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Uisce Éireann

Chemicals Storage Systems: Bulk Storage of Liquid Chemicals

Revision Number	Description of Change	Author(s)	Approved By	Date of Approval
V1.03	Scheduled Review	J Goggin / S Matlák		
2.0	Updated to align with branding. Section 3.2 updated to align with new derogation procedure	J Goggin		

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1 INTRODUCTION

Chemicals play a critical role in the majority of potable water treatment processes, and to a lesser extent, wastewater treatment processes. Various chemicals are therefore delivered, handled, stored and dosed at almost every water and wastewater treatment asset under the control of Uisce Éireann. The requirements for chemical storage will differ from site to site, and are dependent on the treatment processes employed, as well as the size and capacity of the facility. It follows that the extent of chemical usage in water and wastewater processes, allied to the hazardous nature of some of the chemicals in question, makes their safe and effective onsite storage a particular concern to Uisce Éireann.

2 PURPOSE

This Level 7 document is a subsidiary to the Level 6 **TEC-600-06 Chemical Storage Systems – General Specification**, and focusses exclusively on requirements of bulk liquid chemical storage systems. It outlines Uisce Éireann's minimum requirements for all bulk liquid chemical storage systems both for Water Treatment and Wastewater Treatment Assets. This suite of documents forms part of a series of standard 'building block' specifications which are to be used when compiling project designs.

The documents are intended to guide project stakeholders in establishing engineered solutions that deliver robust, reliable and repeatable performance that meet Uisce Éireann's objectives for chemical storage systems on water and wastewater treatment assets. This specification should be read in conjunction with each project's Employer's Requirements which shall set out Uisce Éireann's site-specific requirements for each particular installation. The document user shall note that the application of this, and every other specification within the 'building block' structure must also give due consideration to the health & safety, operability, CAPEX and OPEX of each installation.

2.1 ASSET DATA HIERARCHY

The **TEC-600** suite of specifications are aligned to Uisce Éireann's Asset Data Hierarchy (ADH) which provides a consistent structure for water and wastewater treatment assets and their associated data. The ADH is outlined in Table 1 below and as well as allowing the structured development of suites of 'building block' design specifications, also facilitates the creation of a standardised asset register which can be used as a base for a range of business activities, which includes;

- the planning of efficient operation and maintenance practices;
- more effective capital investment;
- accurate and reliable regulatory reporting.

ADH Level	Name	Description
Level 1 Asset	**Root Node**	Identifies the location in relation to the Uisce Éireann business
Level 2 Asset	**Business Level**	Identifies the location in relation to the Uisce Éireann business
Level 3 Asset	**Regional Level**	Identifies the location in relation to the Uisce Éireann business
Level 4 Asset	**Chart of Accounts Level**	Identifies the location in relation to the Uisce Éireann business
Level 5 Asset	**Site**	Identifies an operational site which is defined by as "an enclosed area of land owned or utilised by UÉ"
Level 6 Asset	**Process**	A grouping of assets which combined, form a distinct stage of a treatment process *e.g. Coagulation, Flocculation, Clarification (CFC)*
Level 7 Asset	**Process Stage**	is a physical entity which forms part of the process *e.g. Sedimentation, Dissolved Air Flotation, etc. as a subset of CFC*
Level 8 Asset	**Asset**	An item or piece of equipment owned by UÉ; it is the building blocks of a site which largely define its maintenance

Table 1: Uisce Éireann Asset Data Hierarchy (ADH)

2.2 SPECIFICATION STRUCTURE

In accordance with the Asset Data Hierarchy, the **TEC-600** suite of specifications are divided into a suite of Level 6 (Process) documents which ultimately aim to specify the minimum requirements for each of the assets described. The content of the Level 6 document will outline general high-level information and requirements relating to the selection and design of the Level 6 (Process) Asset as a whole, without going into the specifics of the Level 7 (Process Stage) document. The structure of the **TEC-600-06** suite of Level 7 specifications is illustrated in Figure 1 below.

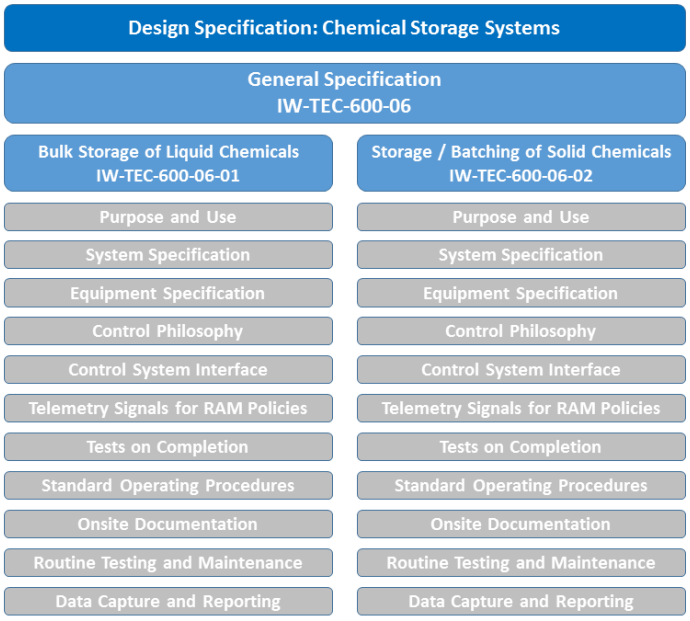

Figure 1: Structure of TEC-600 suite of specifications.

3 SCOPE

The scope of **TEC-600-06-01** covers the bulk storage of all liquid chemicals approved for use on Uisce Éireann treatment assets (water and wastewater), as outlined in Table 1 and detailed in Section 6.

Approved Liquid Chemicals			
Chemical	**Concentration**	**Chemical**	**Concentration**
Aluminium Sulphate	20 - 30%	Potassium Permanganate	4 - 5%
Ferric Chloride	40 - 50%	Sodium Hydroxide	25% or 30%
Ferric Sulphate	40 - 50%	Sodium Hypochlorite	10%
Ferric Nitrate*	0 - 45%	Sodium Nitrate*	0 - 50%
Hydrofluosilicic Acid	10.9%	Sulphuric Acid	96%, (50%**)
Orthophosphoric Acid	75%		
Poly-aluminium Chloride	10% or 18%		
* A mixed ferric and sodium nitrate solution may be used for odour/septicity control purposes at wastewater assets. Precise composition of the solution will be dependent on the chemical manufacturer. ** Specific conditions apply, refer to Section 0			

Table 2: Liquid chemicals approved for bulk storage on Uisce Éireann treatment assets

3.1 TERMINATION POINTS AND EXCLUSIONS

The specification encompasses all elements of a bulk storage system for liquid chemicals, between the point of chemical replenishment (i.e. the filling point), to the associated chemical dosing pumps, as well as certain ancillary features such as emergency showers, eyewashes and control systems. All requirements, processes and policies beyond these termination points shall be covered in associated Level 6 process specific specifications

(i.e. Disinfection, CFC, etc.).

3.2 DEROGATIONS FROM THE SPECIFICATION

Whilst the minimum requirements of this standard / specification shall be met (where applicable) this document is not intended to stifle innovation by the Contractor, or delay progress. Should the Contractor wish to apply for a derogation from any aspect of the document, they shall submit a derogation application to the Employer's Representative, in advance of any proposed departure from the requirements of the specification (the required form for the derogation application will be provided to the Contractor by the Employer's Representative). Submission of the derogation application does not confer permission to proceed, and the application should be submitted allowing sufficient time for the Employer and the Employer's Representative to evaluate. Works can only proceed on the basis of the derogation, after the Contractor has received written confirmation from the Employer's Representative. The written confirmation of the derogation shall be treated as a change order/variation under the contract and its consequences shall be decided pursuant to the change/order variation mechanism of the contract.

The submission of a derogation application shall not impact on the programme of works for the specified project and shall be made at the risk and expense of the Contractor. Uisce Éireann or the Employer's Representative shall retain the right to reject the derogation application in favour of compliance with this document.

For the avoidance of doubt, the derogation, where approved, shall only pertain to the specific circumstance for which the derogation is approved. An approved derogation shall not carry any precedent to another project/contract and shall not be used or applied on other similar projects/contracts or circumstances thereafter. The subject of a derogation can only be applied on another contract/project if it has been directly incorporated into the standards/specifications for the relevant contract/project.

4 DEFINITIONS

Please see Section 4 of **TEC-600-06** for a complete list of terminology and associated definitions used in this specification for various contractual roles.

5 ROLES AND RESPONSIBILITIES

Please see Section 5 of **TEC-600-06** for a description of the responsibilities of key stakeholders involved in the development, maintenance and execution of this specification.

6 SYSTEM SPECIFICATION

While the appointed Contractor shall retain the responsibility for the detailed design of bulk storage systems, minimum Uisce Éireann requirements must be met for all such installations. This section of the specification outlines Uisce Éireann's minimum requirements in relation to the design and general arrangements for bulk storage systems for liquid chemicals. The Contractor shall ensure that each installation is completed in accordance with the details outlined herein.

6.1 GENERAL SYSTEM DESIGN

The Contractor shall adhere to details outlined in the following sections when completing the design of bulk storage systems for liquid chemicals.

6.1.1 Total Bulk Storage Volume (BSV)

For each chemical, the Contractor shall determine the total bulk storage volume (BSV) required in accordance with site specific chemical demands and in accordance with the relevant process specific Uisce Éireann Design Specifications, as applicable. The table below should be used to size the bulk storage volumes. The retention time should be calculated on the basis of the estimated average dose rate, and supplier specification information for bulk concentration (%w/w) and Specific Gravity (SG). Where the target retention time results in a BSV less than the specified minimum , as long as the maximum retention time is not exceeded, this will be accepted. Where existing storage assets can be re-used as an alternative to providing new BSV, the proposed solution will be accepted as long as the minimum retention time is met. In instances where the maximum retention time is exceeded with the minimum stated BSV listed, this shall be discussed on a site specific basis with the UE project and may require the approval of a Derogation request as outlined in section 3.2. .

Chemical	Application	Minimum BSV (m^3)	Target Retention time (days)	Minimum Retention time (days)	Maximum Retention time (days)
Aluminium Sulphate	Wastewater	1.2	14	12	30
Ferric Chloride	Wastewater	1.2	14	12	30
Ferric Sulphate	Wastewater	1.2	14	12	30
Ferric Nitrate	Wastewater	1.2	14	12	30
Hydrofluosilicic Acid	Wastewater	1.2	14	12	30
Orthophosphoric Acid	Wastewater	1.2	14	12	30
Poly-aluminium Chloride	Wastewater	1.2	14	12	30
Polymers (all makes/grades)	Wastewater	1.2	14	12	30
Potassium Permanganate	Wastewater	1.2	14	12	30
Sodium Hydroxide	Wastewater	1.2	14	12	30
Sodium Hypochlorite	Wastewater	1.2	14	12	30
Sodium Nitrate	Wastewater	1.2	14	12	30
Sulphuric Acid	Wastewater	1.2	14	12	30
Sulphuric Acid	Wastewater	1.2	14	12	30
Aluminium Sulphate	Water	1.2	28	22	45
Ferric Chloride	Water	1.2	28	22	45
Ferric Sulphate	Water	1.2	28	22	45
Ferric Nitrate	Water	1.2	28	22	45
Hydrofluosilicic Acid	Water	1.2	28	22	45
Orthophosphoric Acid	Water	1.2	28	22	45
Poly-aluminium Chloride	Water	1.2	28	22	45
Polymers (all makes/grades)	Water	1.2	28	22	45
Potassium Permanganate	Water	1.2	28	22	45
Sodium Hydroxide	Water	1.2	28	22	45
Sodium Hypochlorite	Water	1.2	28	22	45
Sodium Nitrate	Water	1.2	28	22	45
Sulphuric Acid	Water	1.2	28	22	45
Sulphuric Acid	Water	1.2	28	22	45
All others	Water	1.2	28	22	45
All others	Wastewater	1.2	14	12	30

Table 3: Criteria for sizing BSVs

6.1.2 Provision and Sizing of Day Tanks

Day tanks shall be required in line with the table below. For chemicals not listed in the table below, the assumption is that day tanks will not be required, however the designer is required to formally confirm this with the UE project manager and design technical team. If a day tank is required for a chemical and application not listed below, this will require approval of a Derogation request as outlined in section 3.2this shall be In most instances :

Chemical	Application	BSV provided (m^3)	Required (Y/N)	Minimum Volume (m^3)	Target Retention time (days)	Minimum Retention time (days)	Maximum Retention time (days)
Aluminium Sulphate	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Ferric Chloride	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Ferric Sulphate	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Ferric Nitrate	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Hydrofluosilicic Acid	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Orthophosphoric Acid	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Poly-aluminium Chloride	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Polymers (all makes/grades)	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Potassium Permanganate	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Sodium Hydroxide	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Sodium Hypochlorite	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Sodium Nitrate	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Sulphuric Acid	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Sulphuric Acid	Wastewater	n/a	×	n/a	n/a	n/a	n/a
Aluminium Sulphate	Water	n/a	×	n/a	n/a	n/a	n/a
Ferric Chloride	Water	n/a	×	n/a	n/a	n/a	n/a
Ferric Sulphate	Water	n/a	×	n/a	n/a	n/a	n/a
Ferric Nitrate	Water	n/a	×	n/a	n/a	n/a	n/a
Hydrofluosilicic Acid	Water	n/a	ü	n/a	1	0.5	2
Orthophosphoric Acid	Water	n/a	×	n/a	n/a	n/a	n/a
Poly-aluminium Chloride	Water	n/a	×	n/a	n/a	n/a	n/a
Polymers (all makes/grades)	Water	n/a	×	n/a	n/a	n/a	n/a
Potassium Permanganate	Water	n/a	×	n/a	n/a	n/a	n/a
Sodium Hydroxide	Water	n/a	×	n/a	n/a	n/a	n/a
Sodium Hypochlorite	Water	≥ 12	ü	1.2	1	0.5	2
Sodium Nitrate	Water	n/a	×	n/a	n/a	n/a	n/a
Sulphuric Acid	Water	n/a	×	n/a	n/a	n/a	n/a
Sulphuric Acid	Water	n/a	×	n/a	n/a	n/a	n/a
All others	Water	n/a	×	n/a	n/a	n/a	n/a
All others	Wastewater	n/a	×	n/a	n/a	n/a	n/a

Table 4: Criteria for day tank provision

The Contractor shall refer to the process specific Uisce Éireann Design Specifications to fully ascertain the

requirements for a day tank for each chemical proposed. Where existing day tanks have capacities in excess of three days usage, a clearly identifiable maximum fill line should be affixed to the tank, and a procedure implemented to ensure that filling above this line does not take place.

6.1.3 Single and Dual Tank Installations

Standby BSV provision shall be provided in line with the table below. Standby tank installations are deemed necessary in order to provide redundancy in the event of tank failure or to facilitate routine / non-routine maintenance. For standby tank installations, the following general requirements shall apply:

- All tanks provided as part of multiple tank installations for an individual chemical shall be of equal capacity.
- The minimum individual tank volume for dual tank installation shall be 1,200 litres for each tank.
- For all multiple tank installations, the escape of contents from one tank shall not prevent the operation of the others.
- For standby tank installations, the total BSV provided shall comply with the criteria from the tables above with one tank out of service (i.e. for 2 tanks total, 1 tank shall provide full BSV required, for 3 tanks total, tanks shall provide full BSV required etc.)
- Multiple tanks shall not be interconnected between the bulk storage and the dosing rigs, and shall operate entirely independently of each other (i.e. duty / standby) in order to mitigate against the risk of total chemical loss in the event of suction pipework failure. Interconnectedness downstream of the dosing rigs shall be permitted.
- Note that day tanks, if required, shall always be provided as single tank systems, regardless of volume. Multiple day tanks shall not be permitted.

Chemical	Application	BSV provided (m^3)	Standby Provision required (Y/N)
Aluminium Sulphate	Wastewater	n/a	×
Ferric Chloride	Wastewater	n/a	×
Ferric Sulphate	Wastewater	n/a	×
Ferric Nitrate	Wastewater	n/a	×
Hydrofluosilicic Acid	Wastewater	n/a	×
Orthophosphoric Acid	Wastewater	n/a	×
Poly-aluminium Chloride	Wastewater	n/a	×
Polymers (all makes/grades)	Wastewater	n/a	×
Potassium Permanganate	Wastewater	n/a	×
Sodium Hydroxide	Wastewater	n/a	×
Sodium Hypochlorite	Wastewater	n/a	×
Sodium Nitrate	Wastewater	n/a	×
Sulphuric Acid	Wastewater	n/a	×
Sulphuric Acid	Wastewater	n/a	×
Aluminium Sulphate	Water	n/a	×
Ferric Chloride	Water	n/a	×
Ferric Sulphate	Water	n/a	×
Ferric Nitrate	Water	n/a	×
Hydrofluosilicic Acid	Water	n/a	ü
Orthophosphoric Acid	Water	n/a	×
Poly-aluminium Chloride	Water	n/a	×
Polymers (all makes/grades)	Water	n/a	×
Potassium Permanganate	Water	n/a	×
Sodium Hydroxide	Water	n/a	×
Sodium Hypochlorite	Water	≥ 12	ü
Sodium Nitrate	Water	n/a	×
Sulphuric Acid	Water	n/a	×
Sulphuric Acid	Water	n/a	×
All others	Water	n/a	×
All others	Wastewater	n/a	×

6.1.4 Indoor or Outdoor Tank Installation

Indoor installations shall allow for the easy removal and replacement of tanks, that shall not involve any alteration to any permanent structure or the need to remove any fixed equipment. The tank installation proposal shall include a detailed tank replacement plan and method statement for Uisce Éireann's approval.

The following is considered best practise within UE but are not deemed strict requirements. It is the designer responsibility to ensure the possibility of achieving the following is explored fully, but if it proves cost prohibitive (e.g. due to space restrictions on site) the decision on indoor vs outdoor installations shall be a project by project, site specific decision that is agreed between the designer and the UE project team, with no need for derogation approval.

- Bulk storage tank(s) or day tank with individual capacities ≤ 1,500 litres shall be installed indoors.
- Tanks with individual capacities > 1,500 litres should be installed outdoors

6.1.5 Storage and dosing system general considerations

If not otherwise specified in a process-specific Uisce Éireann Specification, the chemical storage and dosing system design shall consider, and should comply with, the following principles:

- Carrier water shall be provided for sulphuric acid dosing and should be considered for other chemicals where appropriate due to low flow rate or velocity, etc. The carrier water shall be appropriately treated for its intended use (e.g. pH correction, softening, etc), shall be taken from the same source as the main water flow and shall be safe to dose into drinking water
- The storage and dosing system components shall incorporate a minimum of 2 layers of physical barriers between the chemical stored/dosed and the operator, i.e. the tanks, pipes and all other components shall be double skinned, double-contained, placed in a cabinet or splash guard provided.
- All parts or components of the installation that require regular access for operation, maintenance or inspection shall incorporate means of safe access in accordance with the relevant UÉ specifications and I.S. standards.
- Double contained pipes should be of rigid construction (i.e. pipes, not hoses) with the external containment made of transparent material.

6.2 INDICATIVE SYSTEM LAYOUTS

To illustrate the requirements outlined in Section 6.1 above, indicative layouts for chemical storage systems of various BSVs are outlined in the following sections. While Uisce Éireann acknowledges that compliance with the indicative layouts in terms of tank positioning, orientation, etc. may not be possible across all installations, the Contractor shall adhere to the requirements of Section 6.1 in terms of BSV proposed, day tank requirements, single/dual tank installation and indoor/outdoor installation. The Contractor shall also allow within their proposals for all equipment shown in the indicative layouts, and all equipment proposed shall be in compliance

with the contents of Section 7 (Equipment Specification) of this document.

Indicative Layout Number	Total Chemical BSV	No. of BSTs	Individual BST Capacity	Location of BST	Day Tank Required	No. of Day Tanks	Location of Day Tank
1	≤ 1,200 litres	1	1,200 litres	Indoors	No	0	n/a
2	≤ 3,000 litres	2	≤ 1,500 litres	Indoors	No	0	n/a
3	≤ 12,000 litres	2	≤ 6,000 litres	Outdoors	No	0	n/a
4	> 12,000 litres	2	> 6,000 litres	Outdoors	Yes	1	Indoor
5	> 12,000 litres	2	> 6,000 litres	Outdoors	Yes	1	Outdoor

Table 5: Indicative layouts of chemical storage systems for bulk liquid chemicals

The following features are deemed requirements on all types of liquid chemical installation, regardless of chemical and purpose:

- The Designer shall ensure that dosing pumps are always mounted in a protective cabinet, in order to contain any leaks which may arise. Any such leaks should drain back to the tank bund.
- The cabinet in which the dosing pumps are to be mounted should be fully enclosed, and incorporate a transparent polycarbonate hinged door which will allow the plant operator to view the pumps without opening the enclosure. The base of the cabinet shall also act as a drip tray and should incorporate a drain back to the bund to allow spillages arising from pump disconnection or leakages to be contained.
- All pumping accessories such as chemical flow meters and calibration tubes should be contained within this cabinet, which shall be installed at chest height on an adjacent wall, on a stainless steel support stand, or on the side wall of the BST (above the level of the bund). Note that the dosing cabinet may not be supported by the any bund walls surrounding the storage tanks, If the specified pumps are too large to fit in the dosing cabinet, then they shall be enclosed in a dedicated bund (separate to the storage tank bund).
- The location of the pump cabinet shall not obstruct replenishment of the chemical stocks and should not have to be temporarily relocated during tank filling.
- All valves throughout the system should be easily accessible by the plant operator, with isolation valves and non- return valves provided on the pump suction and delivery lines.
- Each of the chemical flowmeters shall be capable of being isolated by upstream and downstream valves so that they can be easily removed if calibration, maintenance or replacement is required.
- All valves throughout the system should be easily accessible by the plant operator. If actuated valves are proposed to select the source bulk tank from where the chemical is transferred they shall be insulated and heat traced to operate effectively in external temperatures as low as -18°C. Similarly, isolation valves for the dosing pumps and chemical flowmeters should be contained within the dosing cabinet enclosure.

6.2.1 Indicative Layout No.1 – Total BSV ≤ 1200 Litres

Figure 2 illustrates a chemical storage system where the total BSV ≤ 1,200 litres. The installation is located indoors and a single 1,200 litres BST with an open topped bund will suffice for storage. There is no day tank required, and a duty/standby dosing pump arrangement shall abstract chemical directly from the BST. The dosing pumps will be installed in a wall mounted dosing pump cabinet / kiosk, mounted above the bund level and complete with a drain to the bund. Automatic rotation between dosing pumps shall take place as described in Section 8.1.7 of this document.

