

STD-SPE-E-008

Technical Specification

NETWORK METALLIC PIPELINE ELECTRICAL HAZARD DESIGN REQUIREMENTS

December 2025

Document management

Document authorisation table

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1	23/03/2022	M. Tarlinton	D. Eager	D. Eager
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Issue	Date	Reason for issue
1	23/03/2022	Issued for use
2	8/12/2025	Updated to include changed regarding ACT Professional Engineers' Registration Scheme and update to new specification template.

Document applicability table

Asset area	Applicable (Yes/No)	Asset area	Applicable (Yes/No)
Dams (DAM)	Yes	Water Network (WAT)	Yes
Bulk Water Supply (BWS)	Yes	Sewerage Network (SEW)	Yes
Water Treatment Plants (WTP)	No	Sewage Pump Stations (SPS)	Yes
Water Pump Stations (WPS)	Yes	Sewage Treatment Plants (STP)	No
Reservoirs (RES)	Yes	Recycled Water Systems (REC)	No

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Abbreviations

Acronym	Full form
AC	Alternating Current
ACT	Australian Capital Territory
AS	Australian Standards
AS/NZS	Australian and New Zealand Standards
EG	Earthing Guide
EHMP	Electrical Hazard Management Plan
ENA	Energy Network Australia
EPR	Earth Potential Rise
HV	High Voltage (>1kV AC)
IEEE	Institute of Electrical and Electronic Engineers
LFI	Low Frequency Induction
PPE	Personal Protective Equipment

Definitions

Keyword	Definition
Argon	Safety Assessment Software from Energy Networks Australia
Acceptance	Written acceptance by the Owner that the entire work and all Contract requirements have been completed in accordance with the Contract Documents, as evidenced by the Owner's recordation of a Notice of Completion.
Approval	Does not imply acceptance of responsibility by Icon Water for compliance with this technical specification. Unless approval has been issued in writing, approval has not been granted.
CITECT	SCADA Package from Ci-Technologies
Contract	The Contract Documents which form the Contract for Construction.
Contract Documents	Complete documentation for a Contract, part of which comprises this standard specification.
Contract Drawings	Drawings that form part of the Contract Documents.
Contractor	The person or organisation responsible for construction of the works including testing, commissioning and handover.
Designer	The individual person or organisation responsible for design of the works. The Designer may be Icon Water personnel or an external engineering consultant, a vendor/supplier or an installation Contractor.
Drawings	The drawings, plans, elevations, sections, details, schedules, maps, profiles, diagrams, and other graphic and pictorial representations which indicate the design, character, location, nature, extent, and scope of the Work and which have been prepared by the Designer, approved by the Contractor and Owner and are included and/or referred to in the Contract Documents. Shop Drawings are not Drawings or Contract Documents, as so defined.
Icon Water	The owner and operator of the constructed works.
Icon Water Representative	The nominated person or organisation that has written authority to act on Icon Water's behalf. This may be an Icon Water employee (or employees) such as an Icon Water Inspector or Icon Water Site Surveillance Officer, or a third party engaged to act on Icon Water's behalf.
Icon Water Standard Drawings	Standard Drawings of Icon Water or adopted by Icon Water including but not limited to those produced by the Water Services Association of Australia.
Include	Means including but not limited to and is used to provide clarification or examples of the type and nature of items intended.
Owner	The Owner is defined as Icon Water.
Project	The total construction project of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.

Keyword	Definition
Registered Engineer (Professional Engineer)	According to the Professional Engineers Act 2023, a Professional Engineer is an individual registered under the Act to carry out professional engineering services in one or more areas of engineering including civil, electrical, fire safety, mechanical, and structural. Registered engineers in the ACT are registered with the Professional Engineers Registrar, which is part of the ACT government. This Registrar manages the registration process, including assessing applications, maintaining the register of professional engineers, and ensuring compliance with the Act.
Shall / Must	Indicates that a statement is mandatory.
Should	Indicates a recommendation.
Supplier	As per the definition for “Vendor”.
Vendor	The person or organisation responsible for the fabrication or manufacture and supply of products, materials, equipment and components described herein.
Work	The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work is the result of performing or furnishing labour and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.
WorkSafe	Refers directly to the requirements of WorkSafe ACT but shall also imply the requirements of WorkCover NSW (for Icon facilities within NSW) and SafeWork Australia (where appropriate).

