pitt&sherry

Standard Small Sewer Pump Station (SPS) Switchboard Design

Safety in Design Report

Prepared for

TasWater

Date

28 June 2022

Rev02

Table of Contents

List of figures

List of tables

Appendices

Revision History

Rev No.	Description	Prepared by	Reviewed by	Authorised by	Date
00	SiD Report	SE	PJ	PJ	13/04/2022
01	Appendix A updated	SE	PJ	PJ	14/04/2022
02	Report and appendix updated for publication	SE	PJ	PJ	28/06/2022

1. Background

1.1 Purpose of the Safety in Design Report

The purpose of this Safety in Design (SiD) Report is to specify the hazards identified during the formal Safety in Design (SiD) meeting for a new standard switchboard (SWB) design. This meeting focused on the design of the switchboard only. This report also covers hazards associated with all phases as they relate specifically to the generic design and this includes construction, installation, on-going operation, and maintenance of the SWB and considerations for the demolition of the electrical main switchboard at the end of its life cycle. The risk to the health and safety of persons who are to carry out installation and construction work at specific sites is outside the scope of this report and these risks need to be addressed on a site by site basis.

1.2 Who Should Receive the Safety in Design Report?

The Designer has a statutory duty to provide a report on the potential hazards relating to the installation and construction work to the client who is required under the regulation to pass the report on to the Principal Contractor. This information detailing how the electrical switchboard and installation has been designed to be without risk to health and safety, should also be given to each person who is provided with the design for the purpose of giving effect to it. The Designer must also, on request, supply this information to anyone who constructs, uses, maintains, or demolishes the electrical switchboard and installation within the scope of design.

1.3 Legislation

The Work Health and Safety Act 2011, applicable in all States and territories except Victoria and Western Australia, requires that a Person Conducting a Business or Undertaking (PCBU) that designs a structure and the person who commissions that structure that will be used as a workplace must ensure that the structure is without risks to health and safety so far as is reasonably practicable. The Designer also has a duty under the Act to provide information to each person who is issued with the design documents, indicating the purpose of the structure, the results of any analyses, testing or calculations, and any conditions necessary to ensure that the structure is without risks to health and safety.

The Act defines “structures” to mean anything that is constructed, whether fixed or moveable, temporary or permanent and includes:

- Buildings, masts, towers, framework, pipelines, transport infrastructure and underground works (shaft or tunnels)
- Any component of a structure, and
- Part of a structure.

The Work Health and Safety Regulations 2011 require the Designer to provide a written safety report to the client. The Client then has a responsibility to provide this safe design report to the Principal Contractor. All parties have a duty to consult with each other to ensure communication of this information.

The Safe Work Australia Code of Practice for Safe Design of Building and Structures defines a Designer as a Person Conducting a Business or Undertaking whose profession involves them in:

> *Preparing sketches, plans or drawings for a structure, including variations to a plan or changes to a structure and making decisions for incorporation into a design that may affect the health or safety of persons who construct use or carry out other activities in relation to that structure.*
>
> Designers can include:
> *Architects, building designers, landscape designers, interior designers, builders, town planners, engineers that design part of the structure (e.g. mechanical, structural, civil, electric, hydraulic), services and plant designers and persons specifying how alteration or demolition work is carried out. If a builder or other person changes a design, they then take on the role of Designer.*

Equivalent legislative provisions are in place in Victoria under the Occupational Health and Safety Act 2004 and its subordinate legislation.

1.4 Consultation

Designers are required to consult with other duty holders. This includes, but is not limited to, the Client, Principal Contractor, and construction workers (if known), other Designers such as Engineers, Landscape, Interior and Plant Designers, employers, and workers (or their WHS representative) who will use the proposed installation that is being designed, and any other duty holders specified in the Act. The above persons also have a duty to consult with the Designer and to provide the Designer with any information that could improve the safety of the structure being designed.

2. Systematic Risk Management Process

The following process has been used to identify and manage hazards and risks associated with this design and has been adapted from the Code of Practice: Safe Design of Structures.

