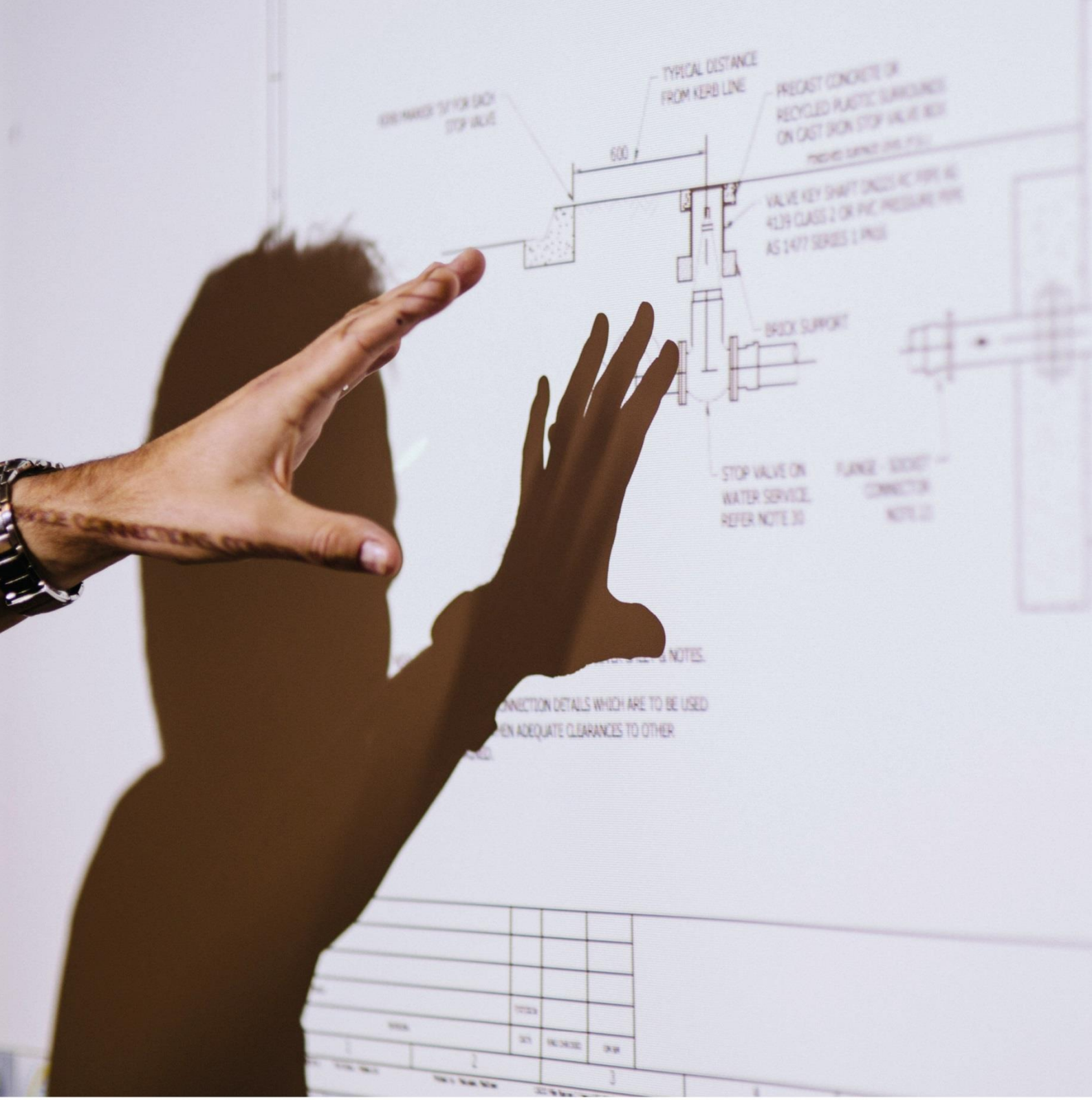

STD-SPE-E-008
NETWORK METALLIC PIPELINE
ELECTRICAL HAZARD DESIGN REQUIREMENTS

icon
WATER

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Document management

Document authorisation table

Issue	Date	Author	Reviewer	Approver
1	23/03/22	Matthew Tarlinton	Darryl Eager	Darryl Eager