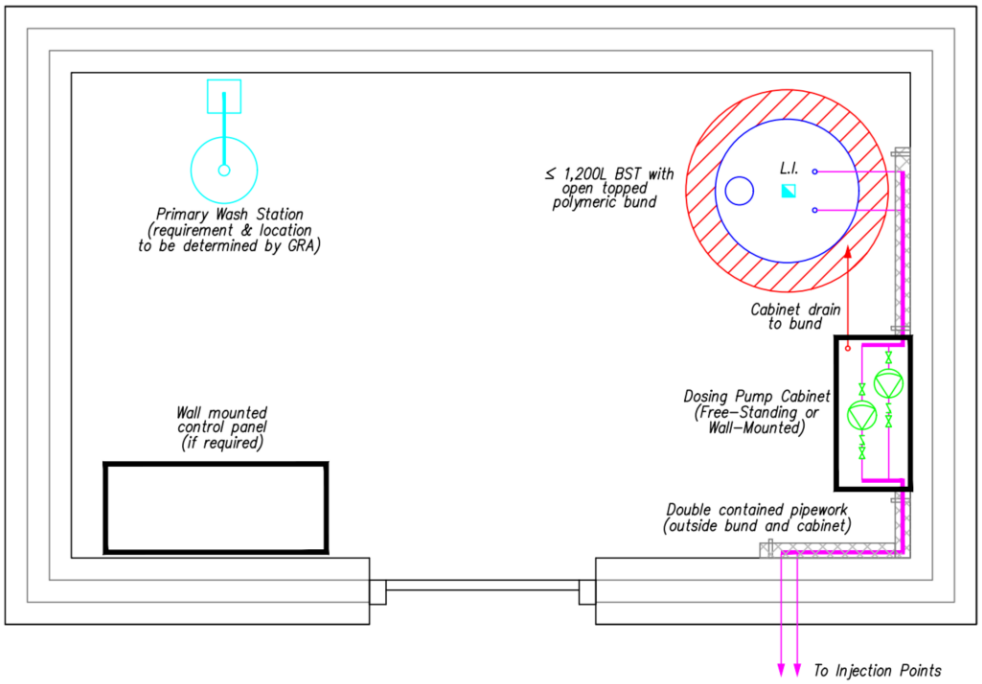

Figure 2: Indicative layout for a single chemical with total BSV ≤ 1,200 litres.

6.2.2 Indicative Layout No.2 – Total BSV ≤ 3000 Litres

Figure 3 illustrates a chemical storage system where the total BSV ≤ 3,000 litres. The installation is located indoors and a dual BST system (individual BST volume ≤ 1,500 litres), together with an open topped bund for each BST, will be required for storage. There is no day tank required, and a single duty dosing pump will be dedicated to each BST. The dosing pumps will be installed in a wall mounted dosing pump cabinet / kiosk, mounted above the bund level and complete with a drain to the bund. The dual BST system will act in a duty / standby configuration with automatic rotation as described in Section 8.1.8 of this document.

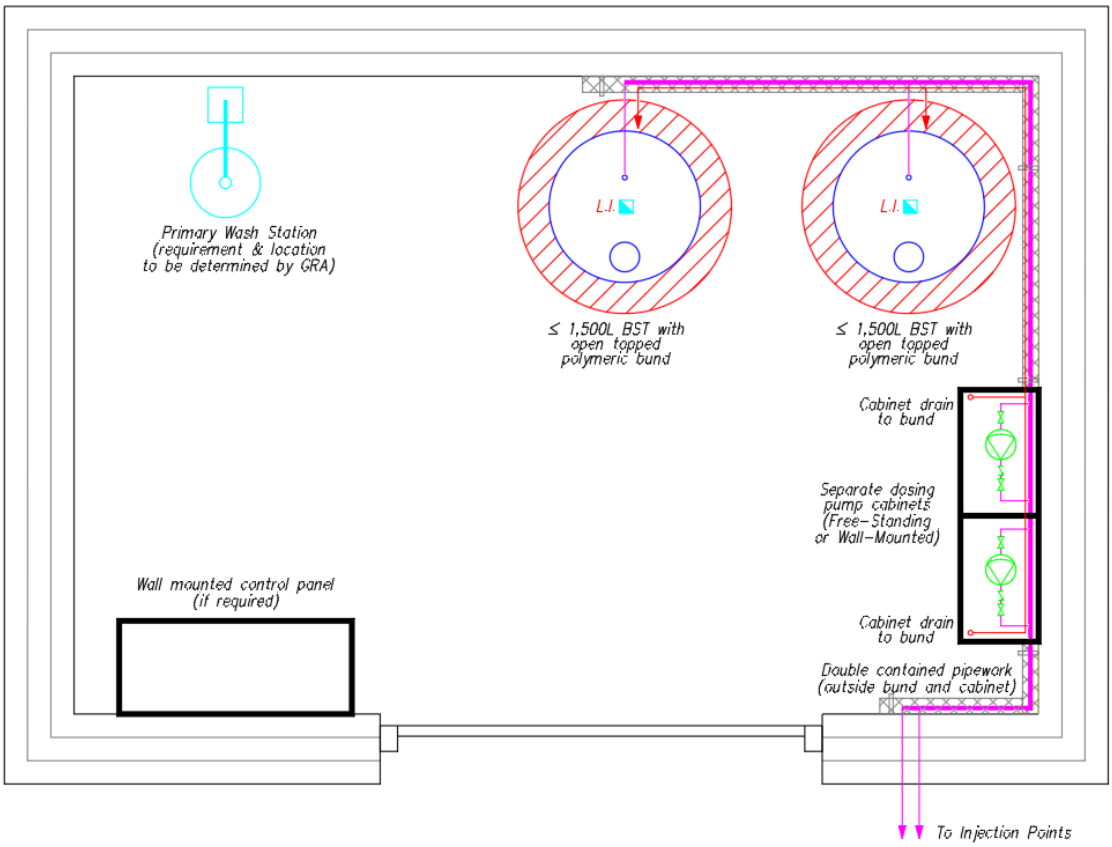

Figure 3: Indicative layout for a single chemical with total BSV ≤ 3,000 litres

6.2.3 Indicative Layout No.3 – Total BSV ≤ 12000 Litres

Figure 4 illustrates a chemical storage system where the total BSV ≤ 12000 litres. The installation is located outdoors and a dual BST system (individual BST volume ≤ 6000 litres), together with an integrated weather shrouded bund for each BST, will be required for storage. There is no day tank required, and a single duty dosing pump will be dedicated to each BST. The dosing pump will be installed in an integrated dosing pump cabinet / kiosk, mounted above the BST bund and complete with a drain to the bund. If the bund wall height exceeds 1.50m, an access stairs and platform of appropriate height, complete with suitably designed hand-railing and kick plate, shall be provided to permit safe access to all cabinets. The dual BST system will act in a duty / standby configuration with automatic rotation as described in Section 8.1.8 of this document.

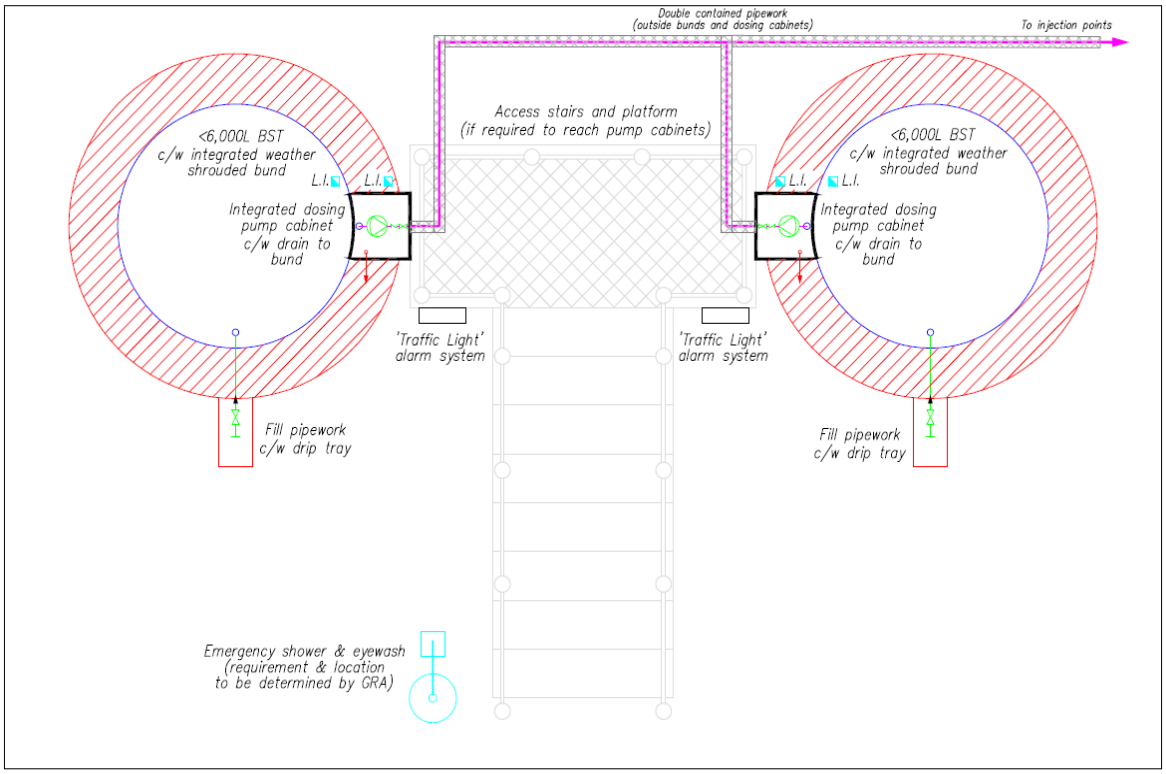

Figure 4: Indicative layout for a single chemical with total BSV ≤ 12000 litres

6.2.4 Indicative Layout No.4 – Total BSV > 12000 Litres (+ Indoor Day Tank)

Figure 5 illustrates a chemical storage system where the total BSV > 12000 litres. The installation is located outdoors and a dual BST system (individual BST volume > 6000 litres), together with an integrated weather shrouded bund for each BST, will be required for storage. A day tank shall be required, and a single duty transfer pump will be dedicated to each BST. The transfer pump will be installed in an integrated transfer pump cabinet / kiosk, mounted above the BST bund and completed with a drain to the bund. If the bund wall height exceeds 1.50m, an access stairs and platform of appropriate height, complete with suitably designed hand-railing and

kick plate, shall be provided to permit safe access to all cabinets. The dual BST system will act in a duty / standby configuration with automatic rotation as described in Section 8.1.8 of this document.

Day tanks with capacities ≤ 1,500 litres shall be installed indoors, and a duty/standby dosing pump arrangement shall abstract chemical directly from the day tank. The dosing pumps will be installed in a wall mounted dosing pump cabinet / kiosk, mounted above the bund level and complete with a drain to the bund. Automatic rotation between dosing pumps shall take place as described in Section 8.1.7 of this document. All day tanks shall be single tank installations, regardless of storage capacity.

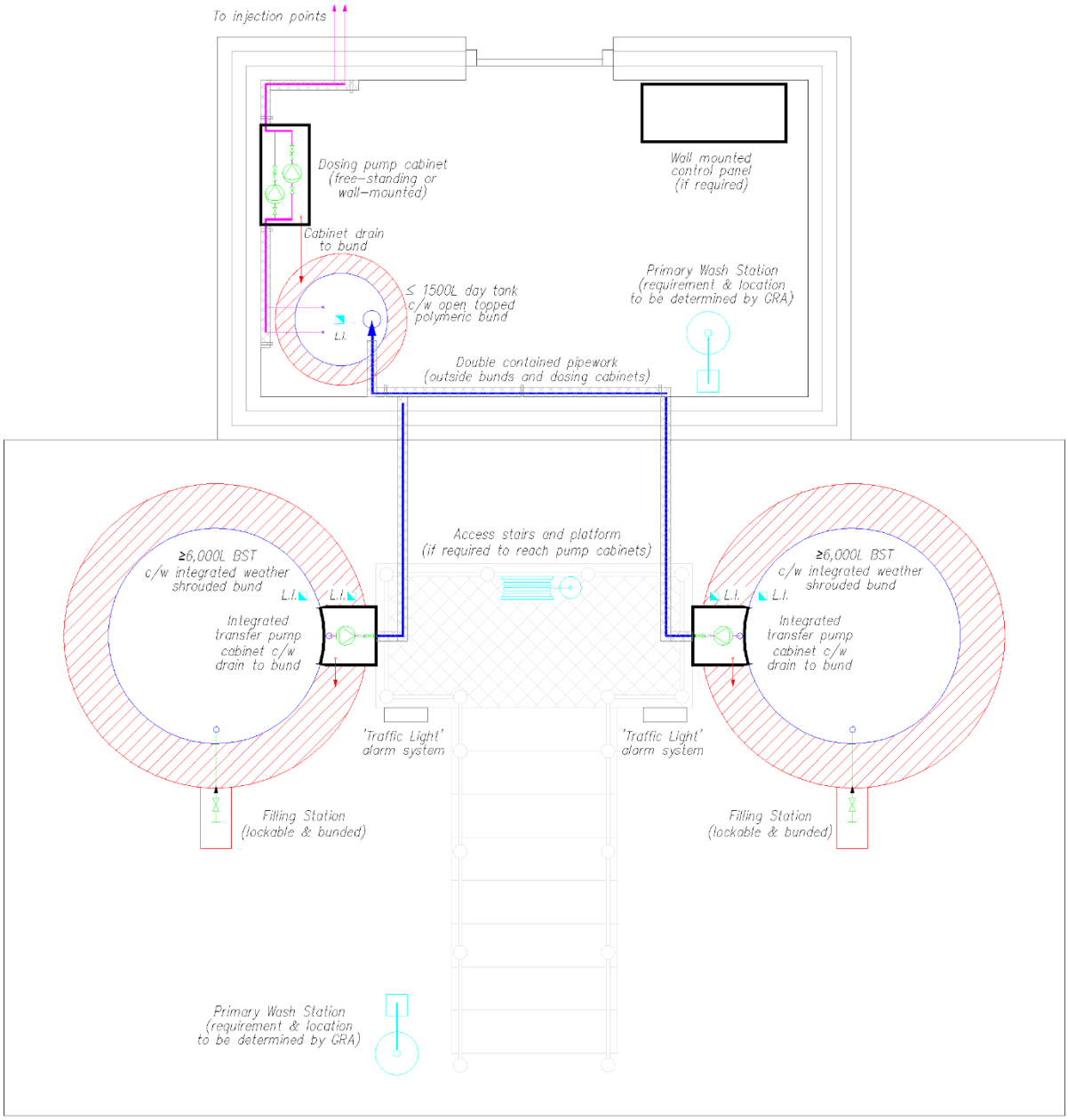

Figure 5: Indicative layout for a single chemical with total BSV ≥ 12000 litres & Indoor Day Tank

6.2.5 Indicative Layout No.5 – Total BSV > 12000 Litres (+ Outdoor Day Tank)

Figure 6 illustrates a chemical storage system where the total BSV > 12000 litres. The installation is located outdoors and a dual BST system (individual BST volume > 6000 litres), together with an integrated weather shrouded bund for each BST, will be required for storage. A day tank shall be required, and a single duty transfer pump will be dedicated to each BST. The transfer pump will be installed in an integrated transfer pump cabinet / kiosk, mounted above the BST bund and completed with a drain to the bund. The dual BST system will act in a duty / standby configuration with automatic rotation as described in Section 8.1.8 of this document.

Day tanks with capacities > 1,500 litres should be installed outdoors, and a duty/standby dosing pump arrangement shall abstract chemical directly from the day tank. The dosing pumps will be installed in an integrated dosing pump cabinet / kiosk, mounted above the day tank bund and completed with a drain to the bund. Automatic rotation between dosing pumps shall take place as described in Section 8.1.7 of this document. All day tanks shall be single tank installations, regardless of storage capacity.

If the bund wall on either the BST or day tank exceeds a height 1.50m, an access stairs and platform of appropriate height, complete with suitably designed hand-railing and kick plate, shall be provided to permit safe access to all pump cabinets.

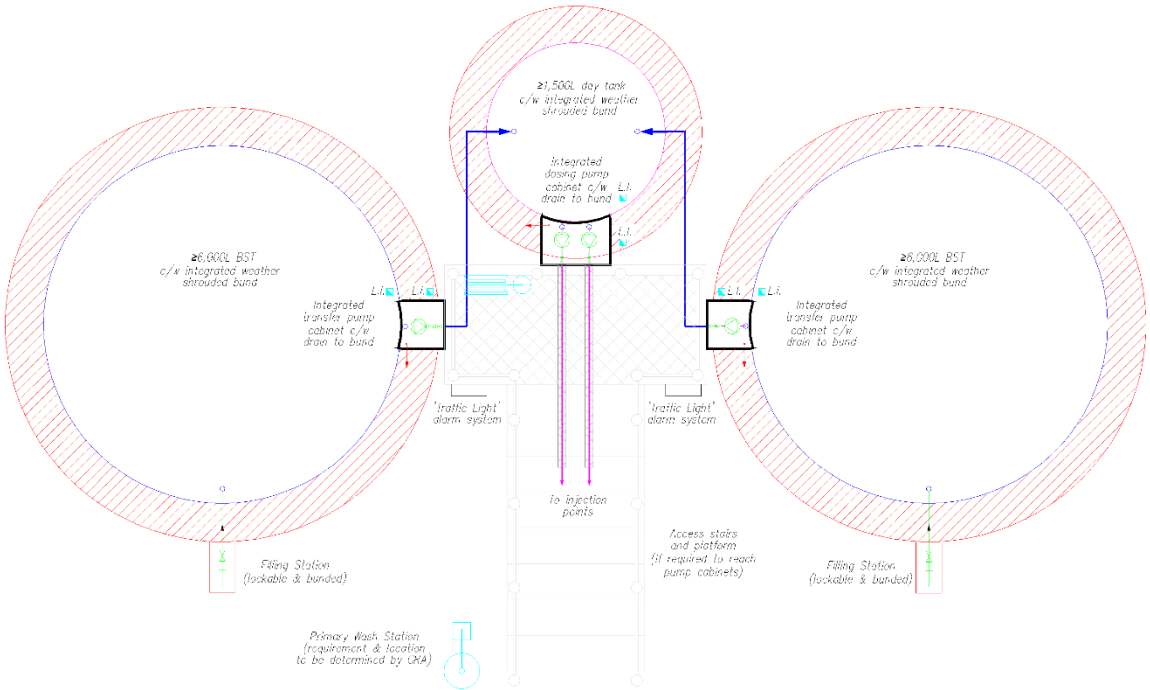

Figure 6: Indicative layout for a single chemical with total BSV ≥ 12000 litres & Outdoor Day Tank.

6.3 SULPHURIC ACID STORAGE

Due to the specific risks and difficulties associated with the long term storage of sulphuric acid, additionally to the general requirements detailed in other sub-sections, the following specific requirements shall be met by the proposed sulphuric acid storage system:

- Pre-approved materials of construction are as outlined in Table 6 and Table 7
- Carbon steel and mild steel shall not be used in the construction of sulphuric acid storage tanks, neither in direct contact with sulphuric acid, nor as a lined core.
- Lined thermoplastic or GRP tanks may only be proposed up to 2,500 L individual tank capacity or 5,000 L total Bulk Storage Volume
- Lined thermoplastic or GRP tanks shall comply with the following:
    - All potential wetted surfaces (including but not limited to: BST internal surface, BST external surface to bund depth, bund internal surface) shall be made of, or appropriately lined with, a resistant material, as listed in Table 8, or by a material specifically certified for resistance to sulfuric acid
    - The tank shall be isolated from the bund floor and raised by >100mm, to allow for the cleaning of the surface of the bund floor without the need to remove any element of the storage system, e.g. by the use of planks raising an open grid decking supporting the storage tank, all made of appropriate materials.
    - The tanks shall be structurally rated and certified for the specific gravity of 96% sulphuric acid
- Chemical compatibility statements/certificates for each of the specific compounds intended to be used for the production of the tank or bund liner, shall be submitted for approval before manufacture, accompanied by test reports in compliance with EN ISO 175.The use of 50% Sulphuric Acid may be considered on sites where individual tank volume is ≤ 2,500L or Bulk Storage Volume is ≤ 5,000 L to allow the use of unlined thermoplastic materials. However, the use of 50% Sulphuric Acid and the use of unlined thermoplastic storage tanks may only be proposed if the TOTEX benefit can be demonstrated compared to the use of 96% sulphuric acid with approved storage materials. The TOTEX analysis shall specifically consider any OPEX cost changes such as those resulting from increased delivery frequency or increased chemical usage volume of the more dilute chemical.
- For the containment of steel storage tanks, appropriately lined or coated concrete bunds may be considered, complying with the requirements outlined in Section 7.5. In addition to the requirements of Section 7.5, the installation shall also comply with the following:
    - The design shall specifically consider and mitigate buoyancy of any elements of the storage system.

- The bund shall incorporate a coated/lined plinth, or equivalent, to support and raise the storage tank by >100mm, to allow for the containment of minor spills without the exposure of the external surface of the storage tank to the spilled material.
- The tank shall be isolated from the plinth to allow for the cleaning of the surface of the plinth and the bund without the need to remove any element of the storage system, e.g. by the use of planks raising an open grid decking supporting the storage tank, all made of appropriate materials.
- The bund shall be lined or coated by a pre-approved material as listed in Table 11, or by a specialist coating system independently certified for resistance to sulfuric acid.

Approved materials of construction for the storage of 96% Sulphuric Acid	Tank Size > 2,500 L	Tank Size ≤ 2,500 L
Unlined Special Alloy SS 904L	ü	ü
Unlined Equivalent Special Alloy [1)]	ü	ü
Lined [2)] Thermoplastic and GRP	-	ü

Table 6: Approved materials of construction for the storage of 96% Sulphuric Acid

Approved materials of construction for the storage of 50% Sulphuric Acid	Tank Size > 2,500 L	Tank Size ≤ 2,500 L
Unlined Special Alloy SS 904L	-	ü
Unlined Equivalent Special Alloy [1)]	-	ü
Lined [2)] Thermoplastic and GRP	-	ü
Unlined Suitable Thermoplastic	-	ü

Table 7: Approved materials of construction for the storage of 50% Sulphuric Acid

1) The Contractor may propose the use of an equivalent special alloy not listed below by submitting a derogation application in accordance with TEC-600-06. Pre-approved SS 904L equivalent special alloys are:
   - WNr. 1.4563 / Alloy 28 / EN X1NiCrMoCuN31-27-4
   - WNr. 2.4660 / Alloy 20 / EN NiCr20CuMo
   - WNr. 2.4858 / Alloy 825 / EN NiCr21Mo
2) Pre-approved lining materials are listed in Table 8.