Note 1: Where the “Icon Water representative” has been nominated in this document, the “Superintendent” may be substituted via prior written approval from Icon Water for “gifted assets”. Regardless, the “Superintendent” and/or “Icon Water Representative” must be clearly shown in the Contractor’s Inspection and Test Plans.

1 Introduction

1.1 Background

There is an inherent risk associated with metallic pipelines due to their conductive nature. While not perfect conductors, pipelines can conduct electricity which can lead to a number of different mechanisms transferring electrical energy onto a pipeline. There are a number of hazards which can arise from electrical energy on pipelines. The example below in Figure 1.1.1, shows an occurrence where the local ground the individual is standing on and a metallic pipeline that the individual is touching are at different potentials, giving rise to a touch voltage.



Figure 1.1.1: Touch Voltage on Metallic Pipeline

To manage the electrical risks associated with metallic pipelines, the design of the infrastructure, pipelines and associated equipment earthing needs to be coordinated to limit the probability of fatality to within acceptable limits. AS/NZS 4853 outlines the minimum requirements for management of electrical hazards on metallic pipelines. This document is intended to supplement AS/NZS 4853 and provide guidance to those installing or performing works on Icon Water pipelines as well as those installing or modifying electrical infrastructure that may affect Icon Water pipelines.

1.2 Scope

This standard and the design process detailed in Section 2 is applicable to new metallic pipelines to be installed within Icon Water's network. It is also applicable to existing metallic pipeline subject to changes, redesign, upgrade, or review of electrical hazards.

Drivers for a review of electrical hazards include:

- Installation of new substations, switching stations or other electrical assets.
- Upgrade to an existing electrical asset including changes to protection settings.
- If there is a concern that an existing electrical installation may pose an unacceptable risk.

Note: this standard does not apply to pipelines located within plant or processing environments.

1.3 Purpose

The purpose of this document is to set out the design processes and requirements when installing or modifying metallic pipelines in Icon Water's network, or when installing assets that may cause electrical hazards on Icon Water's metallic pipelines.

1.4 Relevant Standards

The documents listed in Table 1.4.1 are either referenced by this specification, or shall be read in-conjunction with this specification.

Table 1.4.1 - Referenced Documents

Item	Document number	Title
Australian standards		
1	AS 2067	Substations and high voltage installations exceeding 1 kV a.c.
2	AS/NZS 4853	Electrical hazards on metallic pipelines
3	AS/NZS 60479.1	Effects of current on human beings and livestock – general aspects
IEEE Standards		
4	IEEE Standard 80	Guide for safety in AC substation grounding
5	IEEE Standard 81	Guide for measuring earth resistivity, ground impedance and earth surface potentials of a grounding system
ENA Guidelines		
6	EG-0	Power System Earthing Guide

Note: The documents shall be the latest publication at the time of award of the contract for construction of the works unless noted otherwise in the project specific documentation.

1.5 Designer Qualifications and Handover Report

Given the specialised nature of earthing and to ensure handover (or project completion) report quality, Icon Water recommend only qualified experienced earthing designers are used. Icon Water reserves the right to reject the report on the grounds of quality if deemed unsuitable. Icon Water can provide guidance on preferred earthing consultants if required.

The Designer, or the engineer directly supervising the Designer, must be a Professional Engineer (Registered Engineer) registered under the ACT Professional Engineers Registration Scheme in the relevant area Engineering.