Version control table

Issue	Date	Reason for issue
1	23/03/22	Issued for use

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

EHMP	Electrical Hazard Management Plan
HV	High Voltage (>1kV AC)
LFI	Low Frequency Induction
EPR	Earth Potential Rise

Definitions

Argon	Safety Assessment Software from Energy Networks Australia

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, 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. 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. AS4853 outlines the minimum requirements for management of electrical hazards on metallic pipelines. This document is intended to supplement AS4853 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.

2 Scope

This standard and the design process detailed in section 5 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

This standard does not apply to pipelines located within plant or processing environments.

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.

4 Referenced documents

The documents listed in Table 1 are either referenced by this specification, or shall be read in-conjunction with this specification.

Table 1 Referenced Documents

Item	Document number	Title
Australian Standards		
1	AS/NZS 4853:2012	Electrical hazards on metallic pipelines
2	AS 2067:2016	Substations and high voltage installations exceeding 1 kV a.c.
3	AS/NZS 60479.1:2010	Effects of current on human beings and livestock – general aspects
IEEE Standards		

6	IEEE Standard 80	Guide for safety in AC substation grounding
7	IEEE Standard 81	Guide for measuring earth resistivity, ground impedance and earth surface potentials of a grounding system
ENA Guidelines		
8	EG-0	Power System Earthing Guide

5 Design

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 AS4853:2012.

Contact scenarios used for touch voltage targets on Icon Water assets can be found in Appendix K of AS4853:2012. 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. An example Argon assessment can be found in Appendix A.

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.

5.1 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.

5.1.1 Icon Water

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.

5.1.2 External parties responsibilities

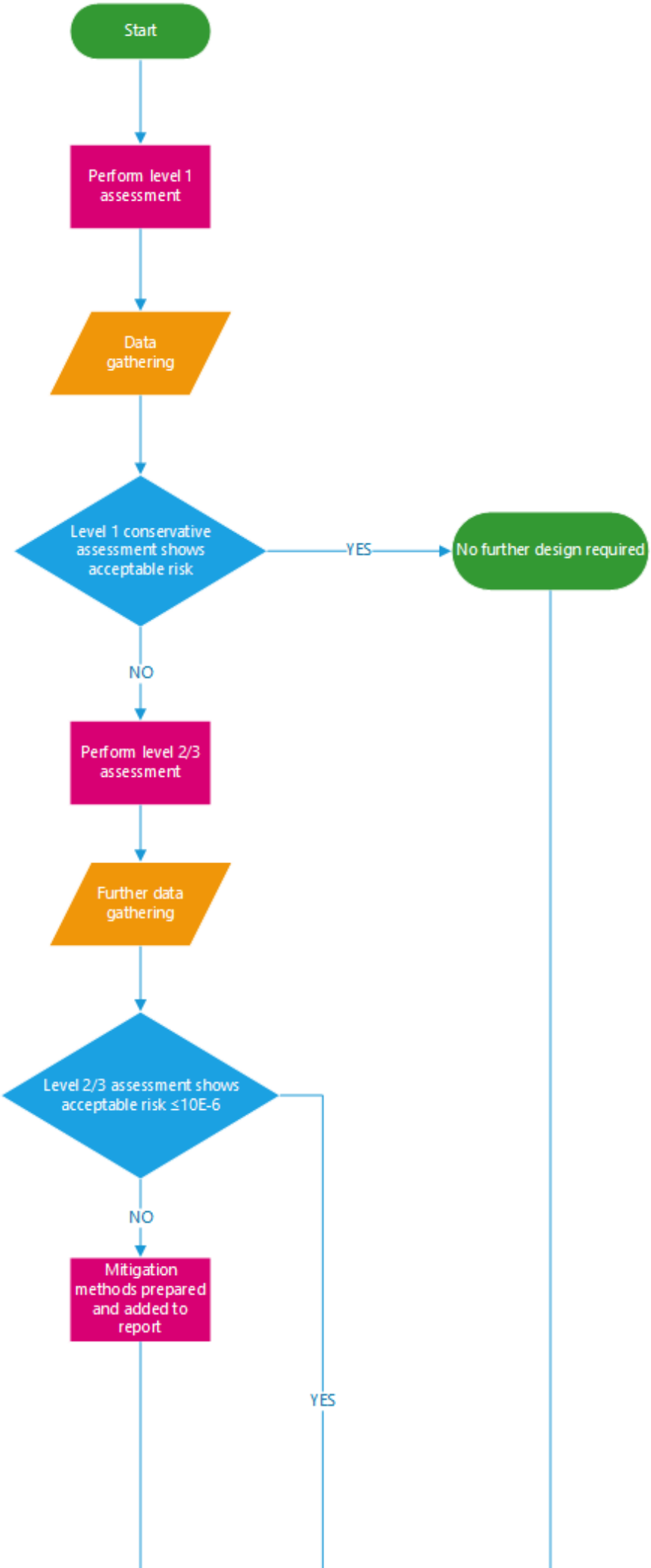
The following responsibilities apply to design, testing and mitigation undertaken by parties external to Icon Water:

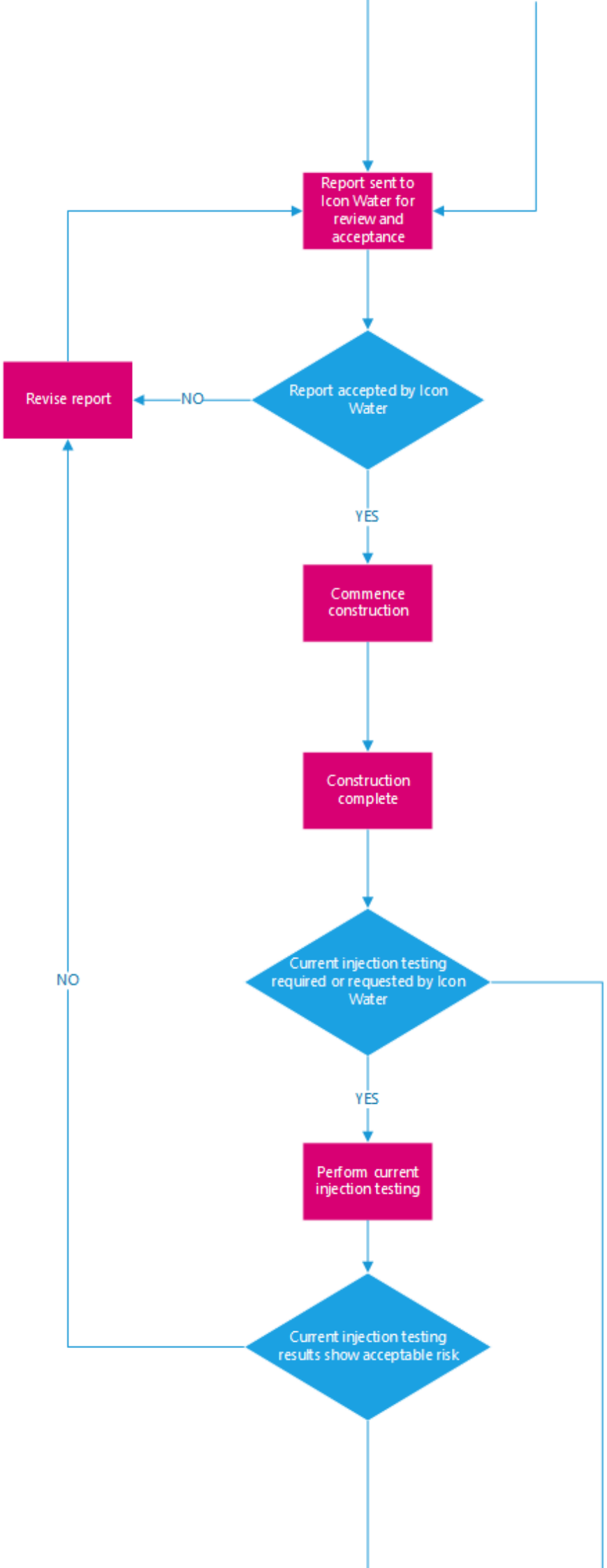
- Notify (via email) Icon Water Earthing Team of any proposed works that may affect Icon Water pipelines, refer to Icon Water contacts listed in this document..
- Provide required documentation to Icon Water in a timely manner.
- Invite Icon Water to participate in design reviews to provide insight and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

