0072 WATER SUPPLY – PUMP STATIONS (DESIGN)

1. General

1.1. Responsibilities

1.1.1. General

Requirement: Provide design and documentation for the construction of an in-line pressure booster pump station(s) and ancillaries for a reticulated water supply (either drinking or dual drinking/non-drinking) conforming to the requirements of WSA 03 and the Water Agency, as documented.

1.1.2. Performance

The designer shall confirm performance requirements with Council before proceeding with the design and receive direction in writing from Council in relation to this.

1.2. Cross References

1.2.1. General

Requirement: This is not a self-contained design document, conform to the following worksection(s):

- 0010 Quality Requirements for Design
- 0071 Water Supply – Reticulation (Design).

1.3. Standards

1.3.1. General

Standard: To WSA 03 Part 1.

1.4. Interpretation

1.4.1. Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- CT: Current transformers.
- LV: Low Voltage.
- HV: High Voltage.
- PVC: Polyvinyl chloride.
- SCADA: Supervisory control and data acquisition system.
- SCR: Silicon controlled rectifiers.
- SPD: Surge Protection device.

- VSD: Variable speed drive.
- WHS: Work health and safety.
- XLPE: Cross-linked polyethylene (or vulcanized polyethylene).

1.4.2. Definitions

General: For the purposes of this worksection the definitions given in WSA 03 Part 0 and the following apply:

- Booster: In-line pressure booster pump station used to increase the hydraulic gradient.
- Commissioning: Running of the plant and equipment to make sure there is flow through the pumping system, carrying out any necessary testing and making adjustments until it is ready and suitable for normal starting and running under service conditions.
- Document: Record of information in writing or graphical form.

2. Pre-Design Planning

2.1. General

2.1.1. System planning

General: Conform to the pre-design planning requirements of 0071 Water Supply – Reticulation (Design).

3. Design Criteria

3.1. General

3.1.1. Requirements

General: Conform to the design requirements of 0071 Water Supply – Reticulation (Design).

Conflicting requirements: If there is conflict between this specification and the Water Agency requirements, seek clarification.

The Designer shall take into account site access, site maintenance and restoration, easement, power supply and working area when locating pump stations in road reserves or on private property. This action constitutes a witness point. The principal shall advise at the time of notification by the designer whether the option to confer on the location is required.

3.2. Power System and Supply

3.2.1. General

Requirement: Conform to the requirements of the power supplier.

The switchboard shall be connected to the local electrical supply system.

Primary supply: Provide for 3 phrase, 4 wire, 400V, 50 Hz, multi earthed neutral (MEN) system with capacity to operate at full pumping load.

Fault level protection: Determine the prospective fault current and design the electrical protection to withstand the prospective fault current level of the incoming supply at the equipment location.

3.2.2. Site Supply

Off-site electrical services: Liaise and provide for all off-site electrical services as required by the local electricity distributors.

3.2.3. Site specific substation

Electricity distributor dedicated substation: If required for the pumping station, determine the following:

- Location of substation.
- Type of service.
- LV Connection point and route of the distribution mains to the point of supply.
- Protection equipment, particularly any LV transformer output protection.
- Easement details.

LV transformer output protection: Provide for short circuit and overload protection at the transformer secondary supply using fault current limiting circuit breakers with adjustable overload and short circuit current setting features, where secondary output supplies are required to be installed by the electricity distributor.

Cascade Protection: Include full discrimination and cascade protection with the electricity distributor's incoming supply protection system and the downstream site protection devices.

3.2.4. Customer owned substation

HV customer service: If a HV supply is provided to the pumping station site, meet the requirements of the electricity distributor for the following:

- HV reticulation.
- HV protection.
- Transformer and LV protection: Set out LV facilities and LV transformer protection in electricity distributor dedicated substations.

3.2.5. Electrical Mains

On-site electrical mains: run on-site electrical mains underground between the electricity supply and the switchboard for the pumping station.
Point of supply for LV sites:

- Pole mounted at the site boundary, where from overhead supplies.
- A private underground termination enclosure at the site boundary, where from underground supply.
- Direct connected customer's mains; run underground from the electricity distributor's connection point to the main switchboard.

Customer's Mains: Provide for customer's mains, associated services and all necessary fault and overload current protection equipment to AS/NZS 3000 Section 3, the local electricity distributor's standards, the local Service and Installation rules.

Minimum size of customer mains: Conform to the following requirements:

- Current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30% minimum.
- A voltage drop less than 1.5% of the maximum demand calculated.
- Single core PVC/PVC cables or XLPE insulated cable.
- Pole termination method: Determine in consultation with the Local Supply Authority.

Protected customer's mains: Provide for short circuit and overload protection, where required by the electricity distributor.
Electricity distributor's service protective devices:

- Low voltage service protective devices: To AS/NZS 3000, the electricity distributor's requirements and the supply authority service and installation rules.
- For service protective devices >100 A: Provide for fault current limiting circuit breakers with adjustable overload and short circuit current facilities with full discrimination and cascade protection between the incoming supply protection systems and the downstream protection systems.

