be allowed under certain situations and but requires acceptance from QUU.

More than one instrument may be only be mounted on a common each instrument stand were ith accepted proval from by QUU.the Superintendent.

Throughout the construction period, instruments shall be adequately protected from the environment by covering with plastic sheet.

Instruments fitted in areas where they are exposed to direct sunlight and rain shall be protected using sunshades. Sun shades shall be easily removable (not requiring demounting of the instrument) to facilitate maintenance. The sun shade enclosures shall have at least 100mm clearance around the instrument transmitter. The sides and top shall protrude at least 100mm in front of the transmitter.

Fittings such as instrument isolating valves and instrument air or gas regulators shall be supported either off the instrument stand or close-coupled to the instrument in manner such that no undue stress is imposed on the tubing installation.

Instruments shall be mounted as close as possible to the process connection. Lengths of impulse lines shall be minimised.

Instruments and instrument impulse lines shall be kept clear and supported independently of pipes, vessels, handrails, ladders, and personnel safety cages. Fixing to vessels shall only be permitted if the vessel manufacturer has provided cleats designed for fixing instruments and associated tray.

Fixing to fireproof members shall be accomplished prior to the application of fireproofing, using brackets with extended stand off to provide adequate clearance for application of fire proofing.

Mounting of instruments directly on to the process pipe connection is permissible only where specifically designed for direct mounting, capable of withstanding line induced vibration and the pipe connection is designed to withstand the associated stresses. Instruments installations designed for direct mounting will be shown on the applicable hook up drawings.

Welding or fixing operations shall not be carried out on any process plant equipment, vessels or pipelines, unless specifically indicated on the installation documents.

To avoid corrosion traps, an inhibitor such as Silicone or nickel based grease shall be applied to bolt threads when bolting through drilled holes and threaded mounting points.

For polymer tanks and other vessels with non-rigid walls and roof the instrument installation associated with these types of vessel shall allow for contraction and expansion of the tanks under normal filling and emptying. PVC backing rings shall be installed where metal fittings are in union with PVC flanges.

5.5 REMOVAL OF EXISTING INSTRUMENTATION AND DECOMMISSIONED EQUIPMENT

The Contractor shall be responsible for the safe and effective removal of the existing instruments from the site.

Unless stated otherwise in the Project Documentation the instruments, including all associated equipment, shall remain the property of QUU and shall be secured, packaged, labelled, loaded and removed from site, delivered to and unloaded at a location specified by QUU's Representative QUU.

With the exception of the nominated instruments, the Contractor shall be responsible for the safe and effective removal and off-site disposal of all decommissioned cables and conduits, waste plant and/or equipment in accordance with all current legislation and local, regional and state/national statutory requirements.

5.6 INSTRUMENT INSTALLATION

Instruments shall be installed as per the QUU accepted installation drawings for each instrument. The Contractor shall provide instrument installation drawings where not provided in the Project Documentation for QUU review.

5.6.1 Temperature Instruments

The Contractor shall ensure that all temperature instruments such as gauges, thermocouples and resistance temperature devices are installed in thermowells, unless specified as surface mounted or indicated otherwise on the datasheets and installation drawings.

Temperature sensors shall be coated with thermally conductive oil prior to sensor insertion. The use of molybdenum disulphide greases are not permitted.

Prior to installation, the Contractor shall check the following and raise a site query if any of these conditions are not met to confirm the arrangement is adequate:

- There is sufficient clearance for inspection and withdrawal of the thermowell and their associated temperature measuring instruments;
- The thermowell would be fully immersed in liquid when fitted to a vessel.

For surface mounted temperature transmitters, the temperature instrument shall be installed in accordance with manufacturer's recommendations.

Test thermowells if any, shall be fitted with 316 SS weather proofing plugs and securing chains.

5.6.2 Pressure and Differential Pressure Instruments

Pressure, DP and flow DP instruments shall be installed in accordance with the relevant hook up drawings.

Where pipe stand mounted, they shall be installed as close to the process tapping as possible.

All pressure gauges shall be installed with rotatable gauge adaptors in accordance with appropriate hook up drawings.

The capillary tubing of filled and sealed instruments shall be adequately supported and protected from damage. The capillary tubing shall not be cut or removed. Any extra length shall be neatly coiled at the instrument end of the tubing. The manufacturer's minimum recommended bending radius shall be followed for any bends required.

All open ports on field mounted instruments shall be protected by installing a length of tubing, fitted with a bug screen.

5.6.3 Level Instruments

Each instrument connected external to the vessel or standpipe shall be installed on full bore piping isolation valves. The exception to this may be radar level transmitters where the transmitter may be removed whilst leaving the probe installed.

If during installation it becomes apparent that future removal may be difficult, QUU shall be notified before any corrective action is taken.

Level instrument installations shall be installed to permit maintenance from a platform or deck. Isolation, vent and drain valves shall be accessible.

The vessel and bridal connections to level instruments shall be aligned to within +/- 20mm, to ensure the external chamber is mounted vertically without exerting any stress on the instrument or galling of the float or displacer within the chamber. Where it is evident that this is not achieved, QUU shall be notified.

Ultrasonic level instruments are not permitted in high humidity areas.

5.6.4 Flow Metering

5.6.4.1 Variable Area Flow Meters

Variable area flow meters shall be mounted in accordance with the manufacturer's recommendation (usually vertical with flow upwards) and piping isometric. The meter must be orientated to allow easy reading of the scale.

The Contractor shall not remove the transducers from the spool pieces.

5.6.4.2 Orifice Plate Flow Meter

Differential pressure transmitters for liquid service shall be located below orifice flanges.

DP Flow transmitters in gas and vapour service shall be located above the orifice flanges.

Orifice meters should be installed horizontally and near the deck or platform for ease of accessibility and safe changing of the orifice plate.

It is not permitted to install an orifice meter such that the person changing the orifice plate is required to stand directly over the top of the fitting.

Flange bolting shall be fully withdrawable and not obstruct the vertical orientation of the tab on the orifice plate. The orientation shall be checked prior to the welding in place of a meter run.

The instrument orientation and location shall allow for adequate space to access and clear blockages from all lines.

5.6.5 Control and Shutdown Pushbuttons

These shall be mounted on instrument stands or a bulk head. Where a number of pushbuttons are required at the same location these can be grouped on a common stand if practical. The pushbuttons shall not be placed at locations where they are susceptible to damage or inadvertent operation. Each pushbutton shall be clearly labelled with a large laminated plastic label. Locations will be shown on Instrument and F&G layouts. Shutdown pushbuttons shall be clearly visible from the escape routes and the walkways and not obstructed by site run equipment.

5.6.6 Control Valves, Shutdown Valves and Relief Valves

All valves shall have facility to be pad locked in open and closed position unless specified otherwise in the Project Documentation.

Actuated valves installed in horizontal pipes shall have their actuators above the valves.

Actuated valves installed in vertical pipes shall have the actuators orientated in line with the pipe and in an accessible position to read display and access terminal box. Extension spindles shall be installed to eliminate requirement for access to confined spaces and in other areas where access is restricted.

Diaphragm and piston actuated linear valves e.g. control valves, shall always be installed with their stems vertical.

Relief valves shall be installed with the spindle in a vertically upward position.

Access shall be from the access platforms, as required.

Elbows shall be installed to all vent pipes to direct discharge to ground.