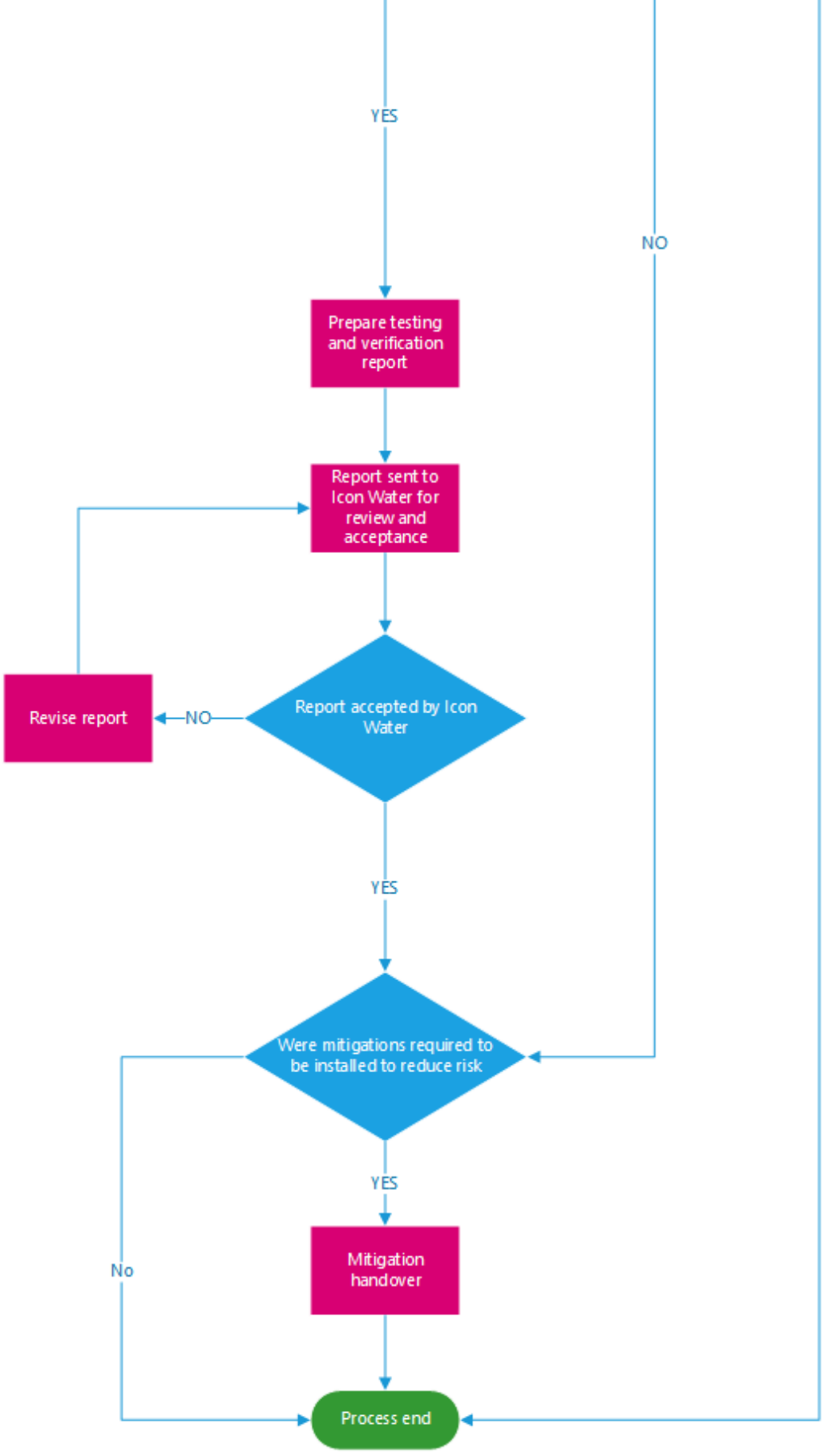
5.2 Design flow

Provided below in Figure 2, is a flowchart showing steps required for Icon Water design acceptance.

Figure 2 Design flow chart




Report sent to Icon Water for review and acceptance
Report accepted by Icon Water
NO
Revise report
YES
Commence construction
Construction complete
Current injection testing required or requested by Icon Water
NO
YES
Perform current injection testing
Current injection testing results show acceptable risk


YES
NO
Prepare testing and verification report
Report sent to Icon Water for review and acceptance
Report accepted by Icon Water
NO
Revise report
YES
Were mitigations required to be installed to reduce risk
YES
No
Mitigation handover
Process end

5.2.1 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.

5.2.2 Level 2 & 3 (ASNZS 4853) assessments

In the event that a level one 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 AS4853, 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 AS4853.

5.3 Design reports

Design reports submitted to Icon Water shall be presented in standard formatting with the following information to allow for efficient processing. Potentially, irrelevant information will be omitted or included in informative appendices.

- 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 below)

Table 2 Example summary table

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

- Mitigation
    - Details of mitigation options assessed to reduce risk if results exceed limits
- Summary of the assessment
- Conclusion and recommendations
- Testing requirements

5.4 Modification of existing inadvertent hazard controls

When performing design and 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.

6 Testing and verification

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

7 Mitigations

7.1 Mitigation methods

The party responsible for design as set out in Clause 5.1 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.