3.3. Electrical Design

3.3.1. General

Notwithstanding other clauses mentioned herein, the Designer shall be responsible for the design of the equipment as suitable for the purpose. Equipment design shall comply with the requirements of the relevant standard specification.

Automatic operation: Design the pump station for fully automatic operation in the unmanned condition.

3.3.2. Power and control cubicle

General: Document the power and control cubicles in conformance with AS/NZS 61439.1.

Inter-changeability: If more than one item of equipment is designed to perform a particular function, make sure that all such items of equipment are identical and completely interchangeable (e.g. pilot lights, pushbuttons, relays, etc.).

Ambient conditions: Determine the ambient conditions for the local area.

Switchboard construction form: Generally Form 2 to AS/NZS 61439.1. Segregate telemetry and communications equipment from the power and control sections of the switchboard.

Switchboard location:

- General: Locate switchboard in a visible location on a concrete plinth. Provide plinth details and physical protection.
- Flood prone areas: Locate switchboards above the flood level on suitable support structures. Detail switchboard support structures and location. Provide for suitable access facilities and working platform in front of the switchboard for safe operation of the equipment.

Phase failure protection: Provide for electronic phase failure relay to monitor the incoming power supply, incorporating:

- Detection of undervoltage (80% of normal voltage).
- Voltage or phase angle imbalance.
- Reverse phase sequence.
- 10 A fuse protection for connection to the three supply phases.

Surge protection: Provide for Type 1 shunt connected metal oxide varistor based SPDs between each phase and neutral at assembly incoming supply terminals, if required by the electricity distributor.

Surge protection devices: Conform to IEC 61643-11 and IEC 61643-12 and install to AS/NZS 3000 Appendix F.

Power factor correction: Consider power factor correction requirements, the energy cost in running the pumping station and cost savings to justify the installation of power factor correction equipment.

Connection facilities for mobile generators: Where generators are required, consider incorporation of safeguards to prevent inadvertent simultaneous connection of mains and generator power. Where necessary, provide for mechanical interlocks and an isolation device or changeover switch, to switch the mobile generator supply to the switchboard.

Anti-condensation heaters: Provide for thermostatically controlled anti-condensation heaters to weatherproof switchboards with an external surface area greater than 4 m^2 based on 40 watts/m^2 of exposed surface area, where environmental conditions may cause condensation to occur within the switchboard. Provide for heaters of the black heater type, mechanically protected and able to be touched without harm.

Provide lightning and surge protection: To all incoming power supply and control power supply.

3.4. Motor Starters

3.4.1. General

General: Provide for electronic VSD starters and motor control devices for the control of water booster pumps to AS/NZS IEC 60947.4.2.

Each boost pump shall include the following electrical control and protection equipment:

- Circuit breaker rated to protect the pump submain and the motor.
- Hybrid VSD motor controller/starter.

3.4.2. Circuit Breakers

General: Moulded case or miniature circuit breaker to AS/NZS 3111.

Selection: Provide for full discrimination and cascade protection for overload and short circuit conditions.

3.4.3. Hybrid VSD motor controller/starter

General: Provide for hybrid VSD motor controller/starter to AS/NZS IEC 60947.4.2 comprising:

- Main line contactor rated for the motor current.
- Electronic VSD starter and controller.
- Thermal overload protection.
- Thermistor protection of motor windings on motors nominally over 15 kw.

Main line contactor: To AS/NZS IEC 60947.4.1 and the following features:

- Block style electromagnetic, air break type generally from the one manufacturer.
- Rated duty: Intermittent class 12.
- Utilisation category: AC-3 or DC-3, as applicable.
- Mechanical durability: 10.
- Contact life: 1 million operations at AC-3 or DC-3, as applicable.
- Three phase contactors: Minimum rating of 16 A, 415 V at category AC-3, rated for the actual motor current at category AC-3.
- Design: To allow for fitting of auxiliary contacts with rating (Ie) of 4 A at 240 V AC.

Electronic VSD starter and controller: Generally to AS/NZS IEC 60947.4.2, AS 61800.2, AS 61800.3 and the following:

- Functional features: To AS 61800.2 Section 3.
- Automatic restart in the event of failure.
- Breakaway torque adjustment.
- Motor starting current limit adjustment.
- Adjustable acceleration time.
- Adjustable deceleration time.
- Phase loss trip.
- Shorted SCR trip.
- Open circuit output trip.
- Motor stalled trip.

Thermal overload protection: To AS/NZS IEC 60947.4.1 and the following additional features:

- Single phase fault protection utilizing differential trip bar mechanisms operating at 60% of motor full load rating under single phasing conditions particularly for delta wound motors.
- Incorporated in motor protection design where thermistor protection is required.
- Manual reset on overload trip unless design conditions dictate automatic reset.

Motors rated 45 kW and above: Provide for electronic motor protection relays in lieu of thermal overload protection relays.

CT protection: Provide for protection CTs and connection of electronic motor protection relays to the secondary side of the CTs where motor currents do not allow for direct connection of the relays into the motor circuit.

3.5. Control and Telemetry System

3.5.1. General

The designer shall provide for telemetry requirements in accordance with the schedule supplied by Council.