1.6 Icon Water Contacts for Technical Enquiries

Technical questions, report submission and general earthing enquiries are facilitated through HydraulicAssetAcceptance@iconwater.com.au

1.7 Icon Water Asset Information and Details

Icon Water's asset information and layouts can be obtained using the following methods:

1. Initially the dial before you dig service should be used to determine if pipelines are present within the area of influence of the design.
2. Further pipeline information as described in AS/NZS 4853: Clause 4.4.3 (b) can be obtained via email. Please send dial before you dig excerpts and descriptions of the data required (i.e. pipeline material, diameter, coating, etc.) to geospatialinfo@iconwater.com.au

Requests will generally be processed within five working days. Specific details and information may not be available for all pipelines.

3. Shape files for modelling purposes can also be obtained by emailing geospatialinfo@iconwater.com.au

1.8 Timeline for reports and enquiries

The nominal turnaround for report processing and review is 4 weeks, to assist in expediting reviews please ensure reports feature all required information, are formatted correctly and do not include large amounts of irrelevant information. Please note Icon Water acceptance does not absolve the designer of responsibility for the design and associated residual risks.

The nominal turn around for enquires and questions is approximately 2 weeks.

2 Design

2.1 General

The design process for assessing electrical hazards on metallic pipelines consists of two categories of assessments:

- Conservative assessments (level 1) that assess the risk based on clearances and exposure lengths.
- Detailed assessments (level 2/3) that compare touch voltages to limits set out in predefined and/or calculated contact scenarios.

Detailed information on the design process for level 1, 2 and 3 assessments can be found in Section 4 of AS/NZS 4853.

Contact scenarios used for touch voltage targets on Icon Water assets can be found in Appendix K of AS/NZS 4853. Icon Water supports the use of modified touch voltage targets based upon Argon generated values, providing the contact frequency and duration remain unchanged and the footwear type is set to standard. The designer must ensure modified values are accurate and based on real/actual data not estimated or theorised values.

The design process is to take into consideration planned and future infrastructure (including potential changes), even if it has not been installed at the time of analysis.

2.2 Responsibilities

The responsibility for design, testing and mitigation lays with the entity that is proposing a change that affects existing infrastructure.

For example:

- It is the responsibility of the Developer to carry out this process in “green field” situations.
- It is Icon Water’s responsibility to carry out the design process if a new pipeline is being installed or changes are being made to an existing pipeline by Icon Water.
- It is the Electrical Utility’s responsibility to carry out this process if new high voltage electrical infrastructure is being installed or changes are being made to existing infrastructure that may affect Icon Water’s pipelines.
- In a Brownfields situation, the design is the responsibility of the persons or entity conducting the works.

2.2.1 Icon Water Responsibilities

Icon Water will:

- Provide all available Icon Water asset information to assist in design, testing and hazard assessment.
- Provide operational input and advice if required or available.
- Participate in meetings or workshops if required.

2.2.2 External Parties Responsibilities

The following responsibilities apply to design, testing and mitigation undertaken by parties external to Icon Water:

- Notify (via email) Icon Water of any proposed works that may affect Icon Water pipelines, refer to Icon Water contacts listed in this document.
- Provide required documentation to Icon Water in a timely manner.
- Invite Icon Water to participate in design reviews to provide insight and to gain an understanding of the proposed changes.
- Source electrical asset information from electrical utilities.
- Request Icon Water asset information from Icon Water.

2.3 Design Flow

Figure 2.3.1 shows the steps required for Icon Water design acceptance.