Clearance shall be provided to allow in-line maintenance of the valve. Adequate clearance shall be provided above, below and around the valve to allow removal of the valves internals and actuator, without the need to remove the valve body from the pipe. Where it is not feasible and the valve is flanged, it may be swung on a bolt axis to provide access.

5.6.7 Cabling

Instrumentation cabling shall be installed in accordance with the relevant sections of TMS1200 Electrical Equipment Installation Specification and the Cable Schedule.

All instrument signal cabling shall be PVC/PVC twisted pair with an overall aluminium screen. Individual pair screen cables are also accepted. Each black and white core of the cable shall be numbered and terminated with a suitable crimp at both ends.

Instrumentation wiring inside enclosures used for analogue signals to PLC or process instrumentation shall be minimum core size 0.5mm^2 .

Instrumentation cables run to field instruments shall have minimum core size 1.5mm^2 .

The screen of all instrumentation cables and panel wiring shall be earthed at only one point.

Cables with single strand (solid) cores are not permitted.

Instrument cables shall be run on cable ladders for all main routes as per relevant cable routing schedule. The location of cable ladders shall not obstruct walkways, escape routes or access to plant or equipment that may require regular access. In all cases, except where agreed, instrumentation and control cabling shall be run on cable ladder.

Sensor extension cables such as those supplied for machine monitoring, (e.g. vibration or bearing temperatures), shall be mechanically protected throughout their length. Where rigid conduit is used, the final 600mm of extension cable adjacent to the machine shall be routed through stainless steel braid armoured hose or heavy duty flexible PVC conduits, which shall be securely glanded at each end. Stuffing boxes shall be provided as necessary to ensure compliance with certification requirements, and to ensure isolation between different hazardous areas (e.g. through an acoustic hood).

In routing of signal wiring, care shall be taken to keep the wiring at segregated and separated from motors or other electrical devices that produce strong magnetic fields. Refer to TMS1200 Electrical Installation Specification for segregation requirements for instrument cables.

Wiring for Intrinsic Safe (IS) loops shall be segregated from non-IS loops. Multi-core cables shall not contain IS and non-IS circuits.

Pulsed signals shall not be run within cable with power wiring or DC signal wiring.

Alarm and shutdown signals shall not be run in the same cable with power wiring.

DC wiring shall not be run with AC wiring.

Instrumentation and control cabling shall be segregated from power cables.

Non-intrinsically safe 4-20mA and 24Vdc digital cables shall be provided with black sheath.

Where cables are being used on IS circuits, they shall be provided with blue sleeving. Terminal points inside cabinets, junction boxes etc. shall be marked or painted blue in accordance with AS/NZS 60079.14.

All instrument field cabling shall be mechanically protected throughout the entire route length. Cables run underground shall be installed in heavy duty orange conduits and conduit trench provided with termite chemical protection. PVC conduits shall have suitable mechanical protection where they transition to above ground. F&G system cables shall be Fire Resistant and identified with red strip over the outer sheath.

5.6.8 Cable Ladder and Conduits

Cable ladder and conduit installation shall be compliant to the requirements TMS1200 Electrical Installation Technical Specification.

Spacing of supports shall ensure that ladders / conduits show no permanent deformation once cables are installed. Supports shall be in accordance with manufacturer's recommendations.

Cable run from the Junction boxes to the field instrument shall be installed in either cable ladder or galvanised steel conduit. Contractor shall be responsible for supply and installation as required.

All cable ladders shall be fitted with covers.

Perforated cable trays as a substitute for cable ladder is not permitted unless accepted under special circumstances by QUU.

5.6.9 Junction Boxes

Individual junction boxes shall be installed to provide segregation between differing system functionality, voltage levels and signals types (Control from Safety, IS from Non IS).

The junction box shall be installed at a height that allows work to be conducted on the internal components comfortably and efficiently.

Cable entries to jJunction Bboxes shall be bottom entry only. Side and top entry can only be considered for indoor junction boxes and only to be installed where accepted in writing from QUU that bottom entry is not a feasible option. Outdoor j where Junction Bbox side and and top top cable entry is not accepted.forbidden.

All unused entry holes in junction boxes shall be plugged with IP66 blanking plugs. The plugs shall be the same type of material as the junction box housing.

Refer TMS1200 Electrical Installation for other requirements for field mounted junction boxes.

5.6.10 Termination and Connection of Cables

All electrical equipment, including glands and adaptors, located within hazardous areas will be ANZ/IEC Ex certified and shall be installed in accordance with the corresponding standards.

All cables shall be installed and terminated as per cable schedule, Cable block diagrams and associated Termination drawings. The Contractor shall gland all cables to the panel/junction boxes.

Where equipment is supplied with blank, undrilled gland plates, they shall be drilled in a workshop as required to suit the glands and maintain required size tolerance. The exception is flameproof boxes (Ex d), which shall only be drilled by the manufacturer. For all outdoor-installed equipment, bottom (preferred) or side (on approval) cable entries only shall be used. Top entries are not acceptable.

Unused cable entries shall be sealed with weatherproof plugs.

All cable cores shall be suitably numbered with sleeve type ferrules of the correct size, for each core at all points of termination. "Grafoplast" ferruling system or an accepted equivalent shall be used with black numbering on a white background and shall fit snugly over the core insulation adjacent to the solderless compression fitting.

Cable markers shall be 'Critchley-Permark' system, or equivalent, stainless steel labels with the cable identification laser etched into the surface. The labels shall be completely free of all sharp edges and shall be fixed at the time of cable installation using stainless steel cable ties. Cable ties shall be installed with a specialist tensioning and cutting tool to avoid sharp edges. The labels shall be 75mm long x 7mm wide and the etched lettering shall be 4mm high.

The Contractor shall supply and install the cable and core markings as per the Documentation/Drawings.

All instrumentation cables shall be terminated using tinned, solderless, insulated shank type crimp fittings of the correct size and material, and applied using the Manufacturer's approved tool. "Boot Lace" style fittings shall be used for "Through" terminals and spade style for under screw terminations. Ring terminals shall only be used where directed.

Unused cores in cables shall be terminated in accordance with detailed installation drawings.

Insulated connecting combs shall be used as necessary.

A minimum distance of 50 mm shall be maintained between a terminal strip and its associated trunking.

All conductors of all cables shall be terminated at both ends, one core per terminal per side. Cable pairs and the screen(s) shall be terminated consecutively, both in the field junction boxes and on the terminal strips in the marshalling cabinet.

5.6.11 Terminations at Field Equipment using Flexible Cords

Where the instrument of field equipment has insufficient cable or conduit entries for the cables to be fitted, the Contractor shall provide a suitable junction box for accepting the cables. The cores shall not be joined in the box but pass through to the instrument terminals.

Where an instrument has flying leads and no terminal box, the Contractor shall provide a terminal box with sufficient suitable terminals. A conduit seal may be required to separate instrument enclosure from the junction box. A multi pin plug and socket is not an accepted alternative arrangement for this application.