SCADA: Provide for connection to SCADA for monitoring and control including water pump station, reservoirs and tanks, control valves, flow meters and chambers. The system must be compatible with those already in use. Confirm requirements with Council before commencing this component of the design.

3.5.2. Instrumentation

Confirm the specific parameters to be monitored with Council prior to commencing the design.

3.5.3. Fire flow operation

Confirm requirements for fire flow operation with Council before commencing the design.

3.5.4. Alarms

The design shall provide for alarms and signal systems with the concurrence of Council.

3.6. Pump Station Structure

3.6.1. General

Requirement: Secure pump units in a purpose-designed building subject to the Development Approval (DA). Considerations include aesthetics, climate, acoustics, WHS, clearance for maintenance, trip hazards, confined spaces and ventilation. Structures must conform to National Construction Code requirements as well as any relevant Australian Standards.

Location: Consider site access, site maintenance and restoration, easement, power supply and working area when locating pump stations in road reserves or on private property.

Dimensions: Provide structure of dimensions to suit the selected equipment including support, handling and access.

Protection against flooding: Locate the floor of the pump station or top of pump well, as appropriate, 1 m above the 1 in 100 year flood level.

3.6.2. Structure

Structural design: Conform to the NATSPEC 03 Structure worksections relevant to the structure being designed.

Alternatively, nominate Council's requirements for building design.

Substructure: If below ground level, mount pumps on plinths and house in a single pump well. Provide for drainage to prevent flooding of the well.

Protection against flotation: Design pump wells against flotation, both during the construction/installation and operation under flood conditions designed as above. Provide a factor of safety of 1.25.

3.6.3. Ladders

Ladders: Conform to AS 1657.

Ladder landings: Set intermediate landings in wells to achieve the minimum head room clearance. Wherever possible, locate the landing adjacent to fittings and machinery requiring maintenance.

Ladder cages: Do not use on ladders in pump station wells.

3.6.4. Covers

General: Design for the possibility of site flooding ingress and overflow, and WHS requirements in providing for access and inspection covers.

3.6.5. Electrical requirements for pump station buildings

General: If the pumping equipment is installed within a pump station building, provide for the following:

- Lighting within the building utilising sealed corrosion resistant lighting fittings.
- 10 A, 240 V switched power outlets. Quantity and location to suit pumping station requirements.
- 15 A, 240 V switched power outlet suitable for electric welding requirements.
- Residual current device protection to AS/NZS 3000 requirements.
- Lighting switches and power outlets: Ironclad or high impact polycarbonate industrial type.

Conduits:

- Electrical accessories: Heavy duty PVC-U conduit.
- Pumping equipment: Heavy duty conduit on tray or on cable ladder.

3.7. Products, Materials and Appurtenances

3.7.1. General

Requirement: Conform to the requirements of 0071 Water Supply - Reticulation (Design).

4. Documentation

4.1. General

4.1.1. Documentation Requirements

Requirement: Conform to the documentation requirements of 0071 Water Supply - Reticulation (Design). Commissioning plan: Document and review the commissioning plan and pre-commissioning checklist for the pump station.

4.2. Drawings

4.2.1. General

Requirement: Provide drawings and/or computer output defining the works and assumed operating and maintenance procedures to the requirements of WSA 03 Section 9.2.

4.2.2. Drawing content

Requirement: Provide drawings to the requirements of WSA 03 Section 9.2 and 0010 Quality Requirements for Design.

4.2.3. Work as Executed drawings

Requirement: Provide an additional set of final construction drawings for the purpose of recording the Work as Executed by the Contractor.

Required Format: AutoCAD .dwg and pdf.

4.3. Specifications

4.3.1. Construction Documentation

Requirement: Prepare technical specifications using the AUS-SPEC Construction worksection templates from the National Classification System including workgroups 02, 03, 11 and 13.

5. Annexure

5.1. Annexure – Referenced documents

The following documents are incorporated into this worksection by reference:

AS 1657	2018	Fixed platforms, walkways, stairways and ladders - Design, construction and installation
AS/NZS 3000	2018	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3111	2009	Approval and test specification - Miniature overcurrent circuit-breakers
AS/NZS IEC 60947		Low-voltage switchgear and control gear
AS/NZS IEC 60947.4.1	2015	Contactors and motor-starters - Electromechanical contactors and motor-starters
AS/NZS IEC 60947.4.2	2015	Contactors and motor-starters - AC semiconductor motor controllers and starters
AS/NZS 61439		Low-voltage switchgear and control gear assemblies
AS/NZS 61439.1	2016	General rules (IEC 61439-1, Ed. 2.0 (2011), MOD)
AS 61800		Adjustable speed electrical power drive systems
AS 61800.2	2004	General requirements - Rating specifications for low voltage adjustable frequency a.c. power drive systems
AS 61800.3	2005	EMC requirements and specific test methods
WSA 03	2011	Water Supply Code of Australia
IEC 61643		Low voltage surge protective devices
IEC 61643-11	2011	Surge protective devices connected to low-voltage power systems – Requirements and test methods
IEC 61643-12	2008	Surge protective devices connected to low-voltage power distribution systems – Selection and application principles