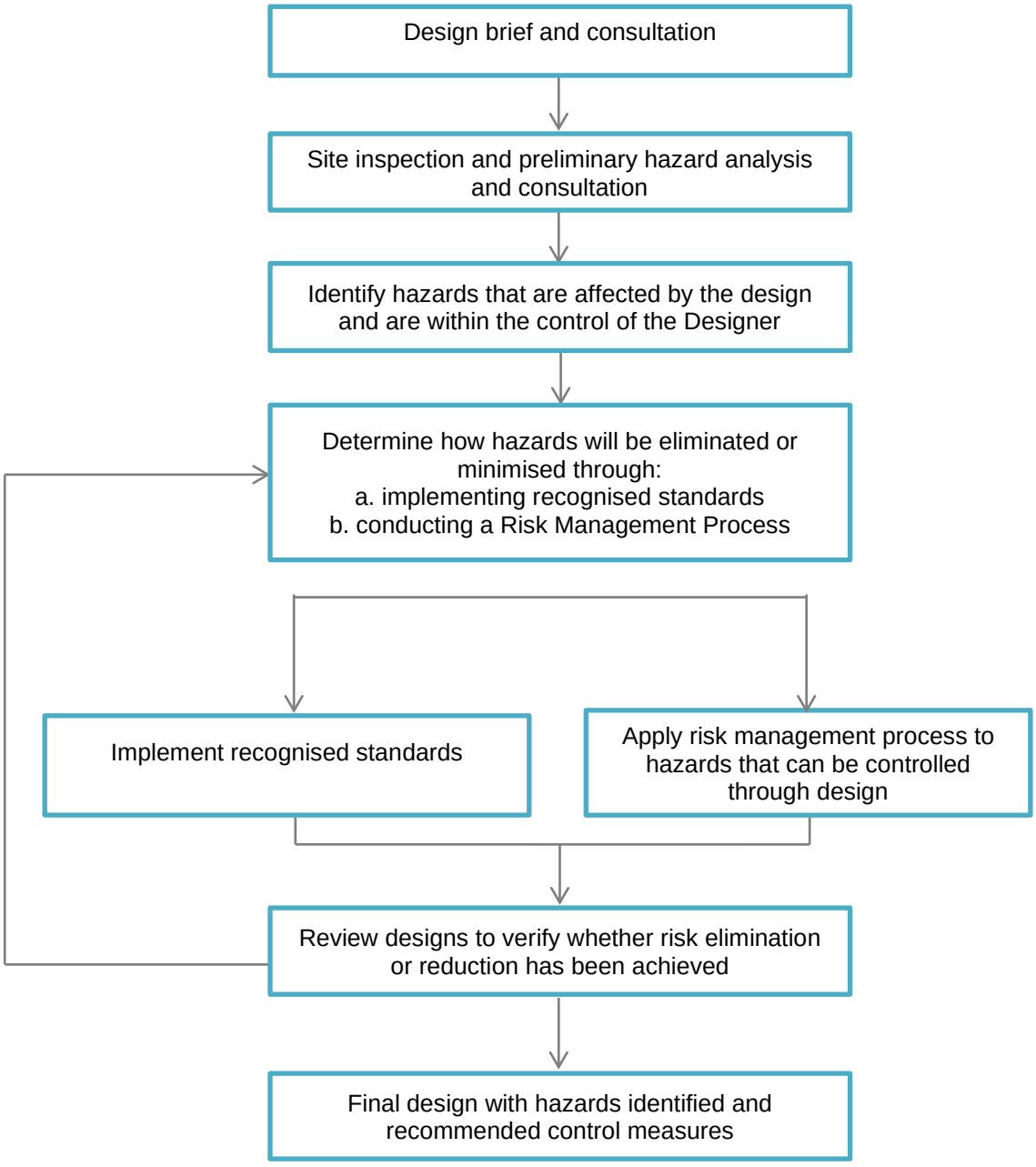

Figure 1: Systematic approach to integrating design and risk management.

3. Project Specific Safety in Design Information

3.1 Background

TasWater previously identified a need to review the current standard two pump Sewage Pump Station (SPS) Switchboard (SWB) design from an asset performance perspective. pitt&sherry was engaged to obtain input from relevant stakeholders and undertake the required review and produce the new design. The initial design concepts have had several rounds of stakeholder feedback beginning with an initial concept meeting on 22/6/21 and following up with three rounds of Stakeholder Review meetings from 14/9/21 through to 23/2/22.