Solenoids, proximity switches, level switches and other items of equipment with DIN type plugs or similar connections not suitable for direct termination of ordinary circular cable shall be connected in the following manner:

- The supply cable shall be terminated at a junction box supplied by the Contractor, close to the device.
- If the item is supplied with a plug, then flexible cord with 0.75 mm² conductors shall be run from the junction box to the plug.
- If the item is supplied with a flexible cord (eg. level switch), the cord shall be connected to the junction box.
- The flexible cord shall be run in conduit for the whole of its length and shrouds fastened at each end with cable ties.
- The Contractor shall supply this type of termination if required for solenoids or field instruments, regardless of whether it is called for on the Contract drawings.

Note: 'Blue Point' style connectors shall not be used.

5.7 EARTHING

5.7.1 General

All instrumentation earthing shall be in accordance with AS/NZS 3000 (Wiring Rules), TMS1200 Electrical Installation Specification.

Intrinsically safe systems shall also conform to AS/NZS 60079.11.

5.7.2 Electrostatic Earthing

Notwithstanding any electrical earthing requirements specified in:

- The Wiring Rules (AS/NZS 3000) and
- The Static Electricity Code, AS 1020.

The following points must be observed in the wiring of screens of the instrument cables installed:

- All field-run instrument signal cables shall be screened against the effects of stray electrostatic radiation by an overall screen and drain wire.
- All single and multi-pair cables shall have an overall screen, which shall be a continuous run and shall only be earthed at a single point – non-instrument end. In specific applications individual and overall screening of multi-cores shall be used.
- This single earth connection of the overall screen is at the isolated earth bars supplied in the Marshalling Cabinets in the control/switch-rooms. All other parts of the screen are sleeved to prevent any contact with earth.

5.7.3 Screens

Where screens are specified, they shall be connected in the following manner:

a) The single PAIR/TRIAD cable end in the field (e.g. Transmitter, receiver, final control element etc.) shall have its screen and drain wire sleeved for isolation from earth.

- b) At the Junction Boxes, the single cable pair end shall have its screen sleeved and connected via the drain wire to an isolated earthing bar which is to be connected to the overall screen of the multi-pair cable carrying those particular signals.
- c) At the incoming cable terminal blocks in the Marshalling rack, or panel, allocable screens shall be connected to a common earth point via panel mounted, isolated earthing connectors.
- d) Where individual + overall multi-core screening is implemented an additional terminal for each pair or triad shall be incorporated at each end of the multi-core for the screen. At the field junction box, the field instrument single pair screens shall be terminated to the respective multi-core individual screen. This screening must be continuous (and isolated from all other screens) up to the control panel where all screens from the same multi-core can be earthed to a single common point. The insulation wrap on each individual pair must be maintained right up to the measuring module. When testing the screens for isolation, each screen must be tested for isolation from all other screens prior to termination at the common earthing point.

5.7.4 Instrument Earthing

The instrument earth shall be used for all non-IS screening applications, such as the screens on signal cables, 0 V references, etc.

Field instrument cables between a junction box and the control cabinet shall have the armour earthed at both ends of the cable via the gland.

Metallic instrumentation housings shall be earthed in accordance with the relevant instrument hook-up drawing. Where the earth bond cannot be assured, a 4mm² single core, insulated conductor shall be provided between the enclosure and an effective local earth point.

All metallic junction boxes in the field shall be solidly bonded to the earthing system.

All non-metallic junction boxes shall be fitted with an earth stud connected to each of the cable glands and bonded to the plant / platform steelwork. This shall provide the earth connection for cable armours.

5.7.5 Intrinsically Safe Earthing

The IS system earth shall be installed such that the impedance between any barrier earthing bar and the control centre main earth point shall not exceed 1 ohm.

Earth leads between the control cabinet IS earth bar and the control outstation earth bar, shall be provided with identification labels at both ends indicating an intrinsically safe circuit.

The arrangement of earthing of intrinsically safe equipment shall comply with equipment or system certification and local and national requirements.

5.8 TUBING, PIPING AND FITTINGS INSTALLATION

Process connections and tubing shall be installed as per the P&ID's and Process and Pneumatic Hook-Up drawings. Any deviation from these must have prior acceptance by QUU.

Tubing expansion sets should be installed to prevent stresses resulting from expansion where extreme vibration or changes in temperature may occur.

All tubing shall be supplied and installed by the Contractor. inTubing accordance with QUU specifications and shall be fully annealed, seamless, cleaned and passivated ASTM A269-10TP 316/316L SS unless otherwise stated in the Hook-Up drawings or agreed in writing with QUU.

All tubing installation shall be neat in appearance, round, free from external scratches and defects, grouped functionally together where practical. All tubing shall be run in either the horizontal or vertical plane except as specified for impulse tubing to achieve the prescribed fall.

All fittings shall meet or exceed the piping specification that they serve.

All tubing and fittings shall be as detailed in the Instrument Installation Hook-Up Drawings.

Full material certification is to be supplied for all materials supplied by the Contractor.

Tubing must be imperial sizes. Only NPT type thread can be used for threaded connections. Any deviation from this shall be subject to QUU acceptance.

Tubing shall be pickled free of scale. When bright annealing is used, pickling is not necessary.

Tubing shall not interfere with access to valves or equipment, nor obstruct passageways. A headroom clearance of 2500mm minimum shall be maintained beneath all piping, valves and fittings installed above access ways.

Instrument valves shall be accessible for operation from floors or platforms unless otherwise accepted by QUU.

Tubes installed, but not connected, shall have the ends closed in to prevent the entry of foreign material. For a period of up to one week adhesive tape may be used, for longer periods, caps or plugs shall be used.

Joints should be systematically staggered and neatly offset when instrument pipes or tubing is run parallel to each other.

Only double ferrule compression fittings similar to Swagelok® shall be used for all tube connections.

Contractor shall ensure the nuts and ferrules are of the same grade, size and of the same manufacture. The fittings shall be installed in strict accordance with the Manufacturer's recommendations, including checking with a gap inspection gauge where relevant.

The mixing of different manufacturer's compression fittings shall not be permitted.

Any discrepancies between the materials/fittings specified and the materials/fittings provided as free issue items shall be resolved with QUU.

Horizontal runs of tubes shall have tubes laid vertically one above the other as far as possible and shall be run with the minimum number of changes of direction consistent with good practice and neat appearance. Standoff mountings shall be used rather than saddles to secure the tubes.

All pneumatic signal tubing shall be cleaned before connection to instruments by blowing through with filtered air.

Single core tubing shall be neatly run using cable tray, Unistrut® trunking or structural steel sections in such a manner as to give the maximum protection against mechanical damage wherever necessary.

The Contractor must pay special attention to the correct positioning of vents and drains to ensure that they are at the highest or lowest points of the piping run as necessary for effective operation. Stainless Steel mesh shall be installed to all vents and drains to prevent vermin ingress.

Impulse tube shall be kept as short as possible consistent with good practice and accessibility. As far as possible, the process impulse lines shall be run in the vertical plane, all horizontal tubing shall be run with a minimum slope of 1 in 12. Tubing for liquid service shall slope downward toward the instrument to ensure self-venting of vapours back to the main process. Tubing for gas service shall slope upward toward the instrument to ensure self-draining of liquids back to the main process.

Where the instruments are installed on immiscible fluids services the impulse lines shall be installed horizontally. These instrument orientations are shown on the relevant hook up drawings.

Impulse tubes for remote located instruments shall be arranged to avoid:

- Movement (thermal expansion) exerting force on the connection and tubing
- Mechanical damage from impact
- Rubbing on valves or steelwork

Where indicated on the hook up drawings instrument manifold vents shall be tubed to the vent header to allow remote safe venting of gases.