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 AS4853.

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

7.2 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 AS4853. 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.

7.3 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 AS4853.

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

8 Report quality

Given the specialised nature of earthing and to ensure 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.

9 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.

10 Icon Water contacts

10.1 Technical Enquires

Technical questions, report submission and general earthing enquiries can be sent to:

Earthing@iconwater.com.au

10.2 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 AS4853: Clause 4.4.3 (b) can be obtained via email. Please send dial before you dig exerpts 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

11 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 that 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.

Appendix A

Figure 3. Example of modified Argon touch voltage scenario.

COINCIDENCE PROBABILITY

Access / Fault Assumptions

Example Only

Scenario Name	User Defined Assumptions	
Description	Distribution Operation - Water Valve	

				Individual	
Fault Frequency	0.1	*per year*	**Contact Frequency**	5	*per Year*
Fault Duration	0.2	*seconds*	**Contact Duration**	3600	*seconds*

Coincidence Reduction

Concidence Reduction Method	None
Concidence Reduction Factor	1

Individual Coincidence Probability = 5.7e-5

FIBRILLATION PROBABILITY

Assumptions

Current Path	Touch Voltage	
Footwear	Standard Footwear	
Wet / Dry ?	Dry	
Soil Resistivity	100	*Ω-m*
Applied Voltage	500	*volts*
Fault Duration	0.2	*seconds*

Surface Layer

Type	None	
Resistivity	0	*Ω-m*
Depth	0	*metres*
Flashover Voltage	Not Specified	*volts*

Fibrillation Probability = 0.0175

RISK DETERMINATION

Individual

Risk Zone :	Negligible

Probability of Fatality = 9.975e-7

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