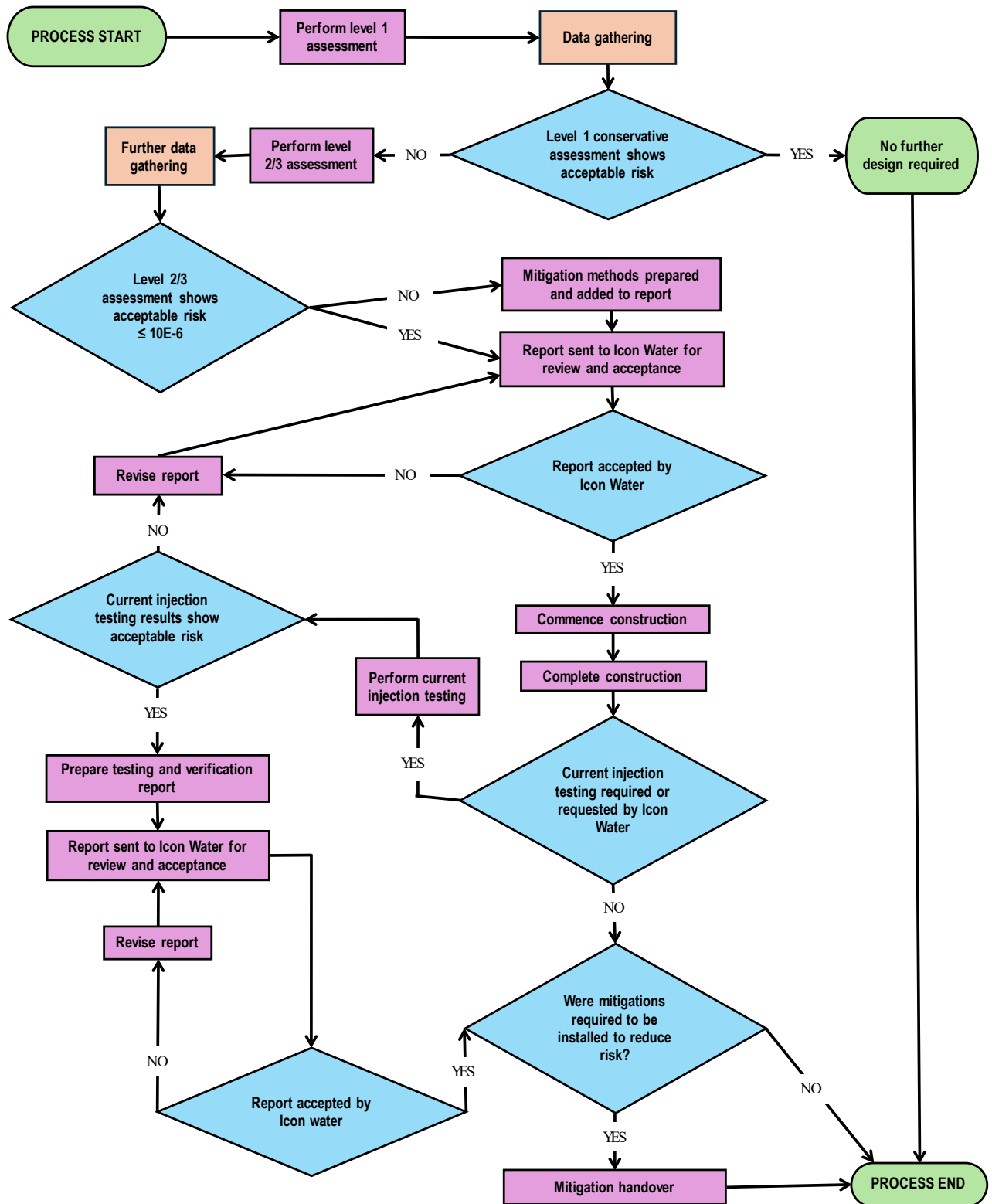


Figure 2.3.1: Design Flow Chart - Steps for Icon Water Acceptance

2.3.1 Level 1 (AS/NZS 4853) Assessments

Icon Water expect the following tasks be undertaken as a minimum for level one assessments:

- The location of electrical, gas, telecommunication and other utilities assets identified.
- The prospective highest ground fault current of the electrical substation or relevant electrical asset be determined.

Icon Water recommend the following tasks be undertaken for level 1 assessments:

- A site visit to validate the collected data and to identify any additional infrastructure.
- Measurement or confirmation of soil resistivity.