All piping and tubing shall be supported by tube clamps to provide adequate mechanical security and installed so that no section or run is left under strain.

All impulse tubes shall be supported with tube clamps (e.g. STAUFF) at a spacing not exceeding the following:

Tube Size	Tube Clamp Spacing
½" OD	1.5m

3/8" OD	0.75m
1/4" OD	0.5m

Alternatively, tubing may be continuously supported in trays.

Tubing shall not be run in electrical cable trays.

Where impulse lines are heat traced and / or lagged provisions shall be made to allow the removal or maintenance of the instrument without removing the entire heat tracing or lagging.

Breakable connections shall be provided adjacent to the instrument to facilitate instrument removal.

Tubing shall be run in a single layer wherever possible with the minimum number of changes of direction and where unions are used; joints shall be offset neatly and shall be systematically staggered when two or more lines run together.

The installation shall facilitate uncomplicated tracing, troubleshooting and replacement.

Tubing runs shall be arranged so that couplings may be tightened without distorting or bending the line.

The impulse tubes shall be bent where necessary using tube benders. There shall be no reworking of tubing and no tight bends. Where a tight bend (<3D radius) is unavoidable an elbow compression fitting shall be used instead.

Impulse tubes shall be lagged, or heat traced and lagged, where the process liquid would otherwise condense, solidify or be otherwise adversely effected by low or high ambient temperatures or where indicated on the installation drawings. Lagging shall also be provided to protect personnel from high or low temperature impulse lines.

Tubes shall be adequately supported and may be run in the horizontal or vertical plane. Where tube runs are horizontal and there is a possibility of oil or dirt falling on tubes, a protective cover shall be installed.

Tubing fittings with galled or deformed threads shall not be installed.

The Contractor shall correctly size tube fittings to match tube connections instead of bushings or swages. The use of bushings is prohibited.

Proper tightening of tubing fittings shall comply with the tubing manufacturer's requirements.

Manufacturer's Go / No Go gauges shall be used to check the gap.

The temperature rating of sealer/lubricant compound shall not be exceeded.

Precautions shall be taken to prevent foreign material entering the instrument tubing before or during installation. All lines shall be blown with oil free dry air before being connected to instruments.

Instrument tubing shall be free of burrs, square cut with a tubing cutter and reamed at all end points as per Manufacturer's recommended practice. Reamed tubing shall be blown completely free of all shavings.

Fittings shall be tightened and checked using fitting gauges as per manufacturer recommended practice. Pressure ratings of female fittings shall be considered in evaluation of overall tubing system pressure capability.

5.8.1 Thread Tape and Sealant

On tubing connections:

- Threaded connections shall be assembled with SWAK (or equivalent) PTFE-free pipe thread sealant where compatible with the process substance.
- Thread sealant tape such as PTFE shall not be used.
- An appropriate thread sealant (Loctite) or lubricant shall be used in the place of thread sealant tapes where compatible with the process substance.

All sealants for special applications and the method of installation shall be accepted by QUU before commencement of installation.

5.8.2 Instrument Air Supply System

The instrument layout drawings will show the approximate location of the air manifolds.

Instrument air manifolds shall be mounted vertically and fitted with a drain valve. The instrument tube shall be labelled with the instrument tag number at the point of isolation, normally the air distribution manifold. Tag number labels shall be attached to the tube using 316 SS banding. Refer Installation drawings for details.

Instrument air systems must be clearly identified and labelled to prevent non-instrument usage.

Spare air manifold take-off points shall be plugged with 316 Stainless Steel threaded pipe plugs. The final tubing run shall be fabricated to reduce the effect of vibration and facilitate easy removal of the control valve or actuated valve.

Some instrument air consumers will require direct connection to the instrument air header (e.g. large pneumatic on/off valve actuators). The piping group will install 1" NB pipe to a location adjacent to these valves. The final tie-in will in accordance with detailed installation drawings.

5.9 SPECIFIC FIRE AND GAS INSTALLATION

5.9.1 General

Fire and Gas detectors shall be located, including elevation and orientation in accordance with the Instrument Location Plans and the BCA.

5.9.2 IR Point Gas Detectors

Gas detectors shall be mounted from secondary or tertiary steelwork. Detectors that cannot be accessed from the ground shall be installed complete with ¼" stainless steel tube down to a calibration point placed 1.3m above the ground but shall not obstruct escape routes. The tubing shall be fitted with a quick connect fitting that blocks the end of the tubing when not connected to a calibration gas bottle. A short length of plastic tube shall be fitted between the detector and the 316 stainless steel tube to avoid putting undue pressure on the detector cowling.

5.9.3 Open Path Gas Detector

Open path gas detectors shall be installed as per the manufacturer's guidelines with respect to the path lengths and clear line of sight. These devices are susceptible to loss of alignment if vibration at the instrument is present, therefore the design of the mounting poles and mounting of the instruments shall prevent vibration, meet the manufacturer's requirements and utilise recommended alignment tools. The Contractor shall check that the path length is at least 20% less than the maximum recommended by the manufacturer before final mounting of the device. The limitation on distance shall not be compromised unless accepted in writing by QUU.

Testing utilises a plastic film placed in the IR beam or with a tube filled with calibration/test gas.

Where feasible the height of the detectors shall allow the film to be placed into the beam but shall not allow normal platform activities to obstruct the detector path, i.e. personnel walking around the platform.

5.9.4 Manual Fire Alarm Call Points

Break glass units and pushbuttons shall be installed 1.4m from the floor level or deck level. Manual Alarm Call points and pushbuttons, complete with labels shall be mounted on an instrument stand and in accordance with the BCA.

5.9.5 Acoustic Gas Leak Detectors (Specific Fire and Gas Detectors)

Acoustic gas leak detectors shall be installed as per the manufacturer's guidelines. All acoustic gas leak detectors shall be fitted with a sunshade when installed outside.

The acoustic gas leak detectors are susceptible to vibration and should therefore be installed in a vibration free location.

The detector housing shall be connected to local ground via the external earth point. Wire should be minimum of 4mm² (8 AWG) and as short as possible

5.10 HAZARDOUS AREAS RATING

Installation of field instrumentation in Hazardous Areas shall comply with TMS1203 General Requirements for Installation of Electrical Equipment in Hazardous Areas.

All equipment and protective systems shall be marked legibly and indelibly with the following minimum particulars:

- Name of the Manufacturer
- Designation of Series or Type
- Serial Number
- Year of Construction
- Specific marking of explosion protection (i.e. Ex) followed by the symbol of the equipment group, category and certificate number
- All information essential to their safe use

The Contractor shall complete fill out HA Installation Check sheets which shall be submitted as part of the handover Ddocumentation package. The HA Checksheetscheck sheets shall be approved by a HA n inspector competent in accordance with AS/NZS 4761.

5.11 LABELS AND EQUIPMENT IDENTIFICATION

A label shall identify each item of equipment. This shall include field instruments, instrument junction boxes, control and marshalling panels, bulkhead connections, wiring, etc. The material, size, wording and layout of the label, shall be in accordance with the standard drawings, equipment list and instrument index and shall be supplied and installed in accordance with the Project Documentation.