3.2 Design Description & Functional Requirements

TasWater has developed a series of design standards and documentation to ensure consistency of their Sewerage Pump Station (SPS) Switchboard designs. These design standards include Switchboard requirements, Civil Works Drawings, Motor Circuits, Process Functional Descriptions and Site Specific Scoping Sheets.

The design of the new SWB has been completed using these standards, particularly the:

- TasWater Standard Motor and Control Circuits
- Small Water Treatment Plant Electrical Asset Design Standard; and
- TasWater Electrical & SCADA Technical Standards.

The Process Functional Description and Site Specific Scoping Sheets developed by TasWater will detail the pump sizes, instrumentation, RTU control and monitoring equipment associated with specific sites. The documents also describe the operation and function of the Sewerage Pump Station and these documents should be read in conjunction with this report, if the reader is un-familiar with the operation of the Sewerage Pump Station.

The new switchboard is intended as a ‘modern’ and ‘standardised’ replacement of the existing switchboard, with an expected 30-year design life. The aim of the new switchboard is to maintain and improve the existing functionality, safety and reliability of the electrical installation.

The TasWater Electrical & SCADA Technical Standards and the specific design requirements for small SPS installations include compliance with applicable Australian Standards including AS/NZS 3000:2018 “Wiring Rules” (and all referenced standards including the AS/NZS 61439 series of standards for “Low-voltage switchgear and controlgear assemblies”). Compliance with these standards addresses most common risks associated with electrical installations, including the risks of electric shock and exposure to arc-flash.

3.3 Methodology

The following methodology was used in the development of the SPS switchboard replacement electrical design:

- Design Development - draft plans were developed following the initial stakeholder meetings to combine the feedback and proposed new switchboard design
- Design Review – three (3) rounds of review were performed on the draft plans. The initial design concepts have had several rounds of stakeholder feedback beginning with an initial concept meeting on 22/6/21 and following up with three rounds of Stakeholder Review meetings from 14/9/21 through to 23/2/22. The draft plans were updated after each round to incorporate the TasWater client review feedback

- Detailed Design - the detailed design was developed during the feedback processes. This included updating the drawings to suit the pump size ranges, provision of M2M or radio telemetry and documenting of standard optional features such as level indication and flow switches to provide pump protection. The schematic drawings were issued in draft format for review by TasWater engineering personnel to confirm that the drawings met with the project requirements. Reviewed items and return comments were then incorporated as client review feedback
- Delivery – upon completion of the design development and detailed design, the final schematic drawings were issued to TasWater (Rev G: Issued for Project Specific Design); and
- These designs formed the basis of this SiD review meeting.

3.4 Preliminary Hazard Identification

During the design review process a spreadsheet register titled "*J21247 – Consolidated Small SPS Design Review Issues"* was maintained to record consideration from the review including the Site Considerations, Construction, Design and Maintenance hazards. Issues raised and discussed during the feedback rounds leading to the final design were recorded in "*J21247 - SPS SWB Review Action & Decision Register*". Most issues were resolved during the design review rounds however the registers formed background material for all personnel attending the SiD meeting.

3.5 Safety in Design Workshop

A SiD Workshop was held for the design on 5 April 2022. The workshop was facilitated by pitt&sherry and attended by stakeholder representatives from TasWater.

The "CHAIR" – Construction Hazard Assessment and Implication Review process was used during the SiD Workshop. The CHAIR process has been developed by industry to bring together all the key stakeholders involved in the design to help identify and eliminate (or minimize) inherent risks in a structured and systematic way.

It provides a rigorous framework for a facilitated discussion that is stimulated by guidewords or prompts. These prompts were used to assist to collectively identify and reduce construction, maintenance repair and demolition safety risks associated with the design.

For this workshop, a CHAIR 1 (review of concept design) was performed for the project. The CHAIR 1 process uses the same methodology as a HAZOP where a set of section guidewords (section 3.5.1) and overview guidewords (section 3.5.2) are applied to each identified section.

Typically, HAZOP risk assessments are separated from CHAIR process assessments but do not have to be. This meeting was not inclusive of a typical HAZOP – due to the generic design nature (no or minimal site interactions) and the limited changes being made to the operational strategy in this design change. However, in this instance any risks or issues identified relating to the HAZOP or operation and maintenance section of the design life cycle of the switchboard replacement were also considered during the identification of risks.