If level 1 analysis results show the installation is compliant in relation to metallic pipelines, no contact is required with Icon Water.

If Low Frequency Induction (LFI) or Earth Potential Rise (EPR) results do not meet the acceptable criteria, a level 2/3 analysis is required or the design must be changed to meet the level 1 analysis acceptable criteria.

2.3.2 Level 2 and 3 (AS/NZS 4853) Assessments

In the event that a level 1 assessment fails to achieve clearances required, a level 2 assessment is to be undertaken. If a level 2 assessment fails to achieve the voltage limit compliance or if the specific scenarios do not match the assumptions made in Appendix K of AS/NZS 4853, a level 3 assessment shall be undertaken.

To carry out the level 2 or 3 assessment, additional information is required and a site inspection shall be performed. The site visit can be performed by another party associated with the designer providing they are competent and familiar with the works. Site inspection details and data requirements for level 2 and 3 assessments can found in Section 4 of AS/NZS 4853.

2.4 Design Reports

Design reports submitted to Icon Water shall be presented in standard formatting with potentially, irrelevant information omitted or included in informative appendices.

Design reports shall have the following information to allow for efficient processing by Icon Water:

- Heading
- Location and other identifying information i.e. project number
- Author
- Reviewer
- Approver
- Version history
- Date
- Table of contents
- Scope

- Abbreviations
- Project description
- Site plan showing earthing layout
- Site details:
 - Location
 - Equipment to be installed/modified
 - Earthing arrangements
 - Design drawings
 - Feeder network
- Electrical Data:
 - Fault currents
 - Protection information
 - All electrical data required to perform calculations in the report
- Soil resistivity:
 - Date of testing
 - Location including map showing testing location
 - Test method used
 - Site ground conditions
 - Weather details
 - Test results
 - Soil Model
- Icon Water asset details:
 - Pipeline construction, diameter
 - Joint type and locations
 - Locations of valves and other appurtenances
 - Clearances to electrical assets
 - Coatings
 - Installed Date
- Touch voltage limits:
 - Clearly defined contact scenarios and voltage limits
 - Customised voltage limits featuring modified contact scenarios will be accompanied with calculation data (featured in appendices)
- Hazard scenarios:
 - Details of the affected assets

- Maps showing all relevant electrical hazards with distances to Icon Water assets
- Modelling and calculations
 - Details of assumptions made during modelling and calculations
 - Details of modelled and calculated results for prospective touch voltages
 - Graphical information
 - Summary table of hazard scenarios, modelled or calculated results & touch voltage limits. Example table format provided in Figure 2.4.1.
- Mitigation:
 - Details of mitigation options assessed to reduce risk if results exceed limits
- Summary of the assessment
- Conclusion and recommendations
- Testing requirements

Location	Affected Persons	Contact Scenario	Touch Voltage (v) Modelled	Negligible Risk Targets	
				Voltage (V)	Risk
Metallic pit lid	Public	Step	600	1700	3.966E-13
Pipeline 56789	Pipeline operator	Touch	150	95	1.275E-5
Valve 12345	Pipeline operator	Touch	200	58	1.322E-3

Note 1: ALARP Region Intolerable Risk Region

Figure 2.4.1: Example modelling and calculations summary table

2.5 Modification of Existing Inadvertent Hazard Controls

During design when existing assets are found to possess inadvertent hazard controls that if altered or removed may lead to unacceptable hazards, the Designer shall note these assets in the report. These assets will be included in an Icon Water developed EHMP to allow for future works to be performed safely.

Example:

An existing valve is surrounded by asphalt that if removed would present an unreasonable risk. If asphalt is required to be removed for maintenance task PPE (insulated gloves) shall be worn when working on the valve.

3 Testing and Verification

If testing is requested by Icon Water or forms part of the initial assessment, a testing report shall be provided to Icon Water for review. The party responsible for design as set out in this document is also responsible for testing and verification.