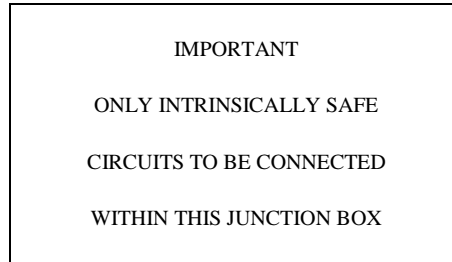
Labels shall be supplied by the Contractor for all remote mounted instruments in addition to the stainless steel tag plates supplied with the instrument. Unless specified otherwise, labels shall comply with Project Documentation.

Control and marshalling panel labels and junction box labels , shall comply with labels requirements as specified in TMS1200 Electrical Installation - Technical Specification.be UV stabilised exterior grade acrylic, with black lettering on a white background.

Junction boxes and control panels Labels for field junction boxes shall be UV stabilised exterior grade acrylic, with black lettering on a white background, unless specified below:

Junction boxes containing shutdown or safety circuits shall have UV stabilised exterior grade acrylic labels, with white lettering on a red background.

Junction boxes containing intrinsically safe circuits shall have UV stabilised exterior grade acrylic labels, with white lettering on a blue back ground. An additional label mounted on the enclosure door or cover shall bear the statement:



When placing labels on HA certified equipment, care must be taken to prevent invalidating equipment certification. Drilling or modification of certified enclosures is not permitted. Labels attached to certified enclosures must not cover the enclosure's own certifying label. Fixing shall not compromise the IP or hazardous area rating of the equipment.

Equipment tag name labels Tag plates shall not be attached to cladding. The equipment tagging convention shall be in accordance with TMS1647 Equipment Tag Naming – Technical Specification QUU Tag naming specification and conform to the following:

- Labels shall be positioned either as shown on the drawings, or immediately adjacent to the item concerned, above or below it, whichever is better for observation. Positioning the label to one side may be done only when the preferred positions are unavailable. The tag shall be installed such that it does not impinge on any instrument tubing or process piping. Where label positioning is difficult, QUU Representative QUU shall determine the final position.
- The labels shall be affixed at the time of assembly of the equipment or when the equipment is installed. All labels, that will be exposed to paint spray, shall be temporarily masked with a transparent material during all construction activities, and then removed at the time of hand over of the work.
- Where external identification labels are not provided with the original equipment or have been lost or damaged, the Contractor shall provide and fit suitable labels.

Fixing of labels shall be by a minimum of two stainless steel screws. For non certified Ex enclosures the screw holes shall be drilled and tapped. Labels larger than 75mm x 25mm shall have four fixing screws. Fixing of labels to enclosures shall not void the IP rating or Ex certification of the equipment. Attachment of labels by means of adhesiveness alone shall not be permitted.

Fixing holes in labels shall be drilled oversize and screws shall not be tightened to the extent that the label cannot move under expansion caused by fluctuations in the enclosure's surface extremes of temperature.

Cables and cable cores shall be identified in accordance with section 5.6.10 of this specification.

6 QUALITY ASSURANCE, INSPECTION & TESTING

The Contractor shall demonstrate that all works comply fully with this specification and all associated Project Documentation.

6.1 QUALITY ASSURANCE

The Contractor shall apply a quality assurance system accredited to AS/NZS ISO 9001:2000 for all works. The effectiveness of the quality assurance system and the Contractor's compliance with it shall be subject to monitoring by QUU's RepresentativeQUU and in addition, may be audited following an agreed period of notice.

The Contractor shall submit a quality control program for QUU's RepresentativeQUU review at the time of Tender. The Contractor shall cooperate with QUU's RepresentativeQUU and QUU's nominated auditors during all stages of the works with respect to quality assurance matters.

Components and works shall be inspected and tested in accordance with quality control and assurance procedures nominated by the Contractor and accepted by QUU's RepresentativeQUU. The Contractor shall identify hold and QUU witness points. points for access by QUU's Representative.

6.2 INSPECTION AND TESTING

QUU's RepresentativeQUU shall be permitted at all times free access to all parts of the Contractor's works including on-site workshops and storage facilities.

The Contractor shall supply all test equipment, tools and materials required and shall be fit for purpose, in good working condition and calibrated. Calibration certificates shall be maintained for all relevant equipment.

6.2.1 Inspection and Test Plan (ITP)

The Contractor shall include typical Inspection and Test Plans (ITP) in their Tender documents. The ITP's shall list typical inspections and tests proposed for all elements of the works.

Prior to commencement of the relevant works the ITPs shall be customised by the Contractor for the project works and have been reviewed and accepted by QUU's RepresentativeQUU. QUU's RepresentativeQUU and the Contractor shall sign off the final version of the ITPs, which, thereafter, shall form part of the contractual documents. The ITPs shall encompass the testing requirements of all relevant standards and statutory/regulatory requirements.

The Contractor shall be responsible for the planning and execution of all inspections and tests, with QUU's RepresentativeQUU having the right to witness any or all of the inspections or tests.

ITPs shall be completed and signed off progressively during the execution of the works.

The Contractor shall notify QUU's RepresentativeQUU, at least 4 days in advance, of the date on which any of the inspections or tests nominated as Hold or Witness points on the ITP's are due to be carried out.

ITP's and Checksheets shall be completed for all works to prove it has been satisfactorily tested to meet all defined requirements whether or not witnessed by QUU's RepresentativeQUU.

Where appropriate, test check-sheets shall state values for all test results. Tests for which the results are indicated as pass or fail shall be qualified by the relevant acceptance criteria.

The following typical documents outline the minimum content to be completed by the Contractor where applicable to the site testing and inspection works:

- CHE68 Site Inspection Checks – Cables
- CHE70 Site Inspection Checks - Instruments
- CHE72 Site Inspection Checks – Cable ladder/ Tray / Ducts
- CHE136 Site Inspection Checks – Field Equipment

6.2.2 Post Installation Inspection

All installation works shall be visually inspected by the Contractor for:

- Correct installation in accordance with appropriate drawings;
- Acceptable workmanship quality;
- Accessibility for operations and maintenance; and
- Compliance with this specification

6.3 INCOMING EQUIPMENT INSPECTIONS

All equipment shall be inspected by the Contractor upon arrival at site for damage and conformance with the purchase orders, specifications and all other relevant documentation. An incoming equipment ITP shall be developed that will detail the exact inspection requirements.

6.2.2 Materials Receipt Inspection

All equipment shall be inspected upon arrival at site for damage and conformance with the purchase orders, specifications and all other relevant documentation. An incoming instrument and equipment ITP shall be prepared by the Contractor that details the exact inspection requirements.

The Contractor shall visually inspect the instrument equipment upon receipt for damage and for conformance to the specifications and purchase requisition(s). Any damage to the equipment or deviation from the specifications or requisitions, including but not limited to, nameplate data, dimensions, accessories, shall be noted and reported immediately to QUU and to the party responsible for the equipment procurement.

Specifically, dimensions of orifice plates, level transmitters, and all in-line instruments shall be checked at time of receipt.

No action shall be taken to repair, replace or modify non-conforming materials without QUU acceptance.

All identification tags shall be left securely attached to the instrument and shall not be removed during installation.