7 EQUIPMENT SPECIFICATION

The Water Industry Mechanical and Electrical Specifications (WIMES) shall form the basis of equipment selection, installation and testing for all liquid bulk chemical storage systems and, in tandem with this document, should be used as a reference point by project stakeholders to ensure compliance with Uisce Éireann requirements.

In addition to the particulars outlined in the WIMES documents, Uisce Éireann has a range of specific requirements for each piece of equipment, which are outlined in the following sections and in **TEC-200 General Mechanical and Electrical Specifications** suite of documents by Uisce Éireann.

While the appointed Contractor shall retain the responsibility for the detailed design of the liquid bulk chemical storage systems, minimum Uisce Éireann requirements must be met for all installed equipment.

This section of the specification outlines Uisce Éireann's minimum requirements in relation to the equipment which forms the constituent parts of each liquid bulk chemical storage system including tanks, bunds, pumps, pipework, instruments, etc. The Contractor shall ensure that all equipment proposed is compliant with the details outlined herein.

Note that where an Uisce Éireann requirement contradicts a WIMES particular, the Uisce Éireann requirement shall take precedence. Should the Contractor wish to deviate from any of the requirements outlined in this section of the specification, they shall submit a Derogation Application as described in Section 3.3 of **TEC-600-06**.

7.1 GENERAL TANK DESIGN

The Contractor shall adhere to details outlined in the following sections of the specification when selecting bulk storage tanks, day tanks or bunds for the storage of liquid chemicals. In addition to the information outlined below, all bulk storage tanks, days tanks and bunds proposed for installation shall comply with CIRIA Document '*C598 – Chemical Storage Tank System – Good Practice*'.

7.1.1 General Design Criteria

All bulk storage tanks, day tanks and bunds proposed for the storage of liquid chemicals shall comply with the following general design criteria:

- All bulk storage tanks proposed shall be designed, constructed and tested in accordance with the relevant standard from the following list:
  - Dual Laminated GRP Tanks — I.S. EN 13121
  - Thermoplastic Tanks — I.S. EN 12573, DVS 2205
  - Polyethylene Tanks (moulded) — I.S. EN 13575

- Vertical Steel Tanks (site fabricated) I.S. EN 14015
- Horizontal Steel Tanks (shop fabricated) I.S. EN 12285-2

- All thermoplastic tanks proposed shall be designed with an overall safety factor (S) of 2.0 (Category 2.0) as defined in I.S. EN 12573.
- All dual laminate or GRP tanks proposed shall be designed, manufactured and tested in accordance with Category 1.0 or Category 2.0, as appropriate, and as described in I.S. EN 13121.
- Each tank and bund design shall consider all applicable structural loads (or combinations of loads), including but not limited to:
  - The static head of the stored chemical (operating and test conditions)
  - The specific gravity of the stored chemical
  - The combined weight of the tank and the stored chemical
  - Wind and snow loads (if tanks are located outdoors)
  - Loads applied during transport and erection
  - Loads imposed by personnel during erection and operation
- The Contractor / tank manufacturer shall provide Uisce Éireann, or their representative, with a list of all major design assumptions made during tank and bund selection, prior to the tank and bund being approved for manufacture or procurement. These design assumptions shall include, but not be limited to;
  - Tank and bund design life (confirmation of compliance with the requirements of Section 7.1.3)
  - Number of fill cycles (confirmation of compliance with the requirements of Section 7.1.3)
  - Corrosion allowance
  - Delivery temperature of the dosing chemical
  - Details of loads considered
  - Details of chemical properties and application details considered (storage depth, specific gravity of chemical, etc)
- All acid storage tanks (i.e. Sulphuric acid, Orthophosphoric acid, Hydrofluosilicic acid, etc) with a volume ≥ 1,000 L shall be isolated and separated from the bund floor as described in Section **Error! Reference source not found.**:
  - The tank shall be isolated from the bund floor and raised by >100mm, to allow for the cleaning of the surface of the bund floor without the need to remove any element of the storage system, e.g. by the use of planks raising an open grid decking supporting the storage tank, all made of appropriate materials.
- All tanks are to be provided with certification confirming completion of spark testing and hydrostatic testing at the factory prior to installation

- All tanks are to be provided with a certificate or statement by the manufacturer confirming chemical compatibility and resistance
- All tanks are to be provided with a design certificate or statement by the manufacturer confirming structural suitability for the specific application
- Intermediate Bulk Containers (IBCs) shall not be accepted as a permanent liquid chemical storage solution, and shall only be used for temporary works or for completion of chemical deliveries.
- If the Designer proposes a system is to be installed in an existing room / building, then they shall demonstrate, to the satisfaction of Uisce Éireann or their representative, the suitability of that building for use, i.e. show that the building is large enough to accommodate all relevant features of the General Design and show how it will be implemented within the existing structure in accordance with the appropriate Indicative Layout diagram
- The Designer shall also allow for any remedial works which may be required to ensure the building has adequate heat insulation, security against unauthorised access, forced air ventilation to the outside of the building, lighting, power supply, water supply and is structurally sound. Note that existing blockwork walls will not be permitted to act as bunded containment .
- Where concrete bunds are proposed they shall be of purpose built cast in-situ concrete construction in accordance with BS8007:1987 Design of Concrete Structures for Retaining Aqueous Liquids, even if proposed within existing rooms or buildings.
- Concrete bunds, if proposed for sulphuric acid applications, shall be appropriately lined in accordance with TEC-600-06. Uisce Éireann will reserve the right to reject any proposed design that does not meet the above criteria.
- For all installations, dosing pumps shall be mounted in a dedicated dosing pump cabinet, with a clear polycarbonate door to allow the plant operator to view the pumps without opening the cabinet.
- The cabinet shall incorporate a drain at its base, with all spillages due to pump/pipework disconnection routed to the make-up tank bund. If the pumps are too large for a cabinet, they shall be installed within a concrete bunded area separate from the make-up tank bund.
- All non-return valves and isolation valves used in the isolation of the dosing pumps shall also be contained within this dosing cabinet or bund.
- The dosing cabinet may be wall mounted, or mounted on a stainless steel access platform if proposed. The installation location of the pumps should not interfere with the day to day operational duties of the plant, and shall not cause an obstruction to routine operational duties, i.e. they shall never have to be temporarily moved to facilitate duties such as chemical replenishment.
- For all Indicative Layouts proposed, the Designer shall ensure that direct and unobstructed access to the bulk tanks and pumping system is available at all times to allow completion of routine operational duties.

- For all Indicative Layouts proposed, the Designer shall ensure that direct and unobstructed access to the bulk tanks and pumping system is available at all times to allow completion of routine operational duties. This shall apply regardless of whether the system is part of an upgrade to an existing facility, a retrofit of an existing pH / alkalinity suppression system or an installation as part of a complete new build treatment works (or part thereof).
- The Designer shall ensure that all indoor areas which contain installations associated with sulphuric acid based pH / alkalinity suppression systems shall be dry environments that can be maintained at a temperature of between 10°C - 20°C, in all climatic conditions down to a minimum external air temperature of -18°C. This is to be achieved by the installation of a thermostatically controlled heating and ventilation system.
- An emergency shower and eyewash shall be provided within the dosing building and shall be supplied with a water pressure of between 2–3 bar. As a shower tray constitutes a trip hazard, especially if an operator's sight has been compromised by exposure of their facial area to a hazardous chemical, the floor area surrounding the shower should be sloped towards the drain in order to prevent flooding of the floor area.
- Where an emergency shower is installed indoors in a temperature controlled area, there shall be no requirement for insulation or heat tracing. Outdoor installations shall require trace heating.
- Bulk tanks will be provided with ultrasonic level measurement, and the bunds will incorporate a leak detection system which will also take the form of a level measurement device.
- All chemical storage tanks (bulk and day tanks) shall be provided with a covered emergency Chemical Spill Tank constructed under or adjacent to the chemical fill hard-standing area. Unless otherwise stated in the Employer's Requirements the tank shall have a holding capacity of at least 6m3 or 25% of the total storage volume, which ever is larger, with an additional freeboard of 300mm. The tank shall be positioned at a location where gravity discharge from the gullies draining the chemical fill hard standing area will be possible to the tank top water level.
- A 'traffic light' alarm system, controlled by the ultrasonic level sensors in each bulk tank shall allow the chemical delivery operator to determine when the tank is full.
- While Uisce Éireann accepts that certain site variations may apply with regard to pipework routes, electricity supplies, access, etc., particularly on existing treatment facilities, the basic process, control systems, and installation layout as described in the General Design and Indicative Layout sections of this document should not be altered without receipt of prior approval from Asset Strategy (Water Treatment).
- Leak detection level indicators (LI003) shall be provided in all bunds, as shown in the schematics, and shall be of probe type instruments (conductivity probes, capacitance probes, etc.). Ultrasonic level probes will not be permitted for use as leak detection as they may return a loss of echo

signal during normal operation. All bunds are to have the capacity to hold 110% of the volume of one of the bulk tanks.

7.1.2 Material Compatibility

Materials pre-approved for the manufacture and/or lining of bulk storage tanks and day tanks are outlined in Table 8 below. For all storage tank proposals, the Contractor shall ensure that the material of manufacture/lining shall be of a grade that is deemed most appropriate for the hazard classification of the chemical in question, and compatible with the chemical, at the storage concentrations proposed.

The Contractor shall not however, rely solely on the information outlined in Table 8, and all material selection for bulk storage tanks shall take site specific conditions into account. The Contractor shall at all times consult the chemical tank manufacturer / supplier to determine the chemical resistivity properties of the materials proposed, and its suitability for the storage and containment of the chemical in question. Should the Contractor propose the use of a material not listed in Table 8 or otherwise in this document, supporting evidence of chemical compatibility and suitability of the specific material (such as: chemical resistance test certificate, chemical compatibility statement, etc.) shall be submitted for review and approval prior to manufacture. General chemical compatibility charts will not be acceptable as proof of resistance/suitability.

	Allowable Dosing Concentrations (% w/w)	SS904L	LDPE	HDPE	PP	PTFE	PVC	PVDF
Aluminium Sulphate	20 - 30%				ü	ü	ü	ü
Ferric Chloride	40% - 50%		ü	ü	ü	ü	ü	ü
Ferric Sulphate	40% - 50%		ü	ü	ü	ü	ü	ü
Ferric Nitrate	0% - 45%				ü	ü	ü	ü
Hydrofluosilicic Acid	10.9%			ü	ü	ü	ü	ü
Orthophosphoric Acid	75%			ü	ü	ü		ü
Poly-aluminium Chloride	10% or 18%			ü	ü	ü	ü	ü
Potassium Permanganate	4% - 5%					ü		ü
Sodium Hydroxide	25% or 30%			ü	ü	ü	ü	ü
Sodium Hypochlorite	10%					ü	ü	ü
Sodium Nitrate	0% - 50%		ü	ü	ü	ü	ü	ü
Sulphuric Acid	96%	ü				ü		ü
Sulphuric Acid	50%		ü	ü	ü	ü		ü

Table 8: Approved materials of construction for tank manufacture & lining.

The details outlined in Table 8 assumes that the concentrations of delivered chemicals are compliant with those outlined in Table 2 and Section 6.3. of **TEC-600-06**.

The Contractor shall submit a Wetted Parts Schedule with their design proposal, to detail selected material of

construction for all parts and components of the chemical storage system that can come into contact with the stored or conveyed chemical.

Other materials of construction may be required by the specific application, and proposed by the Contractor by submitting a Derogation Application in accordance with **TEC-600-06**.

7.1.3 Design Life

All bulk storage tanks, day tanks and bunds proposed shall have a design life of 20 years. The design life of polymeric tanks is often measured in fill cycles rather than years, with one cycle being the equivalent to one fill and one emptying. For the purposes of this specification, one cycle shall be considered complete if the tank has been emptied to below 50% of its capacity, and subsequently replenished.

The Contractor shall ensure that all proposed storage tanks are designed to permit an adequate number of fill cycles to allow the tank to be used for the minimum design life of 20 years. The Contractor shall submit with their proposals, the expected frequency of replenishment, as well as the number of cycles that the tank is rated for. The minimum number of fill cycles required shall be 1,000 for bulk storage tanks and 10,000 for day tanks.

7.1.4 UV Stabilisation

Exposure to ultraviolet (UV) light shall not reduce the design life of bulk storage tanks, day tanks or bunds to below the minimum requirements. The Contractor shall ensure that all polymeric tanks and bunds proposed for outdoor installation are adequately protected from degradation by the use of UV stabilizers, which shall absorb UV light and thereby prevent the formation of free radicals. In cases where the tank is insulated, an outer skin shall surround the insulation material and shall also be protected from degradation by the use of UV stabilizers.

7.1.5 Stainless steel and special alloy fabrications

Manufacturers of stainless steel chemical storage tanks and associated components shall be certified by an independent body in accordance with the requirements of I.S. EN 1090 (EXC2) and I.S. EN ISO 3834-2. Manufacturers of stainless steel chemical storage tanks fabricated of stainless steel materials other than SS 304/304L and SS 316/316L (i.e. special alloys) should be certified to EXC3 in accordance with I.S. EN 1090.

The fabrication process shall be planned by a competent person and in accordance with I.S. EN 1090-2. Welding procedure shall be specified by a competent person in accordance with I.S. EN ISO 15607-15609. The welding procedure should be specified based on pre-production weld tests for all materials other than SS 304/304L and SS316/316L, in accordance with I.S. EN ISO 15613. Welders and welding operatives executing welds shall be qualified as specified in I.S. EN ISO 9606, supervised by a competent welding coordination person qualified in accordance with I.S. EN ISO 14731.

A fabrication and weld testing plan shall be submitted to Uisce Éireann for review. At a minimum, 100% of the welds shall be visually inspected and an appropriate amount of non-destructive testing shall be carried out on

the completed welds. The Contractor shall submit the documentation related to the fabrication process, including copies of the relevant certificates, qualifications, WPSs, etc., upon request by Uisce Éireann.

7.2 BULK STORAGE TANKS

The Contractor shall adhere to details outlined in the following section of the specification when selecting bulk storage tanks for the long term storage of liquid chemicals.

7.3.1 Bulk Storage Tanks General Requirements

All bulk storage tanks and non-concrete bunds for shall be designed in accordance with TEC-600-06 Chemical Storage Systems and referenced documentation outlined therein. Bulk storage tanks shall be manufactured from materials capable of immunity from the corrosive capability of the specified chemical solution and have a design life of 20 years.

Vent(s) shall be provided on all bulk tanks in excess of 1000 litre capacity and should be sized at 100-150% of fill pipe diameter to prevent excess pressures or vacuums during filling. Vents shall be terminated at a suitable external location, remote from air intakes, doors, windows, and parked vehicles, in a downward aspect with a fine corrosion resistant mesh to prevent contamination. Fill points should be located directly over containment areas and provision should be also made for a ball shut off valve to prevent backflow of chemical when the supply hose is disconnected, and to guard against any unauthorized filling without the presence of appropriate site personnel.

Where non transparent bulk tanks are proposed, an audible and visual alarm activated by the ultrasonic level sensor mounted in each bulk tank shall allow the chemical delivery operator determine when the tank is full without monitoring the levels on the HMI screen. The visual element of this alarm shall take the form of a traffic light system as described in TEC-600-06-01. The visual indicator shall be mounted over each of bulk tanks in the storage room/area (one indicator for each bulk tank). The traffic light system can remain active over each of the bulk tanks during normal operations as a means to notify the plant operator that chemical replenishment is required.

All liquid deliveries are to be made in accordance with Section 6.2 of both WIMES 8.02 and WIMES 8.02(C). Bulk storage tanks and valved fill stations should be clearly labelled with the chemical name, its 4 digit UN number and its chemical formula.

For outdoor installations, fill point valves shall be lockable so that they can only be opened by the plant operator. All polymeric bulk tanks proposed for outdoor installation shall be self bunded and each bund shall be weather

protected to prevent against the ingress and retention of rainwater.

Each self-contained bund shall also incorporate a leak detection system to alert the operator of a bulk tank failure. Bund capacity shall be 110% of the storage capacity of the bulk tank.

Where there the UE project team confirms that there is a risk of freezing due to the specific chemical used, all outdoor tanks shall also incorporate an automated heating system to maintain a bulk chemical temperature of over 5°C in all climatic conditions to a minimum external air temperature of -18°C.

7.4.1 Indoor Bulk Storage Tanks

Indoor bulk storage tanks shall be in compliance with the features listed below where appropriate to the specific chemical proposed for storage:

- All tanks shall be thermoplastic with smooth internal and external surfaces
- All tanks shall be manufactured from materials suitable for prolonged exposure to the stored chemical in accordance with the approved materials of construction (see Table 8) and as verified by the GRA
- Where permissible by material compatibility with the stored chemical, all indoor tanks shall be made of translucent material to permit visual leak detection and level inspection
- All tanks shall be graduated to permit visual quantification of liquid level
- All tanks shall be cylindrical, with a split-level, flat-top design which permits the installation of level instrumentation
- All tanks shall, at a minimum, incorporate the following ports, which shall be located on the tank's flat top:
  - Filling port c/w screw cap
  - Extraction port for the connection of pump suction lines
  - Instrument port suitable for the mounting of appropriate level instrument
  - Ventilation port (if required – chemical dependant)
- Tanks with ports located in any area other than the split-level, flat top area shall not be accepted for indoor installation.
-
- All fill points shall be located within the chemical dosing room/area so that there is assurance that the correct bulk tank is being replenished, and that chemical delivery personnel cannot access the fill point without the presence of the plant operator (minimising risk of incorrect chemical being delivered).
- Fill points should also be located over a bund so that spillages during disconnection of filling pipes are contained. For outdoor installations, fill point valves shall be lockable so that they can only be opened by the plant operator
- Each indoor storage tank proposed shall be installed in an appropriately dimensioned bund which shall provide storage equivalent to 110% of the tank's maximum capacity (see Section 7.5 for bund details).

- Where translucent material is inappropriate for use due to non-compatibility with the stored chemical, the distance between the tank wall and the open topped bund shall be sufficient to permit visual leak detection (minimum of 300mm distance between tank wall and bund, or minimum of 600mm diametrical difference).
- Sticker based nameplate outlining critical tank information (see Section 7.11 for further details)
- Each bulk tank is to be provided with ultrasonic level measurement, and the bunds will incorporate a leak detection system which will also take the form of a level measurement device. A 'traffic light' alarm system, controlled by the ultrasonic level sensors in each of the bulk tanks shall allow the chemical delivery operator to determine when the tank is full.

7.4.2 Outdoor Bulk Storage Tanks

Outdoor bulk storage tanks shall be in compliance with the features listed below where appropriate to the specific chemical proposed for storage:

- All polymeric BSTs proposed for outdoor installation shall be of a suitable construction intended for outdoor use .
- All BSTs shall have smooth internal and external surfaces.
- All materials used for manufacture / lining of tanks shall be suitable for prolonged exposure to the stored chemical in accordance with the approved materials of construction (see Table 8) and as verified by the GRA
- All BSTs proposed for outdoor installation shall be vertical, free standing, cylindrical tanks complete with conical roofs.
- The aspect ratio for all BSTs shall be within the range of 1:1 to 1:3 (i.e. the tank height shall at a minimum be equal to the tank diameter, and at a maximum be equal to three times the tank diameter.
- Roofs of all outdoor tanks shall be self-draining with an established system for preventing moisture ingress.
- Insulation should comply with the good practice guidelines listed in CIRIA Document C598.
- All BSTs proposed for outdoor installation shall be supplied with, at a minimum, a 50mm layer of insulating material with a thermal conductivity of 0.038 $W.m^{-1}.K^{-1}$, or better.
- All insulated tanks shall be provided with an external protective 'skin' of at least 6mm, which shall protect the layer of insulating material from moisture ingress or UV degradation.
- All BSTs proposed for outdoor installation shall be supplied with an integrated weather shrouded bund.
- Integrated bunds shall not share a common floor with the BST (i.e. there shall be two barriers against leakage through the base of the BST – the bund floor and the BST floor).
- Integrated bunds shall be welded to the BST at the base perimeter of the BST. The weather shroud shall be welded to the BST at the level at which they meet.

- All bulk tanks proposed for outdoor installation shall be self bunded and each bund shall be weather protected to prevent against the ingress and retention of rainwater.
- Each self-contained bund shall also incorporate a leak detection system to alert the operator of a bulk tank failure. Bund capacity shall be 110% of the storage capacity of the bulk tank.
- Where the UE project team agree bulk chemical freezing is a significant risk, all outdoor tanks shall also incorporate an automated heating system to maintain the bulk at a temperature of over 5°C in all climatic conditions to a minimum external air temperature of -18°C. This judgement should be made based on site specific climate and the freezing point of the specific chemical stored.
- All BSTs proposed for outdoor installation shall be supplied with the following accessories:
  - Filling line complete with tanker connection (male / female) and lockable isolation valve
  - Filling line drain point complete with lockable drain valve
  - Drip tray mounted beneath filling line (all tanks < 6000 litres)
  - Filling station complete with integrated bund (all tanks ≥ 6000 litres)
  - Suitably sized overflow pipe (see Section 7.6.2 for further details)
  - Suitably sized ventilation pipework (see Section 7.6.4 for further details)
  - Integrated dosing pump / transfer pump cabinet / kiosk, mounted above the bund c/w drain to bund
  - Personnel access and inspection ports at appropriate locations (on BST and integrated bund)
  - Immersion heating systems (as required)
  - Visual level indication (cat & mouse / pneumatic level / clear tube level)
  - Access ladders and platforms (if necessary to access elevated manways and ports)
  - Drain point with lockable valve (for both BST and integrated bund)
  - All necessary ports / connections for specified or required pipework (for both BST and bund)
  - All necessary ports / connections for specified or required third party devices (level instruments, immersion heaters, etc.)
  - Lifting and securing points (SWL marked)
  - Embossed nameplate fixed to the BST or integrated bund outlining critical tank information (see Section 7.11 for further details)

7.3 DAY TANKS

The Contractor shall adhere to details outlined in the following section of the specification when selecting day tanks for the short term storage of liquid chemicals.