The report shall feature the following information:

- Heading
- Location and other identifying information i.e. project number
- Author
- Reviewer
- Approver
- Version history
- Date
- Table of contents
- Scope
- Abbreviations
- Introduction:
 - Purpose of the report
 - Details on how the testing was carried out
- Apparatus:
 - List of apparatus used in the test
- Fault levels and protection clearing times:
 - Prospective fault level at site
 - Fault clearing times
- Injection Test Layout:
 - Details with site plans on how the current injection test(s) are laid out including voltage reference, direction of tests and current injection reference
 - Explanation for how each test is performed
- Verification test results:
 - Table featuring test results
- EPR voltage contour graphs or fall of potential model
- Conclusion:
 - Summary
 - Indicate whether the test results are acceptable, If not what hazard mitigation methods are suggested

4 Mitigations and Handover

4.1 Mitigation Methods

The party responsible for design as set out in Clause 2.2 of this document is responsible for the design supply and installation of voltage mitigations to the affected Icon Water assets.

The acceptance of all mitigation measures shall be gained from Icon Water prior to any construction or installation commencing.

Identified Electrical Hazards shall be controlled through the application of the hierarchy of controls.

Guidance for electrical hazard control can be found in Section 6 of AS/NZS 4853.

If further guidance is required from Icon Water, refer to Icon Water contacts listed in this document.

4.2 Safety Management Study Workshop

Where controls are required to be implemented to mitigate a hazard as part of the design process, a safety management study workshop shall be undertaken as per AS/NZS 4853. The workshop will consist of key stakeholders from Icon Water, the relevant electrical utility and or asset owner and level 2/3 designer. The purpose of this workshop is to validate designs and discuss proposed mitigation methods.

4.3 Ongoing Mitigation Management

Icon Water has an obligation as the pipeline owner to ensure that all mitigations that are put in place remain effective for the life of the pipeline. It is Icon Water's responsibility to undertake a Safety Management assessment and subsequently develop an EHMP. The EHMP is used to manage the electrical hazards throughout the life of the pipeline. Icon Water EHMPs also incorporate the integrity component in accordance with Clause 7.4 of AS/NZS 4853.

4.4 Handover of Mitigations

At handover or project completion, the designer shall provide Icon Water with a document detailing:

- What mitigations were put in place
- Photos of mitigations
- A site map (pdf) outlining the location of the mitigation infrastructure
- Reason for each mitigation
- Requirements to ensure the mitigation remains effective

Note: this handover is for record management purposes only and maintenance of mitigation remains the responsibility of the mitigation asset owner.

4.5 Site Energisation

Installations requiring level 2/3 assessments shall not be energised (if electrical) or installed (if pipelines), until all reports have been accepted by Icon Water and mitigation installed if required.

Note: In instances where mitigation requires pipeline to be installed other arrangements will be made to ensure safety.

Appendix A – Technical Specification Update History

A.1 Update History

Issue 1 (23/03/2022) Issue for use

Issue 2 (8/12/2025) Updated to changes regarding ACT Professional Engineers' Registration Scheme, and update to new specification template.

A.2 Issue 2 Updates

Section	Update ^(Note 1)	Comment
Abbreviations & Definitions	Additions	Additional Abbreviations and Definitions added to tables.
Clause 1.5	ACT Registered Engineer	Clause 1.5 updated to include compliance with the ACT Engineers Registration Scheme.
Clause 1.6	Icon Water Contacts for Technical Enquiries	Email address updated
Figure 2.3.1	Design Flow Chart	Chart layout updated to fit on a single page. No change to the content or flow.
Previous Appendix A	Example of Modified Argon Touch Voltage Scenario	Section deleted
Current Appendix A	Technical Specification Update History	Inclusion of Appendix A, Technical Specification Update History.
Entire Document	Format	Update the document to incorporate the new template.

Note1: The updates in the table above refer to additional updates in Issue 2 (compared to Issue 1) unless shown otherwise.



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