6.2.3 Post Installation Inspection

All installation shall be visually inspected by the Contractor for:

- Correct installation in accordance with appropriate drawings;
- Acceptable workmanship quality;
- Accessibility for operations and maintenance; and
- Compliance with this specification

6.36.4 TESTING

6.3.16.4.1 General

All test equipment shall be supplied by the Contractor and certified and traceable to an applicable standard. Before testing or calibration commences a comprehensive list of test equipment intended to be used, along with copies of calibration test certificates, shall be submitted to QUU for review..

The test equipment listed shall have a standard of at least three (3) times better accuracy than the Manufacturer's stated accuracy for the instrument to be tested and shall be calibrated within six months of the test date.

All electrical equipment and installation shall be thoroughly inspected and tested before energising in accordance with QUU requirements and Australian standards including AS 3000 Wiring Rules.

A record of inspection and test results shall be maintained and will form part of the Project handover documentation.

All field instruments shall be provided with a factory calibration certificate in accordance with the instrument data sheets. The Contractor shall provide traceable records of the calibration instrument, method used, range, set point, and results. All instruments shall undergo a proof test before installation and the results recorded and signed off accordingly.

Checks shall include the correct tag number, range, voltage and nameplate as a minimum. Any deviation shall be brought to the attention of QUU and the instrument supplier.

Non-contact radar level transmitters shall be range set-up in-situ once they are installed in their final location to account for any variations in mounting height from those expected during the design phase.

Magnetostrictive and guided wave radar level transmitters were ordered factory calibrated for the level bridge centre to centre range. These transmitters shall be range setup to match the latest instrumentation datasheet settings prior to installation.

With the exception of Fire and Gas detectors, instrument fault and saturation levels shall, where possible, be configured to NAMUR NE43 recommended values, as stated below. Fire and gas detector fault settings shall be configured as per manufacturer's default settings.

Level	4-20 mA Saturation	4-20 mA Alarm (Fault)
Low	3.8 mA	≤ 3.6 mA
High	20.5 mA	≥ 21 mA

The Installation Contractor shall:

- Check all instruments and electrical equipment makes/models against the data sheets provided.
- Check all instrument calibrations against the data sheets provided.
- Check instrument fault settings are as per NAMUR NE43, where supported by the device.
- Complete instrument loop tests of all loops.
- Complete and sign loop calibration sheets for all instrument loops.
- Complete point-to-point pre-commissioning continuity checks for all instruments and electrical equipment between the instrument and electrical equipment, junction boxes, termination panels and I/O cards or distribution boards.
- Test for instrument earth loops for all instruments and electrical equipment.
- Complete FICs for each instrument and electrical equipment.
- Complete HA Checksheets for each instrument and electrical equipment located inside the hazardous area.
- Functional system tests including all control and safety actions with Operations.

6.3.26.4.2 Pre- Installation Testing

The object of pre-installation testing is to ensure that each instrument has been supplied in accordance with its specifications, is functionally correct and is in working order.

The pre-installation test shall be performed just prior to installation as recommended by the Manufacturer of the instrument, with any adjustments being made in strict accordance with the Manufacturer's instructions.

All HART instruments shall be ranged and configured (instrument serial numbers, tag numbers etc.) using the appropriate calibrators. Non-SMART pressure instruments shall be calibrated using pressure pump and temperature instruments using decade boxes or

temperature baths. All batteries installed in instruments shall be date stamped with date of instrument installation.

The Contractor shall notify QUU if any instrument is found to be defective. Defective instruments will normally be returned to the supplier and replaced under warranty.

The acceptance by QUU shall be obtained in writing before any non-standard modifications or adjustments are made.

Where a pre-installation test is not specified or where circumstances prohibit the carrying out of a prescribed test, a test method shall be agreed QUU.

No tests shall be carried out on electronic instruments until a warm up period, as per the Manufacturer's specifications, has elapsed.

F&G detection devices do not require pre-testing prior to installation, only inspection to check for mechanical defects.

6.3.36.4.3 Site Acceptance Testing Requirements

The Contractor shall develop a Site Acceptance Test (SAT) plan that includes a complete set of test check sheets that clearly defines the logical sequence and structured testing of the instruments in accordance with the Project documentation. The SAT plan shall be site specific and will require QUU review and acceptance approval prior to commencement of the SAT. The Contractor shall complete the SAT in accordance with the accepted SA plan and to the satisfaction of the QUU Representative QUU.

Note that the **Site Acceptance Test Procedure- Checklist (CA17 a to h)** will be completed by the Contractor on the day of every Site Acceptance Test. The Contractor shall review this checklist prior to Site Acceptance Testing to ensure all testing can be completed on the day of Site Acceptance Testing.

The Contractor shall present a SAT report at the completion of the SAT to QUU for acceptance. The SAT Report shall contain all records of testing undertaken including completed inspection check sheets, records of instrument calibrations, test equipment calibration certificates. All tests, inspections and check sheets shall be signed and dated by the Contractor. The name and electrical license number of the testing officer shall be provided on each sheet. The test records shall indicate the QUU eEquipment tag name of the instrument, cable or other device.

6.3.3.16.4.3.1 Cables

The instrument cable ITP shall detail the exact test requirements for all instrumentation cables. As minimum requirements the following cable tests shall be completed:

- All cables and wiring shall be tested for continuity on each core.
- All cables and panel wiring insulation resistance.
- The test voltage shall be compatible with the cabling being tested.

Note: Instruments shall not be connected during cable testing.

The ITP shall also include the following:-

- Check all cable terminations are in accordance with termination diagrams. Termination diagrams shall be marked up, signed and issued to QUU as evidence of the tests.
- Check cable number label against cable schedule. Cable schedules shall be marked up, signed and issued to QUU as evidence of the checks.
- Check tightness of all terminations.

6.3.3.26.4.3.2 Earthing and Bonding

The Contractor shall test all instrument earthing interface to any existing earthing system. Tests shall ensure measured resistances are within acceptable levels.

Intrinsically safe systems shall also conform to AS/NZS 60079.11.

6.3.3.36.4.3.3 Hydraulic and Pneumatic and Impulse Lines

The Contractor is responsible for flushing and testing lines downstream of the process isolation valve.

For testing, lines shall where practicable be disconnected immediately downstream of the process isolation valve. The instruments shall be disconnected from the lines during testing. After first flushing with fresh water, the lines shall be hydrostatically tested for a minimum period of 15 minutes without a fall in pressure. The test pressure shall be 1.5 times the process design pressure (max. allowable working pressure). On satisfactory completion of the tests, the lines shall be purged, cleaned and dried out using oil free dry instrument air. The lines shall then be re-connected at the process isolation valve and at the instrument / panel. Pressure tests shall be recorded on an appropriate recorder and form part of the testing records.

Lines that are fitted with regulators must not be hydrostatic tested with the regulators installed. The regulator diaphragm will be damaged if subjected to the full hydrostatic pressure and therefore the regulator must be removed prior to the test.

6.3.3.46.4.3.4 Cold Loop Testing

After installation of the cable systems, the field instruments and the systems termination panels, cold loop checking shall be performed. The Contractor shall cold loop check all instrument loops from the termination panel to the field instrument to verify correct installation prior to any power being applied.

The Junction Box termination diagrams, panel termination diagrams and loop diagrams shall be "As Built" during the cold loop testing.

6.3.3.56.4.3.5 Powered Up Function Testing

The Contractor shall provide full Site Functional Testing for witness by QUU Representative QUUs. The below tests may have to be coordinated with the electrical equipment functional testing outlined in TMS1200 Electrical Installation Technical Specification.