7.4.3 Day Tanks General Requirements

All day tanks shall be manufactured from materials capable of immunity from the corrosive capability of the specified chemical solution and have a design life of 10 years. Where required, chemical transfer between the bulk tank and the day tank shall be performed by a dedicated transfer pump, which shall be controlled by the

ultrasonic level sensors mounted in the bulk tank and the day tank. It should be noted, that days tanks are not permitted for sulphuric acid installations

7.5.1 Indoor Day Tanks

Indoor day tanks shall be in compliance with Section 7.4.1 of this document (Indoor Bulk Storage Tanks), with the following amendments:

- The filling port c/w screw cap shall be replaced by a port which is secured to a dedicated filling line, which shall be pressurised by the associated transfer pump.
- A ventilation port shall always be provided to prevent over pressurisation of the tank during filling.

7.5.2 Outdoor Day Tanks

Outdoor day tanks shall be in compliance with the features listed below where appropriate to the specific chemical proposed for storage:

- All polymeric day tanks proposed for outdoor installation shall be of a suitable construction intended for outdoor use .
- All GRP or dual laminate day tanks shall be one-piece moulded with smooth internal and external surfaces.
- All materials used for manufacture / lining of tanks shall be suitable for prolonged exposure to the stored chemical in accordance with the approved materials of construction (see Table 8) and as verified by the GRA
- All day tanks proposed for outdoor installation shall be vertical, free standing, cylindrical tanks complete with conical roofs.
- The aspect ratio for all outdoor day tanks shall be within the range of 1:1 to 1:3 (i.e. the tank height shall at a minimum be equal to the tank diameter, and at a maximum be equal to three times the tank diameter).
- Roofs of all outdoor tanks shall be self-draining with an established system for preventing moisture ingress.
- Insulation should comply with the good practice guidelines listed in CIRIA Document C598.
- All day tanks proposed for outdoor installation shall be supplied with a 50mm layer of insulating material with a thermal conductivity of 0.038 $W.m^{-1}.K^{-1}$, or better.
- All insulated tanks shall be provided with an external protective ‘skin’ of at least 6mm, which shall protect the layer of insulating material from moisture ingress or UV degradation.
- All day tanks proposed for outdoor installation shall be supplied with an integrated weather shrouded bund.
- Integrated bunds shall not share a common floor with the day tank (i.e. there shall be two barriers against leakage through the base of the day tank – the bund floor and the day tank floor).
- Integrated bunds shall be welded to the day tank at the base perimeter of the day tank. The weather shroud shall be welded to the day tank at the level at which they meet.

- All day tanks proposed for outdoor installation shall be supplied with the following features:
  - Dual transfer lines from bulk storage tanks (one transfer line from each BST) c/w isolation valves
  - Transfer line drain point complete with lockable drain valve and drip tray mounted beneath
  - Suitably sized overflow pipe (see Section 7.6.2 for further details)
  - Suitably sized ventilation pipework (see Section 7.6.4 for further details)
  - Integrated dosing pump cabinet / kiosk, mounted above the bund c/w drain to bund
  - Personnel access and inspection ports at appropriate locations (on day tank and integrated bund)
  - Immersion heating systems
  - Visual level indication (cat & mouse / pneumatic level / clear tube level)
  - Access ladders and platforms (if necessary to access elevated manways and ports)
  - Drain point with lockable valve (for both day tank and integrated bund)
  - All necessary ports / connections for specified or required pipework (for both day tank and bund)
  - All necessary ports / connections for specified or required third party devices (level instruments, immersion heaters, etc.)
  - Lifting and securing points (SWL marked)
  - Embossed nameplate fixed to the day tank or integrated bund outlining critical tank information (see Section 7.11 for further details)
  - Bund leakage alarm probe

7.4 TANK CONNECTIONS

The Contractor shall adhere to details outlined in the following section of the specification when selecting and sizing tank connections.

7.6.1 Filling Lines

Filling lines shall be provided on all tanks with storage capacities ≥ 1200 litres, and the Contractor shall ensure that the destination tank is clearly visible from the tanker connection point. For each tank, an individual filling line shall be proposed and shall be provided with the following features:

- Tanker connection (male / female) and lockable isolation valve
- Filling line drain point complete with lockable drain valve
- Isolation valves and non-return valves to prevent spillage of chemicals during replenishment.
- Drip tray with carrier handles mounted beneath tanker connection (for tanks < 6000 litre capacity). A drain valve shall be connected to the drip tray in order to avoid any handling by site personnel of the drip tray itself should leakage occur.
- Filling cabinet / kiosk, free standing and c/w lockable access door and integrated bund (for tanks ≥ 6000 litre capacity)

- Filling lines shall be securely fastened to prevent mechanical vibration during filling activities.
- Filling lines shall be sized to ensure that consequent filling velocities do not damage the pipe or otherwise risk the integrity of the storage system.
- For metal based fill pipework, pipe size also shall be selected to ensure filling velocities are such that passivated layers formed on pipework of iron based material are not at risk of erosion during replenishment.

7.6.2 Overflow Lines

Overflow lines shall be provided on all tanks with storage capacities ≥ 1200 litres, and shall incorporate the following features:

- The overflow pipe shall be a sized in accordance with Table 9 and discharge appropriately into the bunded area.
- The overflow line shall be located opposite to the filling line's point of entry to the storage tank and above 'high' tank fill alarm levels
- The invert level (or weir level) of the overflow shall be positioned an appropriate distance above the top liquid level of the tank, in accordance with Table 9.

Tank volume	Overflow pipe size (internal)	Headroom clearance
< 6,000 litres	Ø 100 mm	200 mm
≥ 6,000 litres	Ø 150 mm	350 mm

Table 9: Tank overflow requirements

7.6.3 Dosing / Transfer Pump Connection Point

Abstraction points for the connection of chemical dosing pumps / transfer pumps shall be provided on all BST and day tanks, and shall incorporate the following features:

- Dosing / transfer pump connection points shall be at a high level on all tanks with capacities < 1200 litres
- Dosing / transfer pumps connection points shall be at a low level on all tanks with capacities ≥ 1200 litres but shall rise within the weather shrouded bund to the level of the dosing / transfer pump cabinet.
- Foot valves for both low level and high level connections shall be elevated a sufficient distance above tank floor level (minimum 5% of total tank height or 50mm, whichever is smaller) for mitigation against blockages arising from low lying sediment.
- The outlet connection should be valved appropriately and sized based on the dosing rate (50mm NB minimum). Diaphragm valves are unsuitable for this system.

7.6.4 Ventilation Lines

Ventilation lines shall be provided on all tanks with storage capacities ≥ 1200 litres, and on all tanks which are filled with a dedicated filling line (i.e. day tanks), and shall incorporate the following features:

- The ventilation line shall be connected to the storage tank at a level higher than the overflow line
- Vent piping should be located at the top of the tank and rise vertically for discharge at a suitable location (i.e. for indoor installations on day tanks, the ventilation line shall discharge externally)
- The size of the piping should be chosen to prevent any build-up of pressure during delivery.
- Minimum acceptable dimensions for vent pipes shall be 2.5 times that of the largest liquid tank connection.
- Outlets of ventilation lines shall include a mesh, and shall be weatherproof.

7.6.5 Tank Drainage

Low level drainage valves complete with lockable isolation valves shall be provided for all tanks with storage capacities ≥ 1200 litres and shall be connected to the lowest point of the base. For tanks with capacities < 1200 litres, low level drain connections shall not be required and emptying shall be completed by the use of an appropriately chemically resistance barrel pump.

7.6.6 Structural Support of Tank Connections

Tank connections and all pipework systems shall be designed to withstand the maximum pressure experienced by the system, and shall be securely fastened to prevent mechanical vibration during routine operational activities. Unless otherwise confirmed by detailed design calculations or manufacturers' specifications, maximum pipework bracket intervals should be in accordance with the following table:

Nominal Pipe Diameter(mm)	Maximum Pipe Bracket Interval (m)
< 16	0.70
20	0.78
25	0.81
32	0.93
40	1.03
50	1.15
63	1.30
75	1.41
>100	1.88

Table 10: Maximum pipe bracket intervals to minimise mechanical vibration.

7.5 BUNDS

The Contractor shall adhere to details outlined in the following section of the specification when selecting bunds and designing bunding systems for the storage of liquid chemicals.

7.7.1 General Design Criteria

All bunding systems proposed shall be in compliance with the features listed below where appropriate to the specific chemical proposed for storage:

- All new bunds proposed shall be of polymeric, or reinforced polymeric, construction. Lined concrete bunds may be permitted to act as bunded containment for new development installations upon receipt of a

derogation from Uisce Éireann (Asset Strategy). Under no circumstances shall blockwork walls be permitted to act as bunded containment.

- The bund material / protective coating and type of bund construction shall be resistant to corrosion / degradation by the associated chemical and shall be suitable for immersion in the chemical for a minimum of 7 days without deterioration or degradation.
- Every BST and day tank proposed shall be supplied with its own bund, which shall have the capacity to hold a minimum of 110% of its associated BST or day tank's volume.
- Bunds shall be designed to resist all hydrostatic and hydrodynamic forces that may be imposed upon it, due to either a gradual filling of the bund, or sudden catastrophic BST or day tank failure (i.e. wave effects).
- Supports / fixings for tanks, pipework systems and other components / systems shall not compromise the integrity of the bund or protective lining.
- All bunding systems shall be designed to minimise against the risk of jetting (i.e. chemical spraying over the bund walls in the event of tank failure) as a result of high level leakages from bulk storage / day tanks.
- Adequate space between adjacent bunding systems shall be provided to permit access to components / systems for inspection purposes and plant maintenance.
- All bunds shall incorporate a leakage detection probe and alarm system

7.7.2 Indoor Bunds

All indoor bunding systems proposed shall be in compliance with the features listed below where appropriate to the specific chemical proposed for storage:

- Indoor bunds may be open topped (i.e. a separate structure from the BST or day tank), or be integrated to the structure of the BST or day tank
- Where permissible by material compatibility with the stored chemical, all indoor bunds shall be made of translucent material in order to allow for ease of visual leak and level monitoring by the system operator.
- Where translucent material is inappropriate for use due to non-compatibility with the stored chemical, the distance between the tank wall and the open topped bund shall be sufficient to permit visual inspection of the bund floor (minimum of 300mm distance between tank wall and bund, or minimum of 600mm diametrical difference).
- Open topped bunds shall be selected to ensure the avoidance of jetting. This shall be achieved by ensuring:
  - The bund is sufficiently high to ensure all potential leaks are contained, or
  - There is sufficient distance between the bund wall and the associated BST or day tank to ensure that all potential leaks are contained.
- Following the above point, the rim of an open topped bund wall shall be positioned at a minimum distance equal to the difference between the maximum liquid level in the BST or day tank, and the bund wall height.

7.7.3 Outdoor Bunds

All outdoor bunding systems proposed shall be in compliance with the features listed below where appropriate to the specific chemical proposed for storage:

- Outdoor bunds shall be integrated to the structure of the BST or day tank, and be fully weather shrouded to protect against the ingress of rainwater
- The Contractor shall ensure that all bunds proposed for outdoor installation are adequately protected from degradation by the use of UV stabilizers, which shall absorb UV light and thereby prevent the formation of free radicals.

7.7.4 Reuse of Existing Concrete Bunds

In cases where the reuse of existing concrete bunds is proposed (i.e. for projects involving the **replacement** / **upgrade** of existing chemical storage tanks), Uisce Éireann (Asset Strategy) approval must be sought by the Contractor. In order to receive approval, the bund's suitability for reuse must be fully assessed under the GRA. In addition, the Contractor shall demonstrate / confirm the following in each case where reuse of existing concrete bunds is proposed:

- The existing bund will only be used for the containment of a single chemical
- The existing bund is sufficiently sized to contain 110% of the proposed BST / day tank maximum capacity
- The existing bund has been / will be hydrostatically tested in accordance with BS 8007:1987 *Design of Concrete Structures for Retaining Aqueous Liquids* in order to verify that no leakage is occurring.
- The existing bund is fully protected from the ingress of rainwater (if outdoors)
- The existing bund has the adequate dimensions to mitigate against risks proposed by jetting. The Contractor may propose to utilise splash screens to supplement the height of existing bund walls. Splash screens shall be manufactured from a clear material that is resistant to corrosion / degradation by the dosing chemical in accordance with Section 7.1.2.
- The existing bund shall allow adequate space between the proposed tanks and bund walls to permit access to components / systems for inspection purposes and plant maintenance. In addition, the space between the tank and bund wall shall be sufficient to ensure that escape routes are not blocked in the event of a burst / leak, i.e. it shall be possible to escape from the bund without the need to cross directly in front of, or through, bursts or leaks.
- The existing bund is / will be adequately protected from corrosion by an appropriate lining as outlined in Table 11 below. The Contractor shall not however, solely rely on the information outlined in Table 11, and shall at all times consult the chemical tank manufacturer and lining specialist to determine the chemical resistivity properties of the materials proposed, and its resistance against the chemical in question.

	Allowable Dosing Concentrations (% w/w)	ABS	EPDM	Epoxy	Hypalon	Natural Rubber	Neo-prene	FKM	PTFE	PVDF
Aluminium Sulphate	20 - 30%	ü	ü	ü	ü	ü	ü	ü	ü	ü
Ferric Chloride	40% - 50%	ü	ü	ü		ü		ü	ü	ü
Ferric Sulphate	40% - 50%	ü	ü	ü	ü	ü	ü	ü	ü	ü
Ferric Nitrate	0% - 45%	ü	ü	ü	ü	ü	ü	ü	ü	ü
Hydrofluosilicic Acid	10.9%		ü			ü	ü		ü	
Orthophosphoric Acid	75%							ü	ü	
Poly-aluminium Chloride	10% or 18%	ü	ü			ü	ü	ü	ü	ü
Potassium Permanganate	4% - 5%		ü				ü	ü	ü	ü
Sodium Hydroxide	25% or 30%	ü		ü	ü				ü	
Sodium Hypochlorite	10%				ü				ü	ü
Sodium Nitrate	0% - 50%	ü	ü	ü	ü	ü	ü	ü	ü	ü
Sulphuric Acid	96%							ü	ü	ü

Table 11: Approved chemical resistant lining materials for concrete bunds proposed for reuse

7.6 TANK ACCESS

The Contractor shall adhere to details outlined in the following section of the specification when providing manways and inspection hatches to storage tanks and weather shrouded bunds. It may also be necessary to provide permanent access routes if ancillary equipment cannot be accessed from ground level. The Contractor shall follow the recommendations of CIRIA Document C598 for all such facilities.

7.8.1 Manways

- A manway shall be provided on all bulk storage and day tanks with capacities ≥ 1,200 litres to provide access for inspection or maintenance purposes.
- A manway shall be provided on all integrated weather shrouded bunding systems to provide access for inspection and maintenance purposes
- Where possible, manways on tanks and bunds shall be sized at 900mm NB, and permit access for a man wearing protective clothing and a breathing apparatus.
- For smaller tanks, where it is not possible to provide a 900mm NB manway, the largest feasible manway shall be provided in accordance with the tank manufacturer's recommendations. Oval or rounded rectangular shapes should also be considered to maximize manway area.
- All access manways shall be lockable, with access provided to operational staff only.
- Roof entry manways shall be avoided wherever possible. Side entry manways shall be acceptable.

- Manway covers that weigh over 25 kg shall be hinged or provided with a davit.

7.8.2 Inspection Hatches

- A 400mm NB inspection hatch shall be provided on the roof of all tanks with capacities ≥ 1200 litres
- A 400mm NB inspection hatch shall be provided on all weather shrouded bunding systems
- Where a 400mm NB inspection hatch is not possible, the largest diameter hatch will be provided.
- All internal instrumentation shall be mounted beneath a readily accessible inspection hatch that allows removal of the instrument without the need to enter the tank.
- All inspection hatches shall be lockable, with access provided to operational staff only.

7.7 PIPING SYSTEM REQUIREMENTS

The Contractor shall adhere to details outlined in the following section of the specification when selecting chemical pipework and designing chemical piping systems. Piping requirements will vary depending on the stored chemical and all pipework, valves, etc. used shall be chemical specific and selected in accordance with this document, as well as relevant sections of Uisce Éireann's **TEC-200** suite of specifications. Design guidelines are included in **TEC-600-06**.

7.9.1 General Design Criteria

All tank connections and pipework systems proposed shall be in compliance with the features listed below where appropriate to the specific chemical proposed for storage, regardless of function (bulk storage, day storage, chemical transfer, etc.), capacity or orientation.

- All pipework proposed for installation outside a bunded area shall be double contained to mitigate against the risk of pipework failure and consequent BST discharge.
- All pipework installations shall be simple, tidy and all components shall be of a material that is resistant to the chemical to be conveyed. Pipework components shall not pass through or between bund walls.
- The transfer distance between bulk storage tanks and day tanks shall be kept to a minimum. This shall apply regardless of whether the system is part of an upgrade to an existing facility, a retrofit of an existing process or an installation of a complete new build treatment works (or part thereof).
- Pipework systems shall be designed to withstand the maximum pressure experienced by the system and shall be securely fastened to prevent mechanical vibration during routine operational activities (see Section 7.6.6 for details of maximum intervals for pipework brackets)
- All rigid pipework shall be, at a minimum, PN10 rated
- Pipework system material must be resistant to internal corrosion from any associated chemical or protected by means of a suitable coating or internal lining.
- Pipework systems must also be protected from external corrosion and mechanical impact, e.g. collision with delivery vehicles, pallet trucks, swinging doors, foot traffic, etc.

- Where pipe size permits, connections to tanks should be of the bolted flange type (PN16)
- All pipework shall be labelled with the name of chemical it conveys as well as identification of the flow direction.
- A design file shall be required for all piping systems which carry a corrosive liquid or solid. The file shall outline the material of construction, and dimensions of all pipes, valves, and fittings used in the installation.

7.9.2 Material Compatibility

For all piping systems proposed, the Contractor shall ensure that the material of manufacture shall be of a grade that is deemed most appropriate for the hazard classification of the chemical in question, at the storage concentrations proposed. Materials which have been pre-approved for the manufacture of piping systems, as well as associated seals and gaskets, are outlined in Table 12. The Contractor shall not however, solely rely on the information outlined in Table 12, and shall at all times consult the pipework / valve / seal / gasket manufacturer to determine the chemical resistivity properties of the materials proposed, and its suitability for prolonged contact with the chemical in question.

	Allowable Dosing Concentrations (% w/w)	Piping System						Seals and Gaskets				
		LDPE	HDPE	PP	PTFE	PVC	PVDF	EPDM	Hypalon	Natural Rubber	PTFE	Viton
Aluminium Sulphate	20 - 30%			ü	ü	ü	ü	ü	ü	ü	ü	ü
Ferric Chloride	40% - 50%	ü	ü	ü	ü	ü	ü	ü		ü	ü	ü
Ferric Sulphate	40% - 50%	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü
Ferric Nitrate	0% - 45%			ü	ü	ü	ü	ü	ü	ü	ü	ü
Hydrofluosilicic Acid	10.9%			ü	ü	ü	ü	ü		ü	ü	ü
Orthophosphoric Acid	75%			ü	ü						ü	ü
Poly-aluminium Chloride	10% or 18%			ü	ü	ü	ü	ü		ü	ü	ü
Potassium Permanganate	4% - 5%				ü		ü	ü			ü	ü
Sodium Hydroxide	25% or 30%			ü	ü	ü	ü		ü		ü	
Sodium Hypochlorite	10%				ü	ü	ü		ü		ü	
Sodium Nitrate	0% - 50%			ü	ü	ü	ü	ü	ü	ü	ü	ü
Sulphuric Acid	96%				ü	ü	ü				ü	

Table 12: Approved materials of manufacture for piping systems, seals and gaskets

The Contractor shall submit a Wetted Parts Schedule with their design proposal, to detail selected material of construction for all parts and components of the piping system that can come into contact with the stored or conveyed chemical.

7.8 ACILLARY EQUIPMENT REQUIREMENTS

The Contractor shall adhere to details outlined in the following section of the specification when selecting ancillary equipment (i.e. third party equipment which may not be a direct component of the storage tank or bund) for the safe and effective operation of chemical storage systems.

7.10.1 General Design Criteria

All ancillary equipment proposed shall be in compliance with the features listed below where appropriate to the specific chemical proposed for storage:

- All ancillary equipment that is unsuitable for prolonged immersion in the dosing chemical shall be positioned above the expected top liquid level of the tank or bund.
- Ancillary equipment positioned below the expected top liquid level of the bund shall be expected to come into contact with the dosing chemical and all materials shall be selected accordingly.
- Unless otherwise approved by the tank manufacturer, all equipment shall be supported independently from the tank to avoid additional loads which could compromise its integrity.
- The use of electrical junction boxes within bunded envelopes shall not be permitted.

7.10.2 Emergency Shower

All emergency showers proposed shall be 'plumbed-in' systems and shall comply with the ANSI Z358.1 and the I.S. EN 15154 standard as well as the requirements listed below. Where there is a contradiction between the ANSI and/or the I.S. EN standards and this document, the order of precedence shall be:

- requirements as set out in this document
- requirements as set out in the relevant parts of I.S. EN 15154,
- requirements as set out in the ANSI Z358.1.

Emergency Shower Specification

- Emergency shower frames shall be of rigid construction, and the complete shower and pipework installation shall be of corrosion resistant material (and coated where necessary) to provide low maintenance and reliable long term operation in the environment to which they are proposed for installation.
- Emergency shower valves shall be actuated by both an overhead pull rod and a foot pedal. Both actuation methods shall be large enough so as to be easily located and operated when wearing protective gloves / boots.
- Emergency shower valves shall be capable of being opened by the pull rod / foot pedal actuator in a single operation. The maximum force required for this operation shall be 100N.