3.5.1 CHAIR 1 Section Guidewords

- Size
- Heights/Depths
- Position/Location
- Poor Ergonomics
- Movement/Direction
- Load/Force
- Energy
- Timing
- Egress/Access; and
- Maintenance/Repair.

3.5.2 CHAIR 1 Overview Guidewords

- Environmental Conditions
- External Safety Interfaces
- Toxicity
- Fire/Explosion
- Environmental Impact
- Utilities & Services
- Commission/Startup/Shutdown
- Safety Equipment
- Natural Hazards
- Inspection/Testing
- Demolition
- Documentation
- Quality Control; and
- Construction Equipment

Each of these overview guidewords is represented in the meeting using an additional series of prompts (not presented in detail here).

In accordance with the TasWater Safety in Design Guideline (0001-GUI-DE-0006-1), the identified hazards were then recorded using the TasWater SiD Hazard Register (0001-FRM-DE-0015-1) following discussion, using the prompts.

A copy of the SiD Hazard Register resulting is attached as Appendix A.

It is important that site safety risks are reviewed by construction contractors and the operators / maintenance personnel to ensure that they are aware of the risks involved with their works during subsequent project phases.

3.6 Extent of Designers' Works

The Designers' scope was to document the new SWB electrical schematics and general arrangement for application at small sewage pump stations. Whilst, the assessment covers the construction, maintenance and use of the new main switchboard design, location of the new main switchboard on a particular site and the general site electrical installation, are dealt with in other site-specific workshops including risks that exist when personnel are operating and maintaining that site.

It is important that site safety risks are reviewed by operators and maintenance personnel and that control measures are implemented prior to work at the site. Safe work practices are to be utilised in accordance with TasWater policies and procedures and legislative requirements.

With regard to considerations for the demolition of the electrical main switchboard at the end of its life cycle, the proposed switchboard is a single sheet metal work assembly fixed via mounting bolts to a concrete slab. The assembly will contain electrical components and materials compliant with applicable Australian Standards. At end of life, the entire assembly can be decommissioned and removed as a unit for appropriate disposal.

3.7 Risk Assessment

The risk assessment process involves initial hazard identification, and assessment of the associated risks.

The TasWater Safety in Design Guideline provides the following risk assessment matrix, and this has been used to assess risks associated with the identified hazards. The risks are assessed before any controls are applied (initial risk rating) and then reassessed using any applicable recognised standard first and any additional design control measures (risk rating after intended controls).

3.7.1 Determining Level of Risk

Table 1: Risk assessment matrix

		Measure of Probability (Likelihood)				
		Almost Certain	Likely	Moderate	Unlikely	Rare
Measure of Consequence / Severity	Kill / Disable	Catastrophic	Catastrophic	High	High	Medium
	Serious Injury	Catastrophic	High	High	Medium	Low
	Injury	High	High	Medium	Low	Low
	First Aid	High	Medium	Low	Low	Low
	Nothing	Medium	Low	Low	Low	Low

3.7.2 Level of Risk & Action Required

Catastrophic

Risk control measures must be implemented as soon as practicable to reduce this unacceptable risk to health and safety/achievement of project deliverables.

High

Implement cost effective risk control measures and formalise procedures or management responsibility for reducing risk.

Medium

Incorporate cost effective risk control measures within the scope of long-term planning.

Low

Manage by routine procedures.

Table 2: Probability of hazard occurring

Probability of Hazard	
Category of Probability	**Qualitative Description**
Almost Certain	The event is expected to occur in most circumstances.
Likely	The event will probably occur in most circumstances.
Moderate	The event should occur at some time.
Unlikely	The event could occur at some time.
Rare	The event may occur only in exceptional circumstances.

Table 3: Consequences of hazard occurring

Consequence of Hazard	
Category	**Qualitative Description**
Nothing	No injuries, low financial loss. No human injuries or health effects.
First Aid	First aid treatment, medium financial loss. Incidental injury or health effects requiring only first aid treatment or an employee returning to work after a consultation with a doctor. Normally a reversible injury or damage to health.
Injury	Medical treatment required, high financial loss. Injury or damage to health that may require ongoing medical treatment.
Serious Injury	Extensive injuries, loss of production capability, major financial loss. Normally a Lost Time Injury or damage to health, which may require prolonged medical treatment and rehabilitation. This injury may have resulted in a permanent disability.
Kill / Disable	Death, huge financial loss. Injuries or health effects resulting in death or severe permanent disability to one or more persons.