- Testing of all instruments and field devices from the field through to the QUU Telemetry Systems Control Room;
- Failure modes and process plant recovery;
- Functionality testing of the alarms back to the Control Room
- Safety system testing
- Process control (automatic and manual operation).

Before applying power to the loop, all cable, calibration and cold loop checking must be complete and completed check sheets available at the site for QUU Representative QUU to inspect.

Function testing shall demonstrate the complete functionality of the instrument loop over the complete calibration range and including all indications and alarms and shall be in accordance with written test procedures appropriate for the loop.

Setup and configuration of instruments shall be in accordance with manufacturer's instructions and with site specific data obtained from QUU as required.

All installed position limit switches shall be adjusted for proper function.

6.3.3.66.4.3.6 Test Failure

Any instruments, cables or associated equipment that fail a test or have a defect shall be repaired or replaced by the Contractor. All inspections and tests which are affected by the rework shall be repeated by the Contractor

6.3.3.76.4.3.7 Commissioning

The Contractor shall be responsible for the final commissioning of the completed works.

The Contractor may be required to provide plant start-up assistance.

The Contractor shall provide all special tools, software and materials required for site testing and calibration of the instruments.

7 TRAINING AND DOCUMENTATION

The Contractor shall be responsible for providing all documentation in accordance with the Project Documentation requirements and the Supplier Data Requirements List (SDRL).

As a minimum the following documentation shall be maintained by the Contractor during the execution of the works:

- Quality Assurance records including ITP's and the associated check-sheets and test records for all instruments.
- Cable management records including cable drumming schedules to track the cable quantity utilised and cable quantity remaining for all on-site cable.
- Cable traceability records to ensure that all installed cables can be traced to a specific cable drum as supplied from the vendor.
- As-built mark-ups of all Project Documentation to reflect the completed installation.
- A record of all QUU Representative QUU accepted changes to the Project Documentation.
- A record of all QUU Representative QUU supplied directives or Site Instructions.
- A record of all Contractor submitted Technical Queries and the associated QUU Representative QUU responses.
- A record of all QUU Representative QUU accepted Contractor Design Deliverables.
- Survey records/coordinates that detail the exact route of all buried cable installations

Note: All above documentation shall be maintained at the site and available for QUU to inspect upon request.

Upon completion of the contract works the above listed documentation shall be officially submitted by the Contractor to QUU Representative as well as a complete set of the final signed-off as-built documentation.

7.1 TRAINING

The Contractor shall provide a comprehensive training course for all instrumentation included in the Contract scope of work unless specified otherwise in the Project Documentation.

The training includes two (2) off training sessions for maximum duration of 8 hours per day and up to 8 staff per session held on separate days, or as otherwise agreed with QUU. The training must be tailored to the intended audience and shall be conducted on-site or at an agreed location and tailored for (electricians, operators and engineers).

The training course shall include but not necessarily be limited to the following:

- Introduction and overview of the instrumentation including a site walk through;
- Description of the instrumentation including functions and features which shall be supplemented by the electrical installation operations and maintenance manual.
- Instrument operation and configuration and fault finding of related instrumentation
- Preventative and corrective maintenance procedures;
- Engineers and technicians shall be provided a comprehensive site walk-through and inspection, showing all the instrument locations, methods of process connections and practical demonstrations where applicable.
- Engineers and technical staff training require separate training to operators and supplemented by comprehensive training notes.

- Where new proprietary or non-standard instruments have been introduced to QUU, the Contractor shall host a separate vendor specific training course conducted by the Contractor or the instrument vendor. This course shall be onsite and hosted over two sessions over two days.

The Contractor shall provide comprehensive course notes to accompany the training session which will cover each of the topics.

The course notes shall be prepared and submitted to QUU for review no less than 10 working days before the commencement of the first training session.

Training sessions must be provided complete with session plans, outcomes summary and be competency based.

7.2 SITE DOCUMENTATION

7.2.1 Site Record Drawings

During the site works the Contractor shall maintain an updated set of site record drawings and make them available for inspection by QUU upon request. The drawings must not be removed from the site at any time without QUU consent.

On completion of the site works, the red-lined amended drawings are referred to as the “site red-line record drawings”, and shall be copied, stamped, signed by the Contractor’s site representative and dated as well as signed as approved by the nominated Electrical RPEQ and submitted to QUU.

7.3 AS BUILT DOCUMENTATION

The Contractor shall maintain a set of master drawings at the construction site. During the installation phase, the master copy shall be marked in red ink with any changes implemented during the construction.

It is the responsibility of the Contractor to:

- Updated the master set of drawings weekly; and
- Store and maintain up to date inspection check sheets and test result records and certificates generated during testing of the installation works.

Test result records, certificates and drawings with the red-line mark-ups shall be kept in a safe place and will form part of the hand over documentation to QUU.

When a site query has been closed out and the change agreed with QUU, the affected drawings and other documents shall be “Red Lined” to show the revised detail.

7.3.1 As Built Drawings

Unless specified otherwise in the Project Documentation the following CAD drawings shall be back drafted to As-Built status as part of the Contractor’s scope of work:

- Drawing Schedule
- Process and Instrumentation Diagrams
- Instrument location drawings
- Instrument loop diagrams
- Instrument installation drawings(process connection details)

- Termination Diagrams
- Instrument Cable Schedule
- Label Schedule
- Cable Block Diagrams;
- Underground services, conduit and ladder route drawings
- Fire and Gas Detector location drawings and Communication Architecture
- All package-plant related documentation inclusive of all “site-specific customisations” for all instrument related drawings

The Contractor shall mark “As-Built” corrections on construction drawings used for installation “As-Built” shall be clearly and legibly marked up on all drawings and all changes shall be marked up in RED ink, all deletions shall be marked up in cross-hatched BLUE ink.

All drawings shall be stamped, signed and dated by the Contractor. An RPEQ of appropriate discipline shall certify the as built mark-ups.

The latest revised “As Built” marked-up drawings shall be used during all site testing and commissioning checks.

An RPEQ shall certify the final as built CAD drawing revision, with RPEQ initials and number recorded on the CAD drawing.

7.3.2 As Built Documents

All documents as listed in Supplier Data Requirements (SDRL) shall be as As-Built.

An RPEQ shall certify all As Built documents.

7.4 FINAL COMMISSIONING, TESTING AND INSPECTION REPORTS

All finalised commissioning, acceptance testing and inspection and documentation shall be collated into final reports. The reports shall include all test results and shall be in PDF format with all inspection and testing sheets scanned in colour and table of contents provided for quick reference in each document.

The following documents shall be provided by the Contractor.

- Instrument Inspection and Test Reports
- Instrument loop check sheets;
- SAT Report(instrumentation)
- Commissioning Report(entire site)
- AS3000 Certificate of Compliance
- Instrument cable test records
- Functional Test Records for all instrumentation
- IP address information for all instrument devices
- Configuration settings for all instruments that have been configured using DIP switches, dials, communications links or equivalent.

All tests reports and handwritten field documentation shall be scanned at minimum 300 DPI resolution and in colour and delivered to QUU in both hard copy and as scanned electronic pdf files. Scans shall be incorporated into the O&M manual master pdf file.