- It shall be possible to fully open the emergency shower valve within 1 second, and it shall remain open until intentionally closed.
- Shower heads shall be self-draining between the shower valve and the shower head outlet
- The shower head shall be removable for maintenance, but only with the use of original equipment manufacturer (OEM) tools.
- The direction of spray and water distribution shall be the only alterations that can be made to the shower head with the use of OEM tools
- Combination units (emergency shower / eyewash assembly supplied by a single source of flushing fluid) may be proposed in place of individual emergency shower / eyewash installations

Emergency Shower Performance

- Emergency body showers shall comply with Class 2 requirements in accordance with I.S. EN 15154-5.
- Emergency showers shall deliver flushing fluid at minimum rate of 75 litres per minute for a minimum of 15 minutes continuous operation
- The flushing fluid pressure at the shower head shall be maintained in accordance with the manufacturer's requirements
- Water distribution of emergency body showers shall be in compliance with I.S. EN 15154-5

Emergency Shower Installation

- The shower head shall be installed at height 2300 (±100)mm above the surface on which the user stands
- A 'free space' between the centre-line of the shower head and the nearest obstruction (wall, vertical supply tube, plant or equipment) shall be a circle with a minimum radius of 400mm
- The overhead pull rod shall be a maximum of 1700mm above the surface on which the user stands.
- A facility for manual drainage shall be provided from all units

Flushing Fluid Supply

- Each emergency shower shall be connected to a supply of flushing fluid as per the manufacturer's installation instructions to produce the required spray pattern for a minimum period of 15 minutes
- Flushing fluid shall be supplied directly from a potable water main, pressurised artificially or by gravity
- Where it is not possible to guarantee a continuously sufficient supply direct from a potable water main, a header tank with a minimum capacity of 1200L may be proposed, subject to approval by Uisce Éireann
- Header tank proposals shall allow for a continuous turnover of the tank contents, and the Contractor shall outline details such as the proposed elevation of the tank, the expected supply pressure, freeze protection measures and replenishment times (maximum of 30 minutes to replenish while shower is not activated).
- Where utilised, header tanks shall incorporate a facility for manual drainage for testing and maintenance.

- The water supply to each emergency shower from the flushing fluid source shall be via a minimum 25mm diameter supply line.
- Where possible, flushing water should be tepid with a temperature between 15 °C to 35 °C

Freeze Protection

- Each emergency shower shall be self-draining to ensure against freezing in all climatic conditions where air temperatures fall to -18°C. This requirement shall also eliminate the need for heat tracing. Self-draining showers shall take no longer than 3 seconds to fully re-pressurise following activation.
- All supply lines feeding emergency showers shall be protected from freezing in all climatic conditions where air temperatures fall to -18°C, either by sufficient burial, or by adequate heat tracing and insulation.

7.10.3 Emergency Eye/Face Wash

All emergency eye/face washes proposed shall be 'plumbed-in' systems and shall comply with the ANSI Z358.1 and the I.S. EN 15154 standard as well as the requirements listed below. Where there is a contradiction between the ANSI and/or the I.S. EN standards and this document, the order of precedence shall be:

- requirements as set out in this document
- requirements as set out in the relevant parts of I.S. EN 15154,
- requirements as set out in the ANSI Z358.1.

Emergency Eye/Face Wash Specification

- Emergency eye/face wash frames shall be of rigid construction, and the complete eye/face wash and pipework installation shall be of corrosion resistant material (and coated where necessary) to provide low maintenance and reliable long term operation in the environment to which they are proposed for installation.
- Emergency eye/face washes shall ensure a controlled flow of flushing fluid is provided to both eyes and face simultaneously, and at a velocity and pressure low enough to be non-injurious to the user, but sufficient to provide thorough drenching and cleansing in the event of chemical contact with the facial area
- Emergency eye/face washes shall be actuated by both a large hand paddle and a foot pedal. Both actuation methods shall be large enough so as to be easily located and operated when wearing protective gloves / boots.
- Emergency eye/face wash valves shall be capable of being opened by the hand paddle / foot pedal actuator in a single operation. The maximum force required for this operation shall be 100N.
- It shall be possible to fully open the emergency eye/face wash valve within 1 second, and it shall remain open until intentionally closed.
- Emergency eye/face washes shall be designed to provide sufficient room to allow the eyes to be held open with the hands while the eyes and face remains in the flushing fluid stream

- Emergency eye/face wash nozzles shall be protected from air borne contaminants, however such protection shall not require a separate action by the user when activating eye/face wash unit
- Combination units (emergency shower and eye/face wash assembly supplied by a single source of flushing fluid) may be proposed in place of individual emergency shower and eye/face wash installations

Emergency Eye/Face Wash Performance

- Emergency eye/face washes shall deliver flushing fluid at minimum rate of 11 litres per minute for a minimum of 15 minutes continuous operation (5.5 litres per nozzle per minute)
- The flushing column height from each nozzle shall be between 1000 – 1400mm above the surface on which the user stands
- The flushing columns from each nozzle shall provide a flushing pattern of a minimum of 25mm in diameter, at a distance of 200mm above the top of the spray nozzles, before the water column tips over and collapses.
- The centreline of each flushing column shall be between 50 – 60mm apart to allow simultaneous flushing of both eyes. The Contractor shall refer to Section 6.1.8 of ANSI Z358.1 for further details relating to flushing column patterns for eye/face washes.

Emergency Eye/Face Wash Installation

- The eye/face wash shall be installed at height 900 - 1100mm above the surface on which the user stands
- A 'free space' between the centre-line of the eye/face wash bowl and the nearest obstruction (wall, vertical supply tube, plant or equipment) shall be a circle with a minimum radius of 150mm
- A facility for manual drainage shall be provided from all units

Flushing Fluid Supply

- Each emergency eye/face wash shall be connected to a supply of flushing fluid as per the manufacturer's installation instructions to produce the required spray pattern for a minimum period of 15 minutes
- Flushing fluid shall be supplied directly from a potable water main, pressurised artificially or by gravity
- Where it is not possible to guarantee a continuously sufficient supply direct from a potable water main, a header tank with a minimum capacity of 200L may be proposed (if the tank is to supply a single emergency eye / facewash only), subject to approval by Uisce Éireann
- Header tank proposals shall allow for a continuous turnover of the tank contents, and the Contractor shall outline details such as the proposed elevation of the tank, the expected supply pressure, freeze protection measures and replenishment times (maximum of 10 minutes to replenish while eye/face wash is not activated).
- Where utilised, header tanks shall incorporate a facility for manual drainage for testing and maintenance.
- The water supply to each emergency shower from the flushing fluid source shall be via a minimum 25mm diameter supply line.

- Where possible, flushing water should be tepid with a temperature between 15 °C to 35 °C

Freeze Protection

- Each emergency eye/face wash shall be self-draining to ensure against freezing in all climatic conditions where air temperatures fall to -18°C. This requirement shall also eliminate the need for heat tracing. Self-draining eye/face washes shall take no longer than 3 seconds to fully re-pressurise following activation.
- All supply lines feeding emergency eye/face washes shall be protected from freezing in all climatic conditions where air temperatures fall to -18°C, either by sufficient burial, or by adequate heat tracing and insulation.

7.10.4 Combination Units

A combination unit shall be defined as an interconnected assembly of an emergency shower and an emergency eye/face wash supplied by a single source of flushing fluid, and shall be in accordance with the relevant parts of I.S. EN 15154 and ANSI Z358.1. Combination units may be provided at locations where both emergency showers and eye/face washing facilities are required, in lieu of individual shower/eye/face wash units. For all such installations, the specifications outlined in Sections 7.10.2 and 7.10.3 above shall be met by each constituent part of the combination unit.

7.10.5 Drench Hoses

All drench hoses proposed for secondary wash stations (i.e. a wash station installed in a restricted access area, which shall supplement an associated primary wash station) shall be in accordance with ANSI Z358.1, and shall incorporate the features listed below. The Contractor shall note that under no circumstances shall the provision of a drench shower as a secondary wash station relieve their obligation to provide an associated primary wash station(s) consisting of emergency eye/face washes, emergency showers or combination units.

- Drench hoses shall be actuated by a ‘squeeze trigger’ which shall be large enough so as to be easily located and operated when wearing protective gloves.
- It shall be possible to fully open the drench shower valve within 1 second, and it shall remain open until intentionally closed.
- The drench hose shall be capable of delivering flushing fluid at a rate of 75 litres per minute, at a pressure of between 2 - 3 bar, for a continuous 15 minute period
- The flushing fluid supply and the freeze protection measures outlined in Section 7.10.2 of this specification shall also apply to drench showers proposed for secondary wash stations.
- Each drench hose shall be provided with an eye/face wash attachment which shall meet the specifications outlined in Section 7.10.3 above.

7.10.6 Pumping Requirements

Dosing pump and transfer pump requirements are outlined in Table 13 below. The Contractor shall note that for all dual BST installations, a single duty dosing / transfer pump shall be provided for each individual BST. In essence, the pumps themselves will not be duty / standby systems, but the entire BST system will be designed in a duty / standby configuration.

Total BSV (per chemical)	No. of BSTs Required (per chemical)	No. of Dosing Pumps (per BST)	No. of Transfer Pumps (per BST)	No. of Day Tanks Required (per chemical)	No. of Dosing Pumps (per Day Tank)
≤ 1,200 litres	1	2 (D/S)	0	0	0
> 1,200 litres	2	1 (Duty)	0	0	0
≥ 12,000 litres	2	0	1 (D/S)	1	2 (D/S)

Table 13: Required pumping arrangements for various bulk storage volumes

Particular dosing / transfer pump requirements and automated control of dosing systems will vary depending on the process, and consequently, such requirements are outlined in the process specific specifications. However, if not specified otherwise, all dosing and transfer pumps proposed shall be in compliance with the following general requirements:

- All pumps shall comply with the general requirements set out in **TEC-200** suite of specifications.
- All wetted parts (dosing head, suction/pressure connectors, ball seats, seals, impellers, casings etc.) in contact with transfer medium are to be of materials suitable for use with the associated chemical
- Each pump is to be suitable for use with a 230V, 50 Hz, single phase power supply and shall remain operational within permissible ambient temperatures of -10˚C to +45˚C.
- Each proposed pump shall also have an ingress protection rating of IP65, and an insulation class F.
- Each dosing pump proposed shall have the capability to demonstrate the current and totalised flow on its display screen
- Pumping systems for dual tank arrangements shall be designed to ensure that the BSTs are entirely independent of each other (i.e. they shall not be interconnected) in order to mitigate against the risk of total chemical loss in the event of suction pipework failure.
- The Operator Presence Control (OPC) switch (i.e. a ‘dead man’s switch’) which activates all transfer pumps shall be installed in a location that allows full and unobstructed viewing of the translucent day tank, to permit the plant operator to observe the day tank as it fills.
- Indicative layouts which outline pumping arrangements for various bulk storage volumes are presented in Section 6.1.5 of this document.

7.10.7 Pump Cabinet Requirements

Pump cabinet requirements are outlined in Table 14. The Contractor shall note that for all dual BST installations, a single dosing cabinet shall be provided for each individual BST, which shall house a single dosing / transfer pump. Indicative layouts which outline pumping arrangements for various bulk storage volumes are presented in Section 6.1.5 of this document.

Total BSV (per chemical)	No. of BSTs Required (per chemical)	BST Installation Location	Type of Pump Cabinet Required	No. of cabinets Req'd	Drainage outlet
≤ 1,200 litres	1	Indoors	Free-standing or Wall-mounted	1	Drain to tank bund
≤ 3,000 litres	2	Indoors	Free-standing or Wall-mounted	2 (1 per tank)	Drain to tank bund
≥ 3,000 litres	2	Outdoors	Integrated to tank structure	2 (1 per tank)	Drain to tank bund

Table 14: Required pump cabinet arrangements for various bulk storage volumes

All pump cabinets shall be installed in a position which ensures that any leaks / spills which may occur within the cabinet itself are fully contained and returned to the tanks bund. This shall be achieved in the following manner:

- **Indoor Tanks:** for BSTs and day tanks located indoors, the pump cabinet shall be installed so that it's base is a minimum of 300mm above the maximum liquid level in the BST / day tank. The cabinet may be free-standing or wall-mounted and contained spillages shall drain back to the tank bund.
- **Outdoor Tanks:** for BSTs and day tanks located outdoors, the pump cabinet shall be installed so that its base is directly above the tank's weather shrouded bund. The cabinet shall be integrated to the tank structure and contained spillages shall drain back to the tank bund.
- If the bund wall height exceeds 1.50m, an access stairs and platform of appropriate height, complete with suitably designed hand-railing and kick plate, shall be provided to permit safe access to all cabinets.
- Indicative layouts which outline pumping cabinet arrangements for various bulk storage volumes are presented in Section 6.1.5 of this document.

In addition to the installation requirements set out above, all pump cabinets and associated equipment proposed shall be in compliance with the following general design requirements:

- All pump cabinets shall be manufactured from materials suitable for use with the chemical that is to be conveyed / contained.
- All pump cabinets proposed for outdoor installation shall be insulated with a 50mm layer of insulating material with a thermal conductivity of $0.038 W.m^{-1}.K^{-1}$ or better, and be provided with a miniature,

thermostatically controlled heater which shall ensure maintenance of pump operation in ambient air conditions as low as -18°C.

- All pump cabinets shall be provided with an integrated bund, which shall in turn drain back to the main storage tank bund
- The pump cabinet bund shall include a leakage detection probe
- All pump cabinets shall be lockable, with access provided to operational staff only
- All pump cabinet doors shall be provided with a chemically resistant clear panel which shall permit visual inspection of the pumps without a requirement to open the cabinet door.
- All pump cabinet door hinges shall be of stainless steel construction
- All pump cabinet doors shall create, when shut, a seal with the door frame so that leaks / spillages which may occur within the cabinet are fully contained and returned to the bund
- All pump cabinets shall be provided with aluminium side vents. Vents shall be mounted in an elevated position on the cabinet side wall to prevent escape of chemical in the event of a leak within the cabinet.
- All access stairs, platforms, hand-railing and kick plates proposed for use with chemical storage systems shall be manufactured from a GRP material suitable for use with the chemical that is being stored. This is required in order to protect again material corrosion, access platform failure or the emission of explosive gases (hydrogen).

7.10.8 Heating Requirements

In addition to the tank insulation requirements as outlined in Section 0 of this specification, heating facilities shall be provided in order to ensure that all chemicals can be maintained within their optimum temperature range for storage (generally 5°C to 20°C, but Contractor to confirm). This temperature range shall be achievable in all climatic conditions with air temperatures ranging from -18°C to +30°C.

It should be noted, that while many of the approved chemicals have freezing temperatures as low as -17°C, they can begin to crystallize far in advance of reaching this temperature. Similarly, their viscosity can increase far in advance of reaching their freezing temperature. Both of these occurrences may result in reduced chemical dosing and, consequently, sub-optimal treatment.

The freezing temperature of each chemical shall therefore not be treated as the minimum storage temperature, and heating systems shall be implemented to ensure that recommended minimum storage temperatures of each chemical is maintained at all times.

For outdoor installations, or where tanks are stored indoors but the chemical storage room heating system does not allow for efficient continuous heating of the tanks, the Contractor shall provide the following in addition to the insulation requirements previously specified:

- An internal immersion heating system within the tank, and installation of heat tracing and lagging on all external pipework which may retain standing columns of liquid (overflow pipes, vent pipes, etc. shall not require insulation and heat tracing).
- Tank heating shall be realised using bayonet-type electrical heaters or heat exchanger systems. The equipment shall be easily removable for inspection, maintenance and replacement. Removal of the heating equipment shall not result in a leak of the chemical stored within the tank.
- A storage tank mounted thermostat or similar device shall be utilised to automatically activate the internal heating system. The thermostat activation shall be based on liquid temperatures within the tank, with cut in and cut out temperatures appropriately set for each individual chemical in storage.
- An externally mounted thermostat which measures air temperature shall be used to activate heat tracing systems on pipework. Once the outside air temperature drops below 5°C, all heat tracing on pipework shall be activated, regardless of the chemical.
- The tank contents temperature sensor should be located so that it is fully immersed in the stored chemical, regardless of the liquid level within the storage tank.
- Heating systems shall only be activated when the heating coil is covered by a minimum of 150mm of the chemical.
- An independent electrical cut out should be provided as part of the system. This should be activated by unsuitable liquid levels in the tank for the heating / chilling system to be activated, the detection of high / low temperatures within the tank, and the generation of a heater failure alarm.

All heating systems proposed (immersion, heat tracing, etc.) which may come into direct contact with the stored chemical shall be manufactured from materials which are compatible with the chemical. For each heating systems proposed, the Contractor shall at a minimum submit the following design information:

- Full details (specifications, SDS, etc.) of each chemical to be stored outdoors, including information regarding the freezing / crystallization temperatures at the proposed storage concentration.
- Full details of how the tank contents, while in storage, will be maintained above the freezing / crystallization temperature across the full climatic temperature range noted above (i.e. details of internal heating systems, tank lagging, etc.).
- Full details of how an effective chemical pumping / conveying / transfer system shall be maintained across the full climatic temperature range noted above (i.e. details of lagging, heat tracing, etc.).
- Full details of how chemicals which are subject to degradation in elevated temperatures shall be maintained at their recommended storage temperatures across the climatic range noted above (i.e. details of internal chilling systems, lagging, etc.).

7.9 INSTRUMENTATION

The instrument requirements outlined in this section of the specification are intended to ensure that sufficient monitoring systems are implemented in order to facilitate safe storage management of liquid chemical in all specified conditions, as well as maintenance of sufficient chemical inventory on each site at all times. All instrumentation proposed by the Contractor shall be fit for the purpose intended and give operational personnel adequate warning should hazardous situations arise.

7.9.1 Instrumentation Overview

Instrumentation requirements to ensure the effective management of liquid chemical bulk storage systems are outlined in Table 15 below. The Contractor shall note that additional process control instruments (i.e. chlorine analysers, streaming current monitors, pH monitors, process flowmeters, etc.) are not included in Table 15 as they are specific to the chemical being dosed. This table only accounts for instruments common to all chemical storage systems. The Contractor shall allow for chemical specific process control instruments as required, and as outlined in other Uisce Éireann Design Specifications (e.g. TEC-900-05 Disinfection, etc).

Description	Instrument Type	Installation Type	Quantity Required	I/O Type	Function	Data Log
BST / Day Tank Liquid Level	*Ultrasonic / Radar Level Sensor*	All installations	1 (per tank)	A	Stock level mgmt., chemical replenishment mgmt.	Trend
Bund Liquid Level	*Point Level (conductivity probe, capacitance probe)*	All installations	1 (per bund)	D	Leak detection	-
Chemical Temperature	*Immersed chemical thermometer*	outdoor tanks	1 (per tank)	A	Control of outdoor BST / day tank heating system	Trend
Ambient Temperature	*External air thermometer*	outdoor tanks	1 (per site)	A	Control of heat tracing systems on outdoor pipes	Trend
Chemical Flow (from transfer pumps)	*Electromagnetic FM*	All Day Tank installations	1 (per day tank)	A & D	To monitor rate of transfer from BST to day tank	Trend

Table 15: Required instrumentation for the effective management of chemical storage systems.

7.9.2 General Instrumentation Requirements

The Contractor shall comply with all of the general instrumentation requirements as outlined below. The following shall apply for the installation of all instruments, regardless of their function, or location of installation.

- All instruments and components installed shall be manufactured from materials which are compatible with the chemical to be stored and monitored.

- All instruments and components that is unsuitable for prolonged immersion in the chemical monitored shall be positioned above the expected top liquid level of the tank or bund.
- Unless otherwise approved by the tank manufacturer, all equipment shall be supported independently from the tank to avoid additional loads which could compromise its integrity.
- The use of electrical junction boxes within bunded envelopes shall not be permitted.
- All instruments shall be located and / or valved so that removal for maintenance, service or replacement does not require draining / emptying of the storage tank and does not require to enter the bund.
- A continuous analogue indication of tank content level is required for all storage installations. A real time reading of current volume in litres shall also be displayed on the system HMI (i.e. liquid level and volume).
- Ultrasonic and radar level sensors are acceptable technologies for generating analogue level signals, on the condition that they are deemed dependable and fit for purpose by Uisce Éireann or their representative.
- Where foaming is likely to occur in the tank, radar sensors should be used.
- All outdoors tanks shall also be equipped with a visual mechanical level indicator, such as a cat and mouse gauge, a pneumatic level indicator, or equivalent approved by Uisce Éireann Asset Strategy.

7.9.3 Tank level indication - Traffic light System

- For all non-translucent tanks, operational liquid level and filling operations shall be monitored by using a 'traffic light' type visual monitoring system which shall be controlled by the analogue level sensors contained in each tank. The system shall give the following visible signals:
  - Red Light: tank is less than 20% full
  - Amber Light: tank is 20% - 80% full
  - Blinking Green Light: tank is 80% - 95% full
  - Solid Green Light: tank has surpassed 95% of its total capacity and filling may cease

7.9.4 Chemical Flowmeters (Transfer pumps)

Chemical flowmeters shall be installed on each delivery line of all chemical transfer pumps, for the purposes of monitoring the flow and providing a system of generating alarms in the event of delivery line failure. Chemical flowmeters shall be in accordance with the following requirements:

- Chemical flowmeters shall be coriolis mass-flowmeter devices (for measurement of pulsing flows) or in-line electromagnetic or ultrasonic devices (for measurement of consistent flows usually generated by centrifugal/peristaltic/etc. metering pumps).
- Flow meters should be installed as close to the discharge points as reasonably possible to reduce the effect of pulsating flow on measurement accuracy

- All internal or wetted parts are to be resistant to corrosion by contact with the transferred chemical, using chemically resistant components.
- Chemical flowmeters shall be capable of generating a flow measurement of < 2% accuracy of range.
- Flow meter controllers shall be capable of issuing a 4-20mA analogue (live measurement) and a digital pulse signal (programmable bulk/volume measurement) to the control PLC
- Digital readouts displaying the current flow shall be mounted on the instrument, or alternatively wall mounted local to the instrument
- Connections shall be available to accommodate a range of hose / pipework sizes and the instrument shall be rated for a maximum operating pressure of 16 bar.

7.9.5 Ultrasonic/Radar Level Indicators

Ultrasonic or Radar level sensors shall be installed in line with Section 0 to monitor the liquid levels in all storage tanks. Level sensors shall comply with the following requirements:

- Each level sensor/controller shall be capable of issuing a 4-20mA analogue signal to within ±1% accuracy of range
- Sensors and controllers shall be rated to IP68 and shall have a suitable measurement range with an upper limit 20% higher than required for the specific installation
- Level sensor controllers, if provided as separate unit, shall be wall mounted, and installed in an environment which protects the controller from exposure to the elements (indoors, kiosk, cabinet, etc.)
- Appropriate installation locations for level sensor controllers shall be determined on a site-specific basis.