3.8 The Hierarchy of Risk Control

Once assessed, suitable control measures have been identified. Those controls related to the design have been implemented in the design. Controls outside the scope of the design required to further control identified risks are also identified.

The methods for controlling risks are ranked from the highest level of protection and reliability to the lowest. This ranking is known as the *hierarchy of risk control.*

Work Health and Safety Regulations require duty holders to work through the hierarchy below to choose the control that most effectively eliminates or minimizes the risk in the circumstances.

- Elimination
- Substitution
- Isolation
- Engineering
- Administrative; and
- Personal Protective Equipment (Safe Work Australia, 2012).

For further information on the hierarchy of risk control please refer to Manage Work Health and Safety Risks Code of Practice 2011, Safe Work Australia.

Refer to the Risk Register (Appendix A) for the full assessment and a complete list of the generic hazards evaluated during construction, maintenance and use of the design.

TasWater Small SPS SWB Design - Safety in Design Hazard Register

Appendix A

TasWater Small SPS SWB Design - SAFETY IN DESIGN HAZARD REGISTER

Site: TasWater and design engineers to refer to Site Specific Scoping Sheets for site implementation requirements.

Scope: TasWater Small Sewer Pump Station (SPS) Switchboard Design

Prepared by: CS **Date:** 5/04/2022

Revision: 2 **Status:** SiD Workshop

Reference: Consolidated Small SPS Design Review Issues Register - Rev.B

Risk Ranking Matrix

Consequence / Severity	Probability: Almost Certain	Likely	Moderate	Unlikely	Rare
Kill / Disable	C	C	H	H	M
Serious Injury	C	H	H	M	L
Injury	H	H	M	L	L
First Aid	H	M	L	L	L
Nothing	M	L	L	L	L