7.5 SOFTWARE CONFIGURATION FILES

At completion of the commissioning phase the Contractor shall provide two off copies of the instrumentation software configuration files on either CD or DVD and upload the files to a QUU Sharefile link. This is inclusive of the Field bus instrumentation and device Management and Configuration Files and all devices GSD/DTM/EDD files

The control copy of all configuration and programming files must be loaded on the EWS, installed and ready for support purposes at STP's. The latest backup is also to be copied to the QUU Network Access Drive (NAS).

7.6 OPERATIONS AND MAINTENANCE MANUALS

The contractor shall provide Operations and Maintenance (O&M) Manuals for all instrumentation supplied under the Contract. The O&M Manuals shall be separated into logical installation groups, such as by plant production area for large projects.

The Contractor shall provide the O&M manuals in compliance with TMS73 Operations and Maintenance Manuals Technical Specification.

7.7 SOFTWARE LICENCES

The Programming software licences and hardware accessories required to fault find and reconfigure the instruments shall be provided by the Contractor unless specified otherwise in the Project Documentation

7.17.8 EQUIPMENT HAZARDOUS AREA CERTIFICATION

Refer to TMS1203 Hazardous Area Installation - General Requirements for Electrical Equipment Installation Technical Specification for all documentation related to Hazardous Area installations.

All instruments equipment installed in HA's a hazardous area shall be provided with an ANZEx or IEC Ex certificate of conformity. For new sites the Contractor shall provide the HAVD in accordance with TEM518 Hazardous Area Verification Dossier Template. For modifications to existing HA sites the Contractor shall update the existing site HAVD and this shall include removing redundant information from the existing HAVD and adding new information where required. All updates made to the HAVD shall comply with the MP183 HA Management Plan.

Note: Information included in the site HAVD shall not be duplicated in the O&M Manuals.

showing the equipment/fitting is suitable for the area where the equipment is installed in accordance with AS/NZS 3000 (Wiring Rules) and with reference to the Hazardous area dossier. ATEX or certification from other parties is not accepted, unless accompanied by a Conformity Assessment Document and approved by an RPEQ.

7.1.1 Drawings

Drawings and installation specifications will be supplied to the Contractor, as listed in the Project Documentation. All drawings issued will be marked "Issued for Construction" (IFC).

Drawings and Specifications not identified as such shall not be used unless authorised by QUU in writing.

Should any deviation from the contract drawings and/or specifications be deemed necessary by the Contractor then written details of such deviations, and the reasons for them, shall be submitted for QUU acceptance. No deviations from Contract documents shall be made without prior written acceptance from QUU.

The Manufacturer's equipment drawings, installation and operating instructions shall be used where applicable. Any conflict between the Manufacturer's/Vendor's drawings and QUU supplied drawings and/or Specifications shall be referred to QUU.

7.1.2 QA Package

All construction QA/QC documentation and test records shall be provided to QUU as a record of tests completed.

The Contractor shall issue the following documentation to QUU at the completion of the works:-

- Cable test sheets;
- Loop check sheets;
- Instrument Calibration sheets;
- Equipment installation, operation and maintenance manuals (for items supplied by Contractor);
- Equipment and materials technical information (for items supplied by Contractor);
- Full set of as-built construction drawings;
- Inspection and test records;
- FICs; and
- HA Checksheets

7.1.3 Electrical Equipment Hazardous Area Dossier

The Contractor shall issue the following minimum documentation to QUU at the completion of the works for inclusion in the hazardous area dossier for this site:

- Equipment hazardous area certificates
- Installation certificate of conformance for equipment in hazardous areas in accordance with AS/NZS 60079
- Completed individual HA Installation Checksheets
- Completed individual HA Inspection Checksheets
- Completion of the Electrical Equipment Hazardous Area Dossier in accordance with AS/NZS 60079

Refer to TMS1203 Hazardous Area Installation - General Requirements for Electrical Equipment Installation Technical Specification for all documentation related to Hazardous Area installations.

7.1.4 As Built Documentation

The contractor shall maintain a set of master drawings at the construction site. During and after installation, the master copy shall be marked in red ink with any changes implemented during the construction. The red line mark-up shall be updated as an ongoing process during the installation.

It is the responsibility of the Contractor to:

- Keep the drawings updated as an ongoing activity during the construction; and
- Keep the test result records and certificates generated during testing.

Test result records, certificates and drawings with the mark-ups shall be kept in a safe place on the site and will form part of the hand over documentation to QUU.

When a site query has been closed out and the changed agreed, the affected drawings shall be “Red Lined” to show the revised detail.

The following drawings shall be As-Built as part of the Contractor’s scope of work:

- Instrument Layouts;
- Equipment Room Layouts;
- Cable Block Diagrams;
- Junction Box Termination Details;
- Termination Details;
- Loop Diagrams (As-Built as part of the cold loop testing activities);
- Cable Schedules;
- F&G Layouts; and
- Hook-up Diagrams

The Contractor shall mark “As-Built” corrections on construction drawings used for installation “As-Built” shall be clearly and legibly marked up on all drawings and all changes shall be marked up in RED ink, all deletions shall be marked up in cross-hatched BLUE ink.

All drawings shall be stamped, signed and dated by the Contractor.

The latest revised “As Built” marked-up drawings shall be used during all pre-commissioning checks.

In the event that parts of the installation are not covered by drawings supplied by QUU, the Contractor shall provide drawings or sketches.

8 TYPICAL INSTRUMENT INSTALLATION DRAWINGS

8.1

Drawing Number	Title
486/5/7-0498-024	SP302 Progress Rd #2 Sewage Pump Station - Field Instrumentation Installation Details

8 PRACTICAL COMPLETION

Practical completion shall be in accordance with SEQ WS&S D&C Code's 'Asset Information Specification' and the QUU addendum (refer Appendix Q, Volume 3 – Appendices).

Practical completion shall be dependent on the following items:

- Completion and commissioning of the works;
- Dismantling and removal of any temporary equipment
- Restoration of the site following the successful completion of the works in accordance with this specification
- Provision of operator training;
- Supply of operation and maintenance manuals;
- Supply of As-constructed drawings
- Removal of all obsolete equipment

9 DEFECTS LIABILITY PERIOD

The defect liability period shall be for a period of twelve (12) months commencing from the date of Practical Completion during which time the Contractor shall provide unconditional warranty for the works. The Contractor shall attend to on-site rectification of all defects attributable to the Contractor on the works for the duration of the defects liability period.

Access Authorisation by QUU shall be required for the Contractor to gain access to any live equipment and systems.

Any subsequent defects remediation works shall be performed under the QUU change management process. Modifications must be completed under controlled and fully managed conditions. No remedial changes shall occur without approval from QUU. Approval for all non-critical changes shall only be given after the submission and approval of a test plan and further test documents.

Only under critical circumstances shall the Contractor be allowed to rectify a defect without a specific pre-approved plan from QUU. All the updated documentation covering the change shall be submitted to QUU within two (2) days after the change has been made. The instrument configuration files, parameter settings and any wiring changes shall be made available immediately after the change has been made.

While attendance to rectify any defects will normally be scheduled for the next business day, the Contractor shall have skilled staff available on 24/7 basis to attend site to rectify a defect should QUU deem the fault to be of a critical or emergency nature. Direct contact details shall be provided from the start of the defects liability period or from when the system is deemed to be operatable.