7.9.6 Bund Leakage/Level Switches

Leakage level probes shall be installed in each tank bund in line with Section 0 to monitor the liquid levels and provide alarm functionality on leakage detection. Bund leakage/level probes shall comply with the following requirements:

- Bund leakage detection probes shall be conductive or capacitance switches
- Operation voltage shall be 24VDC
- Operational temperature range shall be greater than -20 to +40 °C
- Probes shall be rated to IP65 or better
- The probe shall be capable of detecting a liquid depth of maximum 10 mm in the bund
- Each level probe shall be capable of issuing/switching a digital signal to the control system PLC
- Each installation shall include a visual indicator light of the output signal and an external test switch to allow testing of the functioning of the probe in place

7.9.7 Temperature Probes

Temperature probes shall be installed in line with Section 0 to monitor the temperature of the stored chemicals, control heating arrangement as well as to monitor ambient temperatures. The temperature meters shall be in accordance with the following requirements:

- Temperature probes shall be insertion probe or immersion probe type instruments
- Sensors and controllers shall be rated to IP68
- Each installation shall include a local controller/display
- Controllers shall be capable of issuing a 4-20mA analogue (live measurement) signal to the overall control system.
- Temperature probes shall have an operational temperature range greater than –20°C to +40°C
- Temperature probes shall have a measuring range greater than –20°C to +40°C with an accuracy better than 1°C
- Temperature signals may be taken from a combined probes/sensors provided that:
    - The instrument proposed has the capability to generate an independent signal for all measurements, and
    - The above requirements are otherwise met

7.10 CONTROL SYSTEM

7.10.9 General Requirements

This section outlines the control and automation equipment requirements specific to the implementation of a bulk liquid chemical storage system. All control and automation equipment proposed by the Contractor shall be fit for the purpose intended, facilitate control of the system as per Section 8 of this document, and provide operational personnel with adequate alarms / warning should any hazardous situations arise.

For alarm and remote asset management (RAM) requirements specific to chemical storage systems, project stakeholders shall refer to Section 0 of this document (Provision of Telemetry Signals for RAM Policies), as well as the relevant Uisce Éireann RAM document **UÉ-RAM-SPEC-5000-001**.

7.10.1 MCC Panels

All MCCs proposed for the control of bulk liquid chemical storage systems shall be compliant with the following specifications:

- **TEC-200 General M&E Specification**

MCCs proposed shall also incorporate the process specific features listed below. Whether the MCC is installed as a process specific dedicated **Independent MCC**, or as an **Incorporated MCC**, shall be dependent on the scope of works on each site.

- **Independent MCC** – installed at sites where the scope of works is for the upgrade of the existing system only. Specific features of this type of MCC panel shall include:
    - Independent MCCs shall be installed as a dedicated control panel, mounted locally to the upgraded bulk liquid chemical storage system
    - The MCC provided, and its associated functionality, shall incorporate all the features necessary to manage the bulk liquid chemical storage system in accordance with the requirements of **TEC-600-06** and this specification
    - Independent MCCs shall incorporate a PLC and HMI system dedicated exclusively to the bulk liquid chemical storage system.
    - Where a larger supervisory HMI and/or SCADA system exists on a site, all mimics, data and trends shall be relayed and mimicked on the main control interface which shall replicate the functionality of the localised bulk liquid chemical storage system HMI
    - Independent MCCs shall be of Form 2 construction and be as per the general arrangement layouts shown in Section 7.10.2.
    - Independent MCCs shall be wall mounted and shall incorporate both power distribution and signal terminations for all items of plant and instrumentation,
    - Independent MCCs shall incorporate all necessary breakers, transformers, starters and ancillary equipment required for a fully functional control system
    - Independent MCCs shall be constructed of 1.5mm thick high grade sheet steel and have a powdered and baked enamel finish to RAL7032, 50µm in depth.
    - The door to each Independent MCC shall be hinge mounted and when shut shall provide an ingress protection rating of IP65.
    - Cable entry to Independent MCCs may be top or bottom, whichever best suits the individual installation.
    - Independent MCCs shall incorporate 2 No. 230 VAC domestic outlets, accessible by opening the panel door.
    - Independent MCCs shall incorporate lightning protection systems and uninterruptible power supplies (UPS) in order to protect and maintain all instruments and PLCs in the event of power surges or losses, with a minimum of 15 minutes bridging time.

- **Incorporated MCC** – installed at newly designed treatment plants, green-field builds, or facilities which are undergoing major upgrades which may include replacement of existing MCC facilities. Specific features of this type of MCC panel shall include:
  - Incorporated MCCs may be installed in a dedicated control room, in a location remote from the bulk liquid chemical storage system, and may share a centralised PLC/HMI with one or more other processes
  - The bulk liquid chemical storage system panel shall take the form of the panel into which it is being incorporated (Form 2, Form 4, etc.)
  - Incorporated MCCs, and associated control system, shall facilitate all the system control and functionality required of an Independent MCC

7.10.2 MCC Panel Layouts (Independent MCCs)

Unless specified otherwise in the Employer's Requirements, the panel arrangements as shown below shall apply for all Independent MCC panels installed on bulk liquid chemical storage system.

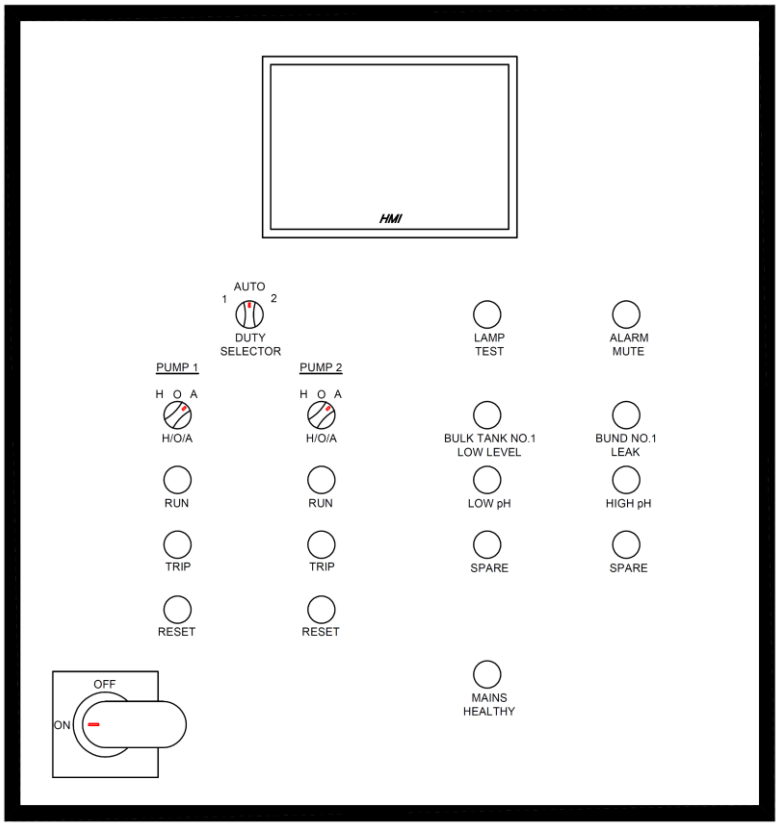

Figure 7: MCC Arrangement for single BST liquid dosing system

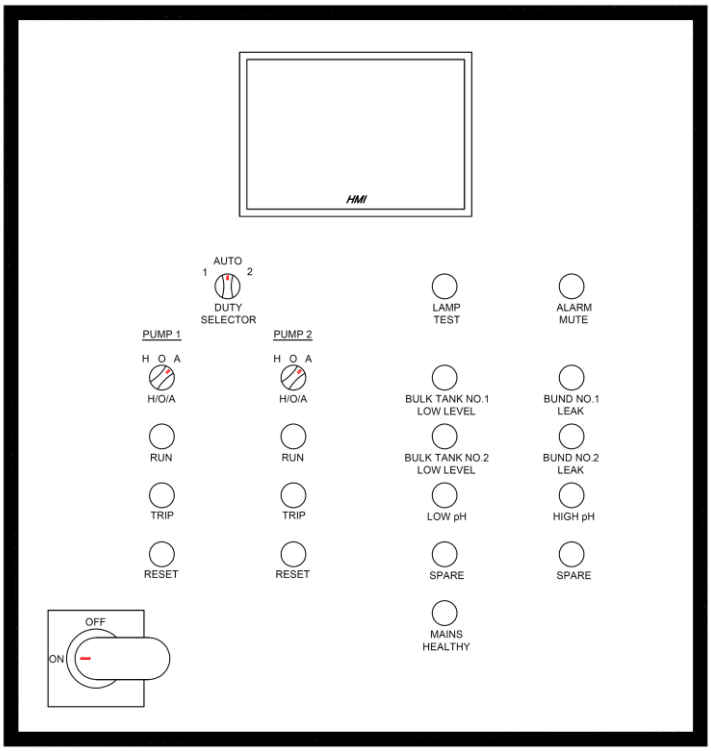

Figure 8: MCC Arrangement for dual BST liquid dosing system

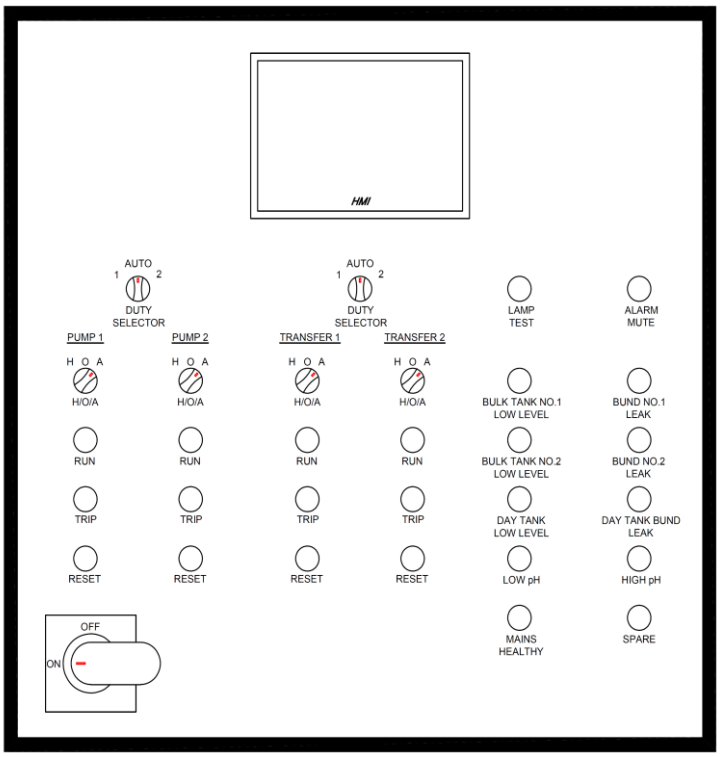

Figure 9: MCC Arrangement for dual BST liquid dosing system (with day tank)

Additional pumps, instrumentation etc. are to be added as required. For newly designed treatment plants, green-field builds, or facilities which are undergoing major upgrades which incorporate replacement of MCC facilities, the panel shown below shall be incorporated into a common centralised control panel. For all independent sulphuric acid pH / alkalinity suppression installations, the panels shall take the form as shown. If a SCADA system is present on site, all signals shall be relayed and mimicked on the main control interface which shall replicate the functionality of the localised pH / alkalinity suppression HMI.

7.10.3 PLC Systems

All PLCs proposed for the purposes of controlling the bulk liquid chemical storage systemshall be compliant with the following specifications:

- **TEC-200 General Mechanical and Electrical Specification**
- **TEC-400 Instrumentation, Control and Automation Specification**

PLCs proposed for bulk liquid chemical storage system shall also incorporate the process specific features listed below.

- The PLC provided, and its associated functionality, shall incorporate all the features necessary to manage the bulk liquid chemical storage system in accordance with the requirements of **TEC-600-06** and this specification.
- The PLC provided shall have sufficient digital and analogue I/O to accommodate all functionalities required by the bulk liquid chemical storage system as described in this document
- The PLC provided shall be capable of expansion should additional I/O signals need to be incorporated.
- The PLC provided shall incorporate an SD card port to allow logging, backup and cloning of the PLC code.
- The PLC provided should be Ethernet compatible and enable connection to an Ethernet based communications network and/or external 4G/LTE or 5G device to permit the remote issue and receipt of signals.
- If no other site-wide means are provided, then the PLC provided for the bulk liquid chemical storage system control shall be connected to a telemetry RTU via Modbus to allow transfer of data to a Countywide Telemetry System
- The PLC provided shall natively support (or shall be suitable for future expansion with an IO module from the same manufacturer to allow) making all information and general signals available to, as well as taking and accepting signals/data from, the plant telemetry system via Modbus/TCP.
- To allow for future requirements and cross-compatibility, the PLC provided shall also natively support (or shall be suitable for future expansion with an IO module from the same manufacturer to allow)

communication via at least any 2 of the below 3 protocols. The PLC shall be capable of making all information and general signals/data available, as well as taking and accepting signals/data, via these interfaces. Protocols to be supported are:

- Ethernet/IP
- ProfiNET IO
- DeviceNET

7.10.4 HMI Systems

All HMIs proposed for the control of the bulk liquid chemical storage system shall be compliant with the following specifications:

- **TEC-200 General Mechanical an Electrical Specification**
- **TEC-400 Instrumentation, Control and Automation Specification**

HMIs proposed for bulk liquid chemical storage systems shall also incorporate the process specific features listed below.

- Combined PLC/HMI devices shall not be permitted for use on bulk liquid chemical storage system installations;
- Both HMI and PLC shall be independently configurable and from the same manufacturer;
- The HMI provided shall have a screen with a minimum diagonal dimension of 250mm
- The HMI provided, and its associated mimics and functionality, shall incorporate all the features necessary to manage the bulk liquid chemical storage system in accordance with the requirements of **TEC-600-06** and this specification
- The HMI provided shall have full 'touch screen' capability, allowing all control functionality as described in Section 8 of this document.
- The HMI provided shall be capable of permitting touch screen properties to all text and graphical on-screen elements
- The HMI provided should incorporate a troubleshooting function to eradicate the requirement for an onsite PC.

7.11LABELLING & ASSET TAGGING

The Contractor shall adhere to details outlined in the following section of the specification when providing labels and nameplates for chemical storage systems and tagging of assets for incorporation into Uisce Éireann's Enterprise Asset Management System (Maximo).

7.11.1 Tank Labelling

All BSTs and day tanks shall be provided with a stickered label, manufactured from vinyl or similar material, which is suitable for outdoor use and will not detach in damp, wet or cold conditions. Stickered tank labels shall be visible from the tank's fill point, and at a minimum detail the following:

- Name of stored / batched chemical
- Concentration of stored chemical
- Relevant CLP data
- Maximum capacity
- Emergency spill contact number
- Specific gravity of chemical

In addition to the stickered tank label described above, all tanks ≥ 1200 litres storage capacity, shall be provided with a permanently fixed nameplate, detailing the following minimum information:

- Tank manufacturer
- Tank serial number
- Date of manufacture of tank
- Material(s) of construction of the tank
- The chemical & concentration the tank is designed to store
- Chemical density
- Design temperature
- Location for use – internal or external
- Maximum fill capacity
- Category of tank

7.11.2 Pipe Labelling

All chemical dosing pipework shall be labelled with a weatherproof sticker showing the direction of flow, and the name and concentration of the chemical being carried. The sticker shall be applied in a highly visible location. If the pipework is too small to accommodate an appropriately sized sticker, the pipe label shall be mounted at a suitable location adjacent to the pipework.

7.11.3 Filling Cabinet Labelling

Where filling cabinets are used, a weatherproof sticker shall be applied to the cabinet to ensure that an incorrect chemical, or the correct chemical but at an incorrect concentration, is not transferred to the tank. This label shall repeat the sticker information as outlined in Section 7.11.1 above.

7.11.4 Asset Tagging

Uisce Éireann seeks to implement an asset management strategy that optimises asset life; balancing capital investment with maintenance and operation of assets. A fundamental aspect of this strategy is Uisce Éireann's Enterprise Asset Management System (Maximo), which provides an electronic inventory of all assets under the ownership of Uisce Éireann, thereby supporting improved levels of maintenance, calibration, etc. in order to maintain asset reliability and maximise lifespan.

To facilitate the effective implementation of the Maximo System, the Contractor shall ensure that all upgraded bulk liquid chemical storage systems are tagged for incorporation in Uisce Éireann's Asset Register in accordance with the following documents:

- **TEC-100-011** Asset Hierarchy Rules and Definitions;
- **TEC-100-013** Asset Tagging Standard;

Bulk liquid chemical storage systems shall be considered a Level 7 Asset (i.e. a **Process Stage**: a physical entity which forms one part of a distinct process) as defined by Uisce Éireann's Asset Data Hierarchy (see **TEC-100-011**). Each Level 7 Asset shall be assigned an overall Asset ID, which will be visible on HMI/SCADA.

Each piece of equipment which forms a constituent part of the bulk liquid chemical storage system (i.e. a tank, a pump, an instrument, etc.) shall be considered a Level 8 asset. All Level 8 assets shall be physically tagged in accordance with **TEC-100-013**. Physical tags shall incorporate the Asset ID as well as each asset's unique QR code.

8 CONTROL PHILOSOPHY

This section of the specification prescribes the minimum control system functionality required for all chemical storage systems (liquid chemicals) installed under **New Development Works** and **Upgrade Works**. Its purpose is to standardise operational performance across all such installations, in terms of the management of chemical stock, duty rotations, issue of alarms, etc. In addition, this section also outlines the minimum information which the Contractor shall include in their detailed Control Philosophy for each installation.

8.1 CONTROL SYSTEM REQUIREMENTS

The Contractor shall ensure that chemical storage systems (liquid chemicals) shall incorporate the minimum control system functionalities as described in the following sections. However the Contractor shall note that the control system requirements presented may not be relevant to all applications of this specification. As such, the control system requirements shall be implemented in accordance with the following, unless specified otherwise in the project specific Employer's Requirements:

- **New Development Works:** The appropriate elements of the control system requirements *shall* be applied for all new development works
- **Upgrade Works** (partial to full): Unless specified otherwise in the project specific Employer's Requirements, the appropriate elements of the control system requirements *shall* be applied for all upgrade works.
- **Replacement Works:** Unless specified otherwise in the project specific Employer's Requirements, the control system requirements *shall not* be applied for replacement works, as this work category relates only to the replacement of individual chemical storage system components (i.e. BSTs, bunds, filling lines, etc.)

8.1.1 Bulk Storage Tank Replenishment

Bulk storage tank replenishment shall be carried out manually by the chemical delivery driver, in the presence of the Site Owner / Manager, or Field Operator / Caretaker. Each BST (in both single and dual tank installations) shall be filled individually, and the control system, in conjunction with the level instrument mounted within each BST, shall facilitate the following automated features:

- A 'traffic light' type visual monitoring system as described in Section 7.9.2
- Issue of all alarms which are pertinent to BST replenishment (i.e. high BST level) in accordance with Section 8.2

8.1.2 Chemical Stock Management

The control system, in conjunction with the level instruments mounted within each BST, shall facilitate the following automated features:

- Display the current level of each individual BST on the chemical storage system HMI/SCADA mimic in metres (correct to two decimal places)
- Display the current total bulk storage volume (in litres) for each individual chemical on the control system HMI/SCADA mimic
- Display the current total bulk volume and as a percentage of the maximum BSV of the storage system
- Issue of all alarms which are pertinent to chemical stock management in accordance with Section 8.2

8.1.3 Leak Detection

The control system, in conjunction with the level instruments mounted within each bund, shall facilitate the following automated features:

- Indication of a neutral (normal) or positive (alarm) level in the containment bund (digital signal)
- Issue of all alarms which are pertinent to high bund levels in accordance with Section 8.2.

8.1.4 Chemical Temperature

The control system, in conjunction with the chemical temperature instrument mounted within each outdoor BST, shall facilitate the following automated features:

- Display the current chemical temperature on the chemical storage system HMI/SCADA mimic in degrees Celsius
- Initiate / inhibit internal immersion chemical heating systems
- Issue of all alarms which are pertinent to chemical stock management in accordance with Section 8.2.

8.1.5 Pump Initiation / Inhibition (Dosing Pumps)

The control system shall ensure that the duty dosing pump is automatically initiated and inhibited in accordance with the requirements of the specific process for which it is installed. In general, the majority of dosing pumps shall be controlled on a flow proportional basis, with fine trimming control sometimes provided by an analytical instrument (chlorine residual monitor, UVA/UVT monitor, pH probe). In such cases, the duty dosing pump shall be initiated / inhibited in response to the following:

- **Pump Initiation**: duty dosing pump to initiate upon receipt of positive flow signal from the control flowmeter to ensure continuous chemical treatment (see process specific specification)
- **Pump Inhibition**: duty dosing pump to be inhibited upon cessation of a flow signal from the control flowmeter to prevent the formation of a chemical 'slug' (see process specific specification)
- Issue of all alarms which are pertinent to dosing pump failure in accordance with Section 8.2.
- Automatic rotation of duty dosing pump in response to dosing pump failure in accordance with Sections 8.1.7 and 8.1.8.

8.1.6 Pump Initiation / Inhibition (Transfer Pumps)

The control system shall ensure that the duty transfer pump is initiated and inhibited in response to the following:

- **Pump Initiation**: unless otherwise approved by Uisce Éireann Asset Strategy, all chemical transfer pumps shall be manually initiated using an Operator Presence Control (OPC) switch (i.e. a 'dead man's switch'). Pressing and holding the switch will cause the duty transfer pump to activate.
- **Pump Inhibition**: Release of the OPC switch will cause the duty transfer pump to be inhibited. In addition, a high level (i.e. full level) detected in the day tank shall automatically inhibit the duty transfer pump, or prevent its initiation.
- Issue of all alarms which are pertinent to transfer pump failure in accordance with Section 8.2.
- Automatic rotation of duty BST system in response to transfer pump failure in accordance with Section 8.1.8.

8.1.7 Duty / Standby Rotation (Single Tank Installations)

For all installations comprising of a single bulk storage tank or day tank, the control system shall be capable of initiating a rotation between duty and standby dosing pumps. The rotation shall ensure that the pumping workload is evenly distributed over both pumps, and each pump should be capable of operating as the duty or standby unit. For all rotations, the newly assigned duty pump shall operate on the same control mechanism as its predecessor (i.e. fixed dose, flow proportional, feed-back / feed-forward signal from an analytical instrument, etc.)

For all single tank installations, the control system shall permit the following rotational functionality:

- **Auto Rotation upon Duty Pump Failure:** the standby pump will be automatically assigned as duty upon failure of the current duty pump
- **Auto Rotation on a Scheduled Time Basis:** the duty and standby pumps will be automatically rotated on a scheduled time basis (when in automatic mode). The run period for each rotation shall be operator adjustable on the control system HMI
- **Rotation upon Manual Selection:** the duty and standby pump selection can be toggled on the control panel or system HMI
- Issue of all alarms which are pertinent to duty dosing pump rotation in accordance with Section 8.2.