Unique number	SiD process stage	Project Phase	Activity/Guide word	Hazard (describe the hazard)	Consequence (describe the consequence of the hazard)	Initial Risk Rating P	C	Risk	Control Measures [Current and recommended additional controls (highlight)]	Risk rating after Intended Controls P	C	Risk	Action on (person, role or team)	Action due (date or project phase i.e. design, construction, operation)	Risk owner	Action status (open or closed)
1	SiD Workshop 1	Design	Switchboard operation and maintenance	Electrical shock, arc flash	Electric shock	Rare	Serious Injury	Low	Switchboard to be custom modular construction, complying with AS/NZS 61439, in accordance with TasWater switchboard manufacture and electrical installation standards.	Rare	Serious Injury	Low	Designer	Design, Construction		
2	SiD Workshop 1	Design	Switchboard controls & pump module arrangement.	Ergonomic	Injury, sprains and strains	Unlikely	Injury	Low	Switchboard designed with pump modules and frequently accessed controls arranged at the top, as per TasWater operator feedback. Isolator heights positioned in accordance with accepted codes of practice.	Rare	Injury	Low	Designer	Design, Construction		
3	SiD Workshop 1	Construction	Equipment delivery and installation.	Hiab (or crane) use for loading and transport of switchboard.	Fall risk, struck by, equipment damage	Moderate	Injury	Medium	Suitable lifting provisions included in plinth, in place of non-load rated 'lifting ears' used in previous design.	Unlikely	Injury	Low	Construction	Construction		
4	SiD Workshop 1	Construction	Equipment delivery and installation.	Weight of switchboard, overloading risk	Fall risk, struck by, equipment damage	Moderate	Injury	Medium	Switchboard weight estimation required prior to Hiab (or crane) use. Authorised and trained Contractors and Operators. Safe rigging procedures and practices.	Unlikely	Injury	Low	Construction	Construction		
5	SiD Workshop 1	Construction	Equipment delivery and installation	Public access & vehicle movements	Strike by	Moderate	Injury	Medium	Access to be restricted to allow for construction. Use temporary barriers, as required. Use a spotter when vehicles are reversing on site.	Unlikely	Injury	Low	Construction	Construction		
5	SiD Workshop 1	Construction	Removal of existing MSB and installation of new MSB.	Manual handling	Injury, sprains and strains	Moderate	Injury	Medium	Use of appropriate mechanical aid e.g. mobile crane, rollers, etc. to avoid manual handling. SWB removal and installation method to be reviewed prior to undertaking the task.	Unlikely	Injury	Low	Construction	Construction		
6	SiD Workshop 1	Operation	Pump inspection and maintenance.	Rotary shaft, remote start/stop	Entrapment, injury	Unlikely	Serious Injury	Medium	Submersible pumps. Shafts/moving parts are fully sealed. Use of TasWater Lock-out, Tag-out procedures. E-stop provided for maintenance and testing of pumps. Use of SWMS and JSEA prior to undertaking of maintenance tasks.	Rare	Serious Injury	Low	Construction	Construction, Operation		
7	SiD Workshop 1	Design	Switchboard location	Ergonomic, clearance between switchboard and pump well.	Restricted movement	Moderate	Injury	Medium	Ensure SWB clearances are in accordance with AS/NZS 3000 (Wiring Rules), min. 600 with doors open. Designer to confirm SWB Location and orientation during design development. Refer to TasWater Small SPS Site Plan Layout Considerations (dwg. TWS-E-038 Sheets 2 to 5)	Unlikely	First Aid	Low	Designer	Design, Construction		
8	SiD Workshop 1	Operation	Power outage, power reliability and generator access	Generator size and availability	Loss and continuation of supply	Unlikely	Nothing	Low	Designer to confirm generator size (44kVA or 110kVA) based on pump sizes. TasWater to consider/ensure suitable generator is available in the local area.	Unlikely	Nothing	Low	Designer	Design, Construction		
9	SiD Workshop 1	Construction	Pump operation, sequencing of installation.	Extended pump-outage	Loss and continuation of supply	Unlikely	Nothing	Low	TasWater to have cut-over plan to inform stakeholders of construction sequence, commissioning, start-up.	Unlikely	Nothing	Low	Construction	Construction		
10	SiD Workshop 1	Operation	Preventative maintenance	Equipment deterioration and failure	Loss and continuation of supply	Unlikely	Nothing	Low	TasWater to ensure Preventative Maintenance tasks (PM's) are developed and updated in Maximo.	Unlikely	Nothing	Low	Construction	Construction, Operation		
11	SiD Workshop 1	Operation	Operating manuals	Operators not being trained adequately	Injury, equipment damage	Likely	First Aid	Low	Operating & Maintenance manuals to be used for operator training by contractors. O&M manuals to be integrated into TasWater documented operational procedures for site.	Unlikely	First Aid	Low	Construction	Construction, Operation		
12	SiD Workshop 1	Construction	Excavation works for civil works and consumer mains cabling	Existing buried electrical services, Open trenches, excavation	Electric shock, damage, fall injury	Moderate	First Aid	Low	Refer to site plans for known cabling locations. Provide temporary barricading during works to prevent falls to trenches and excavations. Contractor to refer to DBYD and comply with all TasWater Excavation Procedure requirements.	Unlikely	First Aid	Low	Construction	Construction		
13	SiD Workshop 1	Construction	Wet-well	Confined space	Entrapment, restricted movement	Moderate	Serious Injury	High	Access to Wet-well not permitted and not required for switchboard renewal construction tasks. All equipment is to be installed from above.	Unlikely	Injury	Low	Construction	Construction, Operation		
14	SiD Workshop 1	Design	Contaminated zone, separated from switchboard	Sewer gas, corrosion	Equipment damage	Likely	Nothing	Low	Contaminated zone is separated from switchboard. Design note added to drawings to ensure 'non-penetrating' bolting of SWB sections to maintain vapour barrier integrity.	Unlikely	Nothing	Low	Designer	Design, Construction		
15	SiD Workshop 1	Design	Door switch failure mode	Equipment failure	Loss of SCADA Monitoring (Alarm) functions.	Unlikely	Nothing	Low	Door switch fault & SCADA Alarm enable scenario raised and discussed. Decision reached to not inhibit the high float sustained alarm, to provide warning indication.	Rare	Nothing	Low	Designer	Design, Construction		

Standard Small Sewer Pump Station (SPS) Switchboard Design - Safety in Design Report

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