For all of the options described above, if rotation (automatic or manual) has occurred as a result of the failure of a duty unit, the control system will inhibit further rotations until the fault has been resolved. Once the fault is cleared, the rotations can resume on the next scheduled time basis, or automatic / manual activation.

8.1.8 Duty / Standby Rotation (Dual Tank Installations)

As specified in Section 7.10.67.10.6, all dual BST installations shall incorporate a single dosing pump (or a single transfer pump) for each individual BST. Therefore in essence, the pumps themselves shall not be installed in a duty / standby arrangement, rather the entire dual BST system shall be designed as a duty / standby configuration.

For all installations comprising of dual BSTs, the control system shall therefore be capable of initiating a rotation between the duty and standby BST systems. The rotation between BST systems shall ensure that the chemical demand is evenly exacted from both tanks, and pumping workload is distributed over both pumps (dosing or transfer). Either of the individual BST/pump arrangements should be capable of operating as the duty or standby system.

For all rotations, the newly assigned duty BST/pump system shall operate on the same control mechanism as its predecessor, (i.e. for dosing pumps - fixed dose, flow proportional, feed-back / feed-forward signal from an analytical instrument; for transfer pumps - manually activated by OPC switch)

For all dual tank installations, the control system shall permit the following rotational functionality:

- **Auto Rotation upon Duty Dosing Pump Failure:** the standby BST system will be automatically assigned as duty upon failure of the duty dosing pump
- **Auto Rotation upon Duty Transfer Pump Failure:** the standby BST system will be automatically assigned as duty upon failure of the duty transfer pump, operating on the same control mechanism (i.e. manually activated)
- **Auto Rotation on a Scheduled Time Basis (for individual BST < 6000 Litres only):** the duty and standby BST will be automatically rotated on a scheduled time basis (when in automatic mode). The run period for each rotation shall be operator adjustable on the control system HMI.
- **Auto Rotation on a Chemical Level Basis (for individual BST ≥ 6000 Litres only):** the BST with the highest chemical level will automatically be assigned as the duty tank. As BSTs ≥ 6000 Litres shall utilise transfer pumps and day tanks, chemical transfer may only occur for 10 – 15 minutes per day. Therefore in order to ensure even abstraction from both BSTs, when the operator presses the OPC switch, the transfer pump shall always abstract chemical from the BST with the highest level. Should the level of the duty BST fall below the level of the standby BST during pumping, the rotation will not activate until after transfer pumping has ceased (i.e. the transfer pump has been inhibited manually by release of the OPC, or automatically by a high level signal received from the day tank).
- **Auto Rotation upon Low Chemical Level:** the standby BST system will be automatically assigned as duty upon detection of a low chemical level (≤ 5%) in the duty BST. Further rotation will be inhibited until replenishment has occurred.
- **Rotation upon Manual Selection:** the duty and standby BST selection can be toggled on the control panel or system HMI
- Issue of all alarms which are pertinent to duty BST rotation in accordance with Section 8.2.

For all of the options described above, if rotation (automatic or manual) has occurred as a result of the failure of a duty unit, the control system will inhibit further rotations until the fault has been resolved. Once the fault is

cleared, the rotations can resume on the next scheduled time basis, or automatic / manual activation.

8.1.9 Ambient Temperature

The ambient air temperature instrument mounted at each chemical storage installation shall facilitate the following automated features:

- Display the current ambient temperature on the chemical storage system HMI mimic in degrees Celsius

8.2 ALARM REQUIREMENTS

The Contractor shall ensure that each chemical storage system has the capability to generate alarms in response to a range of abnormal operational events.

8.2.1 Alarm Classification & Description

Alarms shall be segregated into the High, Medium and Low Priority classes as shown in Table 16, and further categorised in accordance with Uisce Éireann RAM policies (see Section 0 for further details of UÉ RAMs) which will dictate the required response time. Classification and categorisation of alarms shall be based on the Consequence of Failure (CoF) principle, with the intention of prompting a faster response time to high severity events that may lead to detrimental HSQE performance of the chemical storage system or entire treatment asset.

Alarm Class	Alarm Notification Format	Alarm Category (Required Response)	Response Abbreviation	Due Time (Respond in)
High Priority	▪ Locally on HMI / SCADA / MCC ▪ SMS to Recipient	Immediate - Critical	IMM	1 hour
		Same Day - Urgent	SD-U	3 hours
		Same Day – Best Endeavour	SD-BE	6 hours
Medium Priority	▪ Locally on HMI / SCADA / MCC ▪ SMS to Recipient	Next Day	ND	1 day
		Next Working Day	NWD	3 days
Low Priority	▪ Locally on HMI / SCADA / MCC	Next Week	NW	7 days
		Next Visit	NV	30 days

Table 16: Classification and categorisation of alarms.

8.2.2 Wait Function (Debounce)

The Contractor shall implement a *Wait* (debounce) function for each alarm, so that the generation of nuisance alarms is limited. The *Wait* function shall apply a delay to each condition before it is presented as an alarm. The *Wait* period shall be adjustable on the operator interface but shall restrict debounce periods to a minimum duration of 3 minutes, and a maximum duration of 360 minutes, on all real time measurements. Should the alarm be based on intermittent analysis, the *Wait* function shall utilise an adjustable quantity metric in place of a time duration (i.e. alarms shall not be initiated until 3 consecutive 'out of specification' readings are detected). Note that the Wait function shall only apply to process performance monitoring, and not to equipment failure notification, which shall generate instantaneous alarms.

8.2.3 SMS Alarm Recipients

A facility shall be implemented to permit the primary recipients of SMS alarms to acknowledge the alarm with an appropriate SMS response. Acknowledgement of an alarm shall inhibit the generation of further SMS messages associated with that alarm but shall not clear any of the other alarm notifications (i.e. flashing HMI/SCADA mimic). Should an acknowledgement of the alarm fail to be received within 30 minutes of alarm issue, a hierarchal system shall be in place to reissue the SMS alarm to a secondary recipient.

Further non-acknowledgement shall result in the alarm being reissued to a tertiary recipient. Recipients of SMS alarms shall be chosen from the following personnel, in accordance with UÉ RAM policy:

- Site Owner / Manager
- Field Operator / Caretaker
- Operational Management Centre (OMC) – nominated individual
- Maintainer (Mechanical / Electrical)

8.2.4 Chemical Storage System Alarms

Table 17 outlines the minimum alarm generation requirements for chemical storage systems (bulk storage of liquid chemicals), and specifies the type of alarm that each occurrence should generate. With the exception of equipment failure notifications, please note that alarms shall not be initiated until 3 consecutive 'out of specification' readings are detected, or upon detection of a sustained reading lasting more than 3 minutes.

Event	Low Priority Alarm	Medium Priority Alarm	High Priority Alarm
Dosing Pump Failure *(assume D/S configuration)*	-	1 Pump in D/S configuration fails	2 Pumps in D/S configuration fails
Transfer Pump Failure *(assume D/S configuration)*	-	1 Pump in D/S configuration fails	2 Pumps in D/S configuration fails
Low BST Level *(individual BST)*	-	-	≤ 5% of maximum storage level
High BST Level *(individual BST)*	-	-	≥ 100% of maximum storage level
Low Bulk Storage Volume *(Sum of BST Levels)*	≤ 40% Total BSV remaining	≤ 20% Total BSV remaining	≤ 10% Total BSV remaining
Low Day Tank Volume *(DT Level)*	≤ 40% DTV remaining	≤ 20% DTV remaining	≤ 10% DTV remaining
High Bund Level *(BST / DT Leak Detection)*	-	-	Positive level (≥ 10%) detected in bund
Chemical Temperature (immersion heater failure)	-	T < 5°C T > 20°C	T ≤ crystallisation temp as described in SDS
Instrument Failure	All ***monitoring*** instruments	All ***process control*** instruments	All ***critical process*** **control** instruments

Event	Low Priority Alarm	Medium Priority Alarm	High Priority Alarm
Wash Station Activation	-	-	> 3 minute operation of any emergency wash facility
System Shutdown	-	-	Any event that initiates a process shutdown

Table 17: Chemical storage system alarms.

8.2.5 Critical Control Points

Critical Control Points refer to certain High Priority Alarms which, when generated, shall result in the inhibition of the entire treatment process. For example, failure of both duty and standby sodium hypochlorite dosing pumps shall result in no primary disinfection at many water treatment plants. In such an event, flow through the entire plant shall automatically shut down to ensure the safety and security of the water supply.

Critical Control Points shall only follow the generation of a High Priority Alarm (never a Low or Medium Priority), however not all High Priority Alarms shall result in an automatic shutdown. The Contractor shall refer to the process specific design specifications to determine which High Priority Alarms should be accompanied by a Critical Control Point, and the value at which it is initiated.

8.2.6 Alarm Response Table

The Contractor will be required to prepare, and submit to Uisce Éireann for approval, a detailed Alarm Response Table for all chemical storage systems proposed. The Alarm Response Table shall be submitted by the Contractor as part of his Design Submission packages for approval, and shall be updated and resubmitted as required to account for all changes made as the design, installation or commissioning progresses.

8.3 CONTRACTOR'S CONTROL PHILOSOPHY

A detailed Control Philosophy shall be developed and submitted by the Contractor as part of their Design Submission packages for approval. The Contractor's Control Philosophy shall consist of the following:

- Control Philosophy Document
- Piping & Instrumentation Diagram (P&ID)
- Motor and Instrument Lists, I/O Lists and all other pertinent supplementary information

The detailed Control Philosophy shall be updated and resubmitted as required to account for all changes made as the design, installation or commissioning of the chemical storage system progresses. A final Control Philosophy, which should present a precise account of how the system is controlled, shall be included with the Operation and Maintenance Manual submitted for each installation.

8.3.1 Control Philosophy Document

The Control Philosophy shall be a text based account of how the minimum control system requirements outlined in Sections 8 to 8.2 shall be implemented on site, as well as any further site specific control requirements which may be necessary to ensure optimum performance of each chemical storage system. The document shall be read in conjunction with a detailed Piping and Instrumentation Diagram (P&ID) which shall be submitted in tandem.

The Control Philosophy shall allow Uisce Éireann and the Employer's Representative to gain a comprehensive understanding of how all automated features of the chemical storage system shall function prior to approval of design. In order to achieve this, the Control Philosophy shall, at a minimum, contain the following sections:

- **Section 1: General Executive Summary**

  A brief description of the chemical storage system outlining it's proposed location, it's purpose, site specific requirements and constraints, design assumptions and any other information necessary for a reader with limited knowledge of the specific installation.

- **Section 2: Reference Documents**

  A list of reference documents with which the Control Philosophy should be read. These documents may be included as Annexes to the Control Philosophy and shall include, but not be limited to:

  - Piping & Instrumentation Diagrams
  - General Arrangement Drawings
  - Motor & Instrument Lists
  - I/O Lists
  - Original Set-Points of all Fixed Value control inputs established at commissioning stage

- **Section 3: Control System Hardware Architecture (MCC Panels, PLCs, HMIs)**

  An architectural description of the control hardware proposed to fulfil the automation requirements of the chemical storage system. This section shall include:

  - A schedule of **proposed hardware** (MCC panels, PLCs, HMIs, etc.) including tags and descriptions
  - A detailed description of control system architecture, supplemented by diagrams, to fully illustrate the control system's hardware components (PLCs, HMIs, instruments, etc.),
  - A detailed description of control system architecture, supplemented by diagrams, to fully illustrate how the chemical storage system shall be integrated and interact with any existing supervisory / overall plant control system.

- A detailed description of the communications system (hardwired, fibre, ethernet, fieldbus, etc.), supplemented by diagrams, to fully illustrate how system comms will be implemented
- An example of a control system architecture diagram for an entire WTP facility is given below:

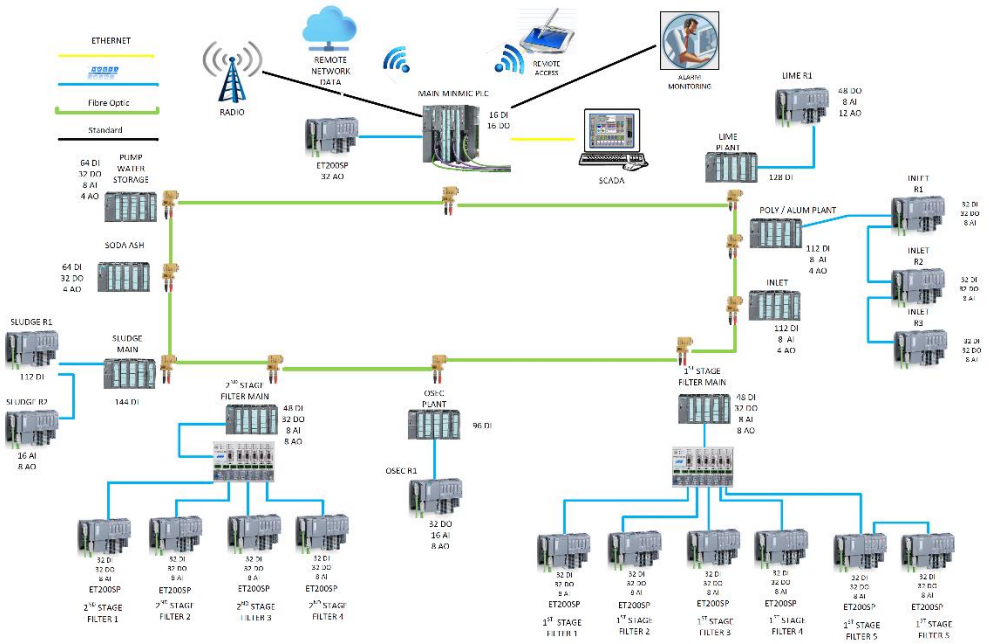

Figure 10: Typical control system architecture diagram for an entire WTP facility.

- **Section 4: Control System Software Functionality**

A detailed description of all the automated functions available for each aspect of the chemical storage control system. This section shall include, but not be limited to:

- **BST Replenishment**: a description of all automated functionality provided by the proposed control system for all activities associated with the replenishment of bulk chemical storage tanks
- **Chemical Stock Management**: a description of all automated functionality provided by the proposed control system for all activities associated with the management of chemical stocks
- **Chemical Leak Detection**: a description of all automated functionality provided by the proposed control system for all activities associated with the detection of chemical leaks
- **Chemical Availability**: a description of all automated functionality provided by the proposed control system to ensure the availability of chemical under all climatic conditions (i.e. immersion heating & heat tracing)
- **Transfer Pump Initiation / Inhibition**: a description of all automated functionality provided by the proposed control system for all activities associated with chemical transfer pumping

- **Dosing Pump Initiation / Inhibition**: a description of all automated functionality provided by the proposed control system for all activities associated with chemical dosing (however this item may be incorporated into the dedicated process specific control philosophy)
- **Duty / Standby Rotation (Single Tank Installation)**: a description of all automated functionality provided by the proposed control system for all activities associated with rotation between duty and standby chemical dosing pumps (however this item may be incorporated into the dedicated process specific control philosophy)
- **Duty / Standby Rotation (Dual Tank Installation)**: a description of all automated functionality provided by the proposed control system for all activities associated with rotation between duty and standby bulk storage systems

- **Section 5: Pumps, Motors & Drives**

For each pump, motor or drive proposed, the Contractor shall include within their Control Philosophy a brief description of its automated operation. This description shall clearly outline:

- How each pump/motor/drive is initiated
- How each pump/motor/drive is inhibited
- How the speed of each pump/motor/drive is controlled (if it is a variable speed system)
- All alarms generated by each pump/motor/drive (these will typically be failure alarms)

Each description shall be accompanied by a **Control Table** and an **Alarm Table** in accordance with the templates shown below, which summarises the salient performance aspects of each pump, motor or drive proposed. Each table shall be populated with all relevant equipment specific information. Contractors may add rows if necessary.

Control Table			
Pump/Motor/Drive	*<Insert pump/motor/drive name here>*		
Tag No.	*<Insert pump/motor/drive tag number here>*		
Function	**Control Details**	**Units**	**Set Point**
Initiation	*<details of what initiates this item>*		
Inhibition	*<details of what inhibits this item>*		
Control	*<details of what controls this item (speed control)>*		

Alarm Table

Pump/Motor/Drive	*<Insert instrument name here>*	
Tag No.	*<Insert instrument tag number here>*	
Function	**Alarm Details**	**Alarm Trigger**
Low Priority Alarm	*<Insert details of LP alarm>*	*<equipment failure>*
Medium Priority Alarm	*<Insert details of MP alarm>*	*<equipment failure>*
High Priority Alarm	*<Insert details of HP alarm>*	*<equipment failure>*

- **Section 6: Instrumentation**

For each instrument proposed, the Contractor shall include within their Control Philosophy a brief description of its monitoring / control function. This description shall clearly outline:

- Details of what each instrument monitors
- Details of what each instrument controls
- Details of the type of signals issues by each instrument [digital / analogue (4..20mA)]
- All alarms generated by each instrument and their proposed set points

Each description shall be accompanied by a **Control Table** and an **Alarm Table** in accordance with the templates shown below, which summarises the salient performance aspects of each instrument proposed. Each table shall be populated with all relevant equipment specific information. Contractors may add rows if necessary.

Instrument Control Table		
Instrument Name	*<Insert instrument name here>*	
Tag No.	*<Insert instrument tag number here>*	
Function	**Control / Monitoring Details**	**Signal Type**
Control	*<details of what this item controls/monitors>*	*<digital / analogue>*
Monitoring	*<details of what this item controls/monitors>*	*<digital / analogue>*

Instrument Alarm Table			
Instrument Name	*<Insert instrument name here>*		
Tag No.	*<Insert instrument tag number here>*		
Alarm Priority	**Alarm Details**	**Units**	**Set Point**
Low Priority Alarm	*<Insert details of LP alarm>*		
Medium Priority Alarm	*<Insert details of MP alarm>*		
High Priority Alarm	*<Insert details of HP alarm>*		

- **Section 7: User Interface**

  If a new HMI is proposed for the chemical storage system, or if a new chemical storage mimic is to be developed for incorporation to an existing supervisory HMI or SCADA, the Control Philosophy shall give a detailed description of the proposed user interface and all control functions which will be available therein. This shall include but not be limited to:

  - A list and description of each page available to the user on the HMI/SCADA interface (see Section 9 for Control System Interface requirements) for each chemical storage system, identifying which pages/functions shall be password protected.
  - A screenshot of the proposed system overview mimic for approval, which shall show all equipment items and instruments proposed for inclusion on the system mimic, complete with associated tag numbers. An example of the expected mimic standard is shown overleaf:

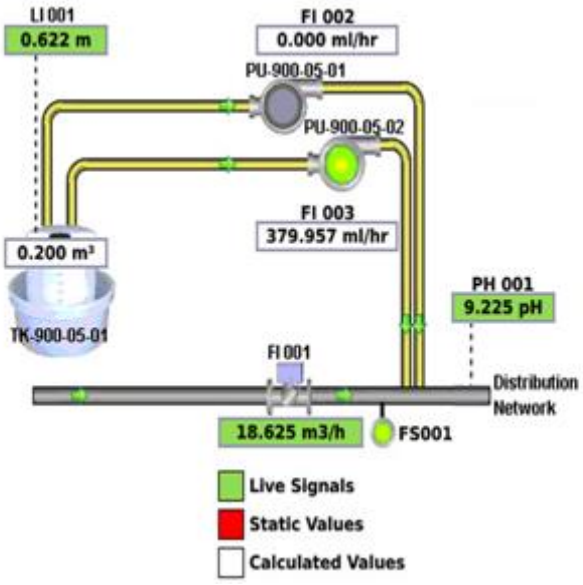

Figure 11: Example of a pH & alkalinity adjustment system overview mimic

- A list of all equipment items and instruments, complete with associated tag numbers which shall be visible on the proposed system mimic (BSTs, day tanks, pumps, motors, instruments, emergency showers, etc.)
- A description of how each item of equipment's status will be represented on the system mimic, and the functionality available for that item of equipment via the HMI/SCADA interface. This shall be presented within the Control Philosophy as a table for each item of equipment proposed. An example for a set of dosing pumps is outlined below:

Equipment HMI Status	
Equipment Name	*<Insert equipment name here>*
Tag No.	*<Insert equipment tag number here>*
Status	**Mimic Displayed As:**
Running / Normal	Green
Stopped / Normal	Grey
Fault	Flashing Red
Attention	Attention
Current Duty Unit	Indicated by a Green Dot over duty unit mimic
Interface Functionality	
<describe all the control functionality for this equipment item which is available for the system user via the HMI/SCADA interface. i.e. duty/standby toggle, set point adjustment, etc.>	

- A description of how each instruments status will be represented on the system mimic, and the functionality available for that instrument via the HMI/SCADA interface. This shall be presented within the Control Philosophy as a table for each item instrument proposed. An example for a level sensor is outlined below:

Instrument HMI Status	
Instrument Name	*<Insert instrument name here>*
Tag No.	*<Insert instrument tag number here>*
Status	**Status Description**
Operational	Grey
Fault	Flashing Red
Reading Visibility	*<instrument reading visible / not visible on HMI/SCADA interface>*
Interface Functionality	

<describe all the control functionality for this instrument which is available for the system user via the HMI/SCADA interface, i.e. alarm set point adjustment, etc.>

- A list of all alarms which will be visible on the system mimic, relayed off site, their proposed wait periods, and a description of how they will be displayed, acknowledged and reset.
- A description of the various alarm pages that will be available for each HMI/SCADA interface. At a minimum, the following alarm pages shall be provided:
  - **Active Alarm Page** – this page shall give a description of each active alarm, it's activation time and date, it's current status and it's priority
  - **Alarm History Page** – this page shall give a description of each historical alarm which has been activated and resolved during the preceding 28 days, it's activation time and date, it's resolution time and date, it's current status and it's priority
  - **Alarm Recipient Page** – this page shall allow the mobile phone numbers of SMS alarm recipients to be entered on a hierarchical basis
  - **Alarm Set Point Page** – this page shall allow the set points for alarms to be adjusted, and shall allow alarms to be disabled. This page shall be password protected.
- The final version of the Control Philosophy for incorporation to the O&M Manual shall include screen shots for each page of HMI/SCADA interface, with full descriptions of the system functionality that is available to the user.

8.3.2 Piping and Instrumentation Diagram (P&ID)

A detailed Piping and Instrumentation Diagram (P&ID), to be read in conjunction with the Control Philosophy document, shall be developed in accordance with the latest revision of Uisce Éireann's Technical Standards Document **TEC-100-006** (Piping & Instrumentation Diagram Standards). All equipment, instruments and pipework represented on the P&ID shall be tagged in accordance **TEC-100-006**. Consistent and corresponding tags shall be used in the main Control Philosophy document to refer to specific elements in the P&IDs.

8.3.3 Motor List

A detailed Motor List, to be read in conjunction with the Control Philosophy document, shall be developed and submitted as part of the Contractor's Control Philosophy package. Equipment items actuated by mechanisms other than induction motors (i.e. solenoid driven metering pumps, etc.) may also be included on the motor list. For each item on the motor list, the following information at a minimum shall be included:

- Motor Name and Tag Number
- Manufacturer & Model Number
- Serial Number
- Installed Power (kW)
- Expected Absorbed Power (kW)
- Configuration (Duty / Standby)
- Proposed Starter (DOL, S/D, SS, VSD)
- Voltage (V) & Frequency (Hz)
- Starting Current (A)
- Current drawn at ½ Load, ¾ Load, Full Load (A)
- Rated Speed (rpm)
- Speed Control
- Efficiency (%) at Duty Point
- Ingress Protection Rating
- ATEX Rating (if applicable)
- AC Heater
- Thermistor
- Insulation Class

8.3.4 Instrument List

A detailed Instrument List, to be read in conjunction with the Control Philosophy document, shall be developed and submitted as part of the Contractor's Control Philosophy package. For each item on the instrument list, the following information at a minimum shall be included:

- Instrument Name and Tag Number
- Manufacturer & Model Number
- Serial Number
- Installed Power (kW)
- Supply Voltage (110V, 240V, 24V DC, etc.)
- Digital Outputs (Quantity)
- Analogue Outputs (Quantity)
- Analogue Output Types (4..20mA.)
- Range Limits (minimum & maximum)
- Units

8.3.5 I/O List

A detailed I/O List, to be read in conjunction with the Control Philosophy document, shall be developed and submitted as part of the Contractor's Control Philosophy package. The following at a minimum shall be included for each PLC proposed for the automated control of chemical storage systems:

- Digital Inputs (DI)
- Digital Outputs (DO)
- Analogue Inputs (AI)
- Analogue Outputs (AO)
- Pulse Input (PI)

8.3.6 Original Set Points

A summary table, showing original set-points for all Fixed Value control input parameters established at commissioning stage, shall be developed and submitted as part of the Contractor's Control Philosophy package.

9 CONTROL SYSTEM INTERFACE (HMI/SCADA)

Unless otherwise approved by Uisce Éireann Asset Strategy, Human Machine Interfaces (HMI) shall only be utilised on Level 5 (Site) or Level 6 (Process) Assets. Similarly, SCADA systems shall only be utilised on Level 5 (Site) Assets. A brief explanation of Uisce Éireann's Asset Data Hierarchy (ADH) is presented below. The Contractor shall refer to the **TEC-100-011** Asset Hierarchy Rules and Definitions document for further details of ADH.

- **Level 1 - 4 (Root Node, Business Level, Regional Level, Chart of Accounts Level):** Identifies the location in relation to the Uisce Éireann (UÉ) business.
- **Level 5 (Site):** An operational site defined as "an enclosed area of land owned or utilised by UÉ".
- **Level 6 (Process):** A grouping of assets which combined, form a distinct stage of a treatment process e.g. Preliminary Treatment, CFC, Filtration, Disinfection, Corrosion Control, etc.
- **Level 7 (Process Stage):** a physical entity which forms part of a process eg. Screening, Chemical Storage
- **Level 8 (Asset):** An item or piece of equipment owned by UÉ; it is the building blocks of a site which largely define its maintenance

9.1 CONTROL SYSTEM INTERFACE HARDWARE (HMI/SCADA)

As chemical storage systems are regarded by the AIR document as a Level 7 (Process Stage) Asset, they shall not require dedicated control system interface hardware (HMI / SCADA). Instead, all information collated from chemical storage system equipment and instrumentation shall be mimicked on the Level 6 (Process) or Level 5 (Site) control system hardware for which the chemical storage system is being used. For example:

- Mimics of sodium hypochlorite (NaOCl) storage systems shall be displayed on the Disinfection Process HMI (Level 6), or on the overall site HMI/SCADA (Level 5)
- Mimics of aluminium sulphate $Al_2(SO_4)_3$ storage systems shall be displayed on the CFC Process HMI (Level 6), or on the overall site HMI/SCADA (Level 5)

For treatment plants with only a single HMI, or an overall plant SCADA, specific Level 6 processes (CFC, Disinfection, etc.) shall be mimicked on separate pages of a Level 5 control system interface, and mimics of associated chemical storage systems shall be grouped with their respective Level 6 process.

9.2 CONTROL SYSTEM INTERFACE SOFTWARE (USER PAGES)

When developing control system interfaces for chemical storage systems, the Contractor shall refer to Uisce Éireann's Design Specifications for Level 6 Assets (**TEC-700** Series for wastewater treatment, **TEC-900** series for water treatment), which define the precise requirements for each particular process. However, at a minimum the pages listed below shall be provided on the control system interface for each chemical storage system:

- Home Screen
- Main Menu Page
- User Log In Page
- Level 6 (Process) Mimic Page
- Level 7 (Process Stage) Mimic Page
- Trend Selection Page
- Trend Graph Pages
- Digital & Analogue I/O Pages
- Settings Page
- Totaliser Page
- Total Hours Run Page
- Control System Overview
- Active Alarm Page
- Alarm History Page
- Alarm Recipient Page
- Alarm Set Point Page
- Data Overview Page
- PLC to USB Transfer Page

The Designer shall ensure that any installed dosing system has the capability to operate in a fully automated fashion in accordance with Uisce Éireann's requirements, and be capable of maintaining the target set points associated with the relevant system. The system shall be designed to minimise the DWSP hazards and to ensure consistent and reliable performance under normal and abnormal operating conditions (i.e. respond to variations in flow, alkalinity, raw water pH, pump failure, etc.). A HMI touchscreen of minimum 175mm diagonal measurement shall provide the plant operator with a visual representation of the installation and will also allow process adjustments to be made in order to optimise the operation of the system. The HMI screen shall take the following structure architecture:

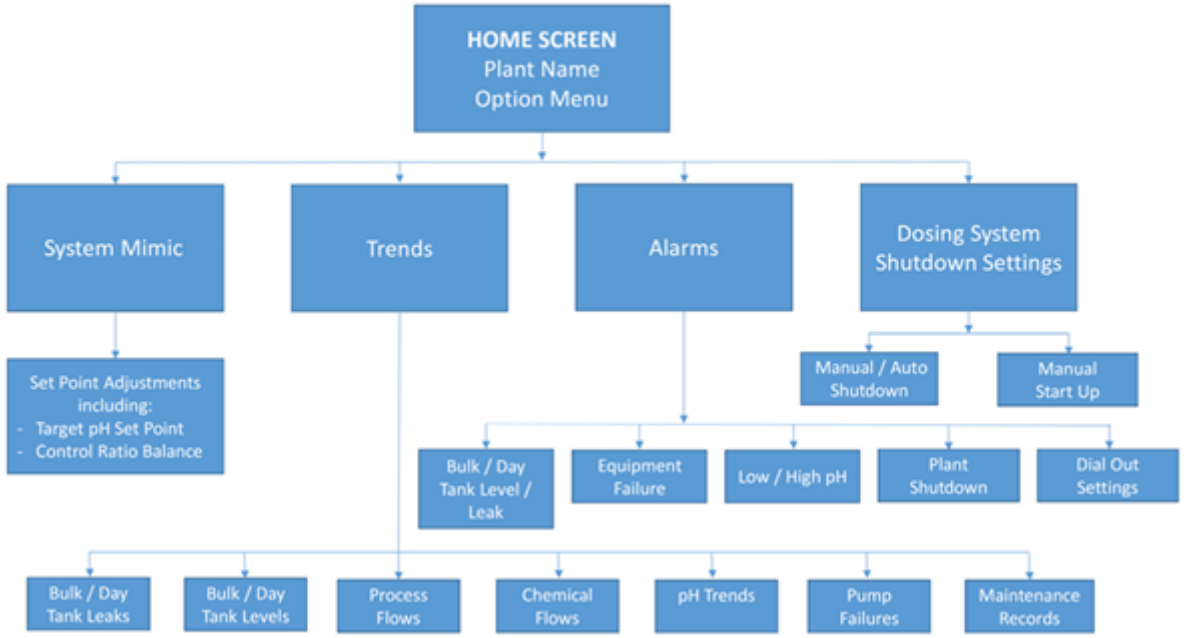

Diagram 4: pH / alkalinity suppression system HMI screen hierarchy for sulphuric acid dosing system.

Home Screen

The home screen of the HMI shall show the name of the plant and include four icons allowing the plant operator to select which screen he / she wishes to view. The icons shall be labelled as shown above and as follows; pH / Alkalinity Suppression System Mimic, Trends, Alarms and Dosing System Shutdown Settings.

System Mimic

The System Mimic will show a precise representation of the *General Design* that has been implemented on site. It should be used as an overview screen which shall allow the operator to both view and make control adjustments to the chemical dosing system installed. Each element of the process shall be represented (bulk tanks, day tanks, bunds, dosing pumps, transfer pumps, actuated valves, instruments and pipework) and feedback signals from each instrument shall be used to allow the current measurement be displayed on the mimic (i.e. the level of chemical in bulk tanks shall be displayed in real time beside the bulk tank mimic, the process water flow through FI001 shall be displayed beside the process water flowmeter mimic, etc.).

The unique tag number for each tank, pump, instrument and item of plant shall also be displayed on the screen beside the mimic of that particular item. If an item of plant has an element of functionality adjustment, then touching its mimic shall introduce a schedule of options which will allow the operator to make adjustments. For example, touching the dosing pump mimic shall open another screen which will allow the operator toggle the duty/standby pumps or adjust the control ratio between flow proportionality and measured pH values.
The mimic of operational pumps should be presented in green, and the standby pump mimic should be presented in black. If a fault signal is returned by one of the pumps or instruments then its onscreen mimic should flash between red and black, allowing the operator to see where a fault has occurred. The selected control ratio between flow proportionality and measured pH shall also be clearly displayed on the mimic screen.

Every page on the HMI hierarchy should also incorporate a ‘Home’ button which will return the user to the Home screen, and a ‘Back’ button which will return the user to the previously visited page. On pages that allow functionality adjustment, an ‘Apply’ button should appear if any changes or adjustments are made to the current settings. New settings will not be saved until the operator presses the ‘Apply’ button, at which point the user will be returned to the previously visited page.

Trends

The Trends page will allow the operator to view historical readings and graphs for the previous 30 days for each of the instruments used on the pH / alkalinity suppression system. This page will also allow the operator to view historical records of pump, instrument and plant failures and enter details of maintenance procedures completed (maintenance dates, type of work that was carried out, date of last delivery). As per previous pages, the trend screen will incorporate a ‘Home’ button which will return the user to the Home screen, and a ‘Back’ button which will return the user to the previously visited page.

Alarms

The Alarms page will allow the plant operator to view a historical record of generated alarms for a period of up to 30 days prior to the date of access. This page shall also allow the operator to view the alarm generation set points, but shall not allow their adjustment. While the operator has the capability of adjusting the Target pH Set Point to within ± 0.5 pH units of the commissioned target, consequently the Level 2 alarm will automatically adjust to between ± 0.2 of the newly selected set point, and the Level 1 alarm and system shutdown will automatically adjust to between ± 0.5 of the newly selected set point. The record of generated alarms will show the type of alarm generated (Level 1 or Level 2) and give the date and time that the alarm was raised and inhibited. The alarm screen will incorporate a 'Home' button which will return the user to the Home screen, and a 'Back' button which will return the user to the previously visited page.

Dosing System Shutdown

The Dosing System Shutdown Settings shall allow the operator to adjust the set points at which an automatic shutdown of the sulphuric acid pump occurs. This is to prevent over dosing of sulphuric acid, which may result in the stripping of all residual alkalinity and the creation of a corrosive water. Automatic shutdown of the dosing system will also occur upon a 'no-flow' detection from the raw water flowmeter. This will avoid the creation of a low pH 'slug' within the raw water process pipework. The HMI screen shall also allow the operator to initiate a manual shutdown if required, and incorporate a function for restarting the system after a manual *or* automatic shutdown has been initiated.

9.3 SECURITY OF SYSTEM CONTROL

To ensure that precise operational control of the coagulation dosing system is maintained, a password hierarchy shall be implemented on the HMI screen. There shall be 3 levels of security, as follows:

- Level 1: No password required. Access permitted for all.
- Level 2: Password required. Access permitted for operators and service personnel.
- Level 3: Password required. Access permitted for process commissioners only.

Level 1

Level 1 functions shall be available to all HMI users. Functions shall include display of all settings, mimics, current instrument readings, set-points, alarms and trends, however no adjustment or alterations shall be allowable under Level 1 access.

Level 2

Level 2 functions shall require the HMI user to enter a password to gain access, and should

be available to the plant operator and service personnel. All Level 1 functions will be available, but the plant operator and service personnel shall also have access to make changes to certain control functions and set points, including;

- Adjust control ratio of flow proportionality to SCM / UVA / turbidity trim set point.
- Toggle duty pumps, adjust automatic toggle frequency between duty and standby, inhibit one dosing pump to allow for maintenance or replacement
- Adjust total net charge target set-points as measured by SCM (only as far as the maximum and minimum values as set under Level 3 access)
- Adjust cut-in / cut-out level control parameters for transfer pumps (if applicable)
- Adjust bulk tank / day tank high and low level alarm set points (but only within the maximum and minimum range as set under Level 3 access)
- Adjust alarm set points and shut down limits (but only within the maximum and minimum range as set under Level 3 access)
- Select active dial out phone number, or add / change dial out phone numbers to allow alarms to be sent to a number of different caretakers. Also allow for a hierarchy of alarm SMS – i.e. no acknowledgement from active caretaker after (adjustable) time period, then SMS issued to next number on the hierarchy

Level 3

Level 3 functions shall require the HMI user to enter a password to gain access and should be available to the plant initial commissioning personnel. All Level 1 and Level 2 functions will be available, but the commissioning staff shall also have access to make changes to certain control functions and set points, including:

- Adjust dosing pump control (adjust stroke length, stroke frequency and stroke speed) and set the base line dosing requirements in proportion to the flowrates as determined by the jar tests.
- Setting of maximum and minimum limits for net charge target set-points
- Setting of maximum and minimum limits for control ratio adjustment of flow proportionality to SCM / UVA / turbidity measurements
- Setting of maximum and minimum ranges for bulk tank / day tank level alarms

Setting of maximum and minimum ranges for all alarm set-points and emergency shutdown triggers

PROVISION OF TELEMETRY SIGNALS FOR RAM POLICIES

Uisce Éireann has developed a suite of Remote Asset Management (RAM) Policies for a wide range of assets which outline:

- The responses to be taken upon generation of an alarm, and the associated response time
- An asset management approach to performance monitoring

To facilitate this policy, Contractors shall ensure that for each asset, appropriate instrumentation and telemetry systems shall be installed to monitor and relay the signals outlined in the UÉ Signal Provision Standard (**UÉ-RAM-SPEC-5000-001**). The Signal Provision Standard summarises the signals required in each of the individual RAM policy documents.

10.1 RAM POLICIES FOR BULK STORAGE OF LIQUID CHEMICALS

The Contractor shall refer to the UÉ RAM policies in **UÉ-RAM-SPEC-5000-001**. There is no dedicated Uisce Éireann RAM Policy for the bulk storage of liquid chemicals, therefore the Contractor shall utilise the appropriate process specific RAM Policy that is relevant to the proposed storage application as well as the relevant general policies. The relevant RAMs shall be implemented across all applications of this specification, namely:

- **Replacement Works:** replacement of individual chemical storage system components
- **Upgrade Works:** partial to full upgrades of chemical storage systems
- **New Development Works:** development of new chemical storage system (existing or greenfield sites)

Section No.	RAM Policy Name
Section 7.1	Mains Failure, Emergency Generators, Transformers and Incomers
Section 7.2.	Operating Technology
Section 7.3	Control Valves
Section 7.4	Flow Metering including UWWTD Flow Metering
Section 7.5.	Intruder Alarm

Table 18: General RAM policy sections of UÉ-RAM-SPEC-5000-001

The Contractor shall refer to Section 7.11.4 of this document (Asset Tagging) for further information on Uisce Éireanns Enterprise Asset Management System (Maximo) which outlines the assignment of unique tag numbers and QR codes to all Uisce Éireann assets.

10 TESTS ON COMPLETION

Project stakeholders shall refer to the **TEC-600-05 Commissioning, Testing and Handover – General Specification** for details of the general steps to be followed during commissioning of chemical storage systems. **TEC-600-05** also provides a summary of the documentation to be submitted at each stage of the commissioning process. The following sections focus on the specific Tests on Completion requirements for chemical storage systems.

All chemical storage systems shall be subjected to a rigorous testing schedule by the Contractor in advance of acceptance by Uisce Éireann. Unless specified otherwise in the project specific Employer's Requirements, the Contractor shall carry out the Tests on Completion for chemical storage systems in the sequence outlined in in this section. The Contractor shall require the approval of each stage of the sequence before advancing to the next.

11.1 COMMISSIONING PLAN

The Contractor shall develop a Commissioning Plan for submission and approval prior to undertaking any commissioning tests at the works, in accordance with **TEC-600-05**. The Commissioning Plan shall outline the procedures proposed for each test, the pass/fail parameters for each test, and where applicable, shall include Test Schedules and Sign Off documentation for all tests that are to be witnessed by Uisce Éireann or their representative (e.g. Site Acceptance Tests).

Tests on Completion shall not proceed until Uisce Éireann, or the Employer's representative, has approved the Commissioning Plan. The Commissioning Plan for chemical storage systems may be prepared as a standalone document, or it may be prepared as a subsection of an overall Commissioning Plan for projects where chemical storage systems are a part of a larger asset upgrade/development.

11.2 PRE-COMMISSIONING TESTS

Pre-Commissioning Tests shall be carried out by the Contractor to confirm, in advance of attended Commissioning Tests, that each item of plant and/or infrastructure installed as part of the chemical storage system:

- Can be safely operated and poses no health and safety risk to the Test Administrator or witnesses
- Is fully functional, and in terms of instrumentation, fully calibrated and reading accurately
- Is fit for purpose in terms of performing its required function
- Is therefore ready for witness testing (i.e. Commissioning Tests)

11.2.1 Pre-Commissioning Test Records

It shall not be mandatory for the Employer's Representative to witness Pre-Commissioning Tests for chemical storage systems. For this reason, the Contractor shall be required to maintain comprehensive records of **all** Pre-Commissioning Tests completed, to demonstrate that the chemical storage system is ready to advance to Commissioning Tests. Records for Pre-Commissioning Tests shall include;

- Dates and times of the commencement of each test
- A detailed procedure of how each test was carried out
- A detailed record of all conditions under which each test was carried out
- A detailed record of all results obtained from each test carried out
- Details of remedial actions taken (if necessary) and details of all retests
- A test completion certificate, signed off by all personnel responsible for the completion of each test.
- Copies of completed and signed Commissioning Sheets for all installed plant and instruments

11.2.2 Pre-Commissioning Tests

While the Contractor's Commissioning Plan shall provide a comprehensive account of all pre-Commissioning Tests to be completed for each chemical storage system installation, the following tests shall, at a minimum, be included:

General Tests

The Contractor shall carry out a comprehensive physical inspection of the works to ensure that all plant and equipment required has been provided and properly installed, and that the areas where Commissioning Tests will be completed are adequately secured. General Pre-Commissioning Tests shall at a minimum include:

- Inspection to ensure that all equipment and instrumentation is adequately secured and that all fixing bolts are properly tightened
- Inspection to ensure that all safety precautions have been implemented, particularly that all guards/protective enclosures are in place, and all access routes are cleared and free from trip hazards
- Inspection to confirm that there are no exposed electrical wires, and covers to all control panels, connector boxes, junction boxes, etc. are properly secured
- Inspection to ensure that all cuttings and waste, resulting from the installation of the mechanical and electrical equipment, has been removed from the test area
- All pipework has been adequately flushed to remove dust, solids and debris which may remain from construction / installation activities.

Instrument Tests

The Contractor shall carry out a comprehensive physical inspection of all instruments associated with the chemical storage system (as well as their monitoring and control functionality). Pre-Commissioning Tests of chemical storage system instruments shall at a minimum include:

- Checking and verifying the calibration and accuracy of all instrumentation
- Checking that each instrument is correctly powered, and that the correct output range has been selected
- Check that all instrumentation is properly protected from power surges, power overload, etc.
- Check that all instrumentation is properly connected and tagged as shown on the P&ID and Control Philosophy
- Each instrumentation loop shall be tested to ensure correct operation

MCC Panel Tests

The Contractor shall carry out a comprehensive physical inspection of each MCC Panel associated with the chemical storage system. Pre-Commissioning Tests of MCC panels shall at a minimum include:

- Confirmation that power is available at the panel, and that all cables have been properly terminated
- All mechanical/electrical interlocks, and the sequential operation of all motor-controlled equipment are operating correctly
- All lamps, indicators, safety cut-outs, instruments and safety equipment has been properly installed and tested.
- Each item of plant is functionally checked to ensure the correct operation of “Manual Control”, “Remote Control” and “Automatic Control” functions (where such control features are applicable).

Functional Tests

The Contractor shall carry out a comprehensive functional inspection of the chemical storage system as a whole, to verify that the system is operating in full accordance with the requirements of this specification and the approved Control Philosophy. Functional Pre-Commissioning Tests of chemical storage systems shall at a minimum include:

- Verification that all functions of the Level 6 (or Level 5) control system interface, for which the relevant chemical storage system forms a constituent part, operates in accordance with the approved control philosophy
- Verification that mechanical and electrical plant responds to user instructions issued from the Level 6 (or Level 5) control system interface (i.e. duty rotations, manual inhibitions, etc.)
- Verification that all alarms are generated and issued in accordance with the approved control philosophy

Weather Tests

The Contractor shall carry out comprehensive weather tests on all tanks and bunds installed outdoors, to verify in advance of initial chemical fill or hydrostatic drop tests, that the roof of the BST and bund's weather shroud are fully protected from the ingress of rainwater. While the Contractor shall submit a detailed procedure for their Weather Tests as part of their Commissioning Plan, the following outline procedures must be followed for each test of this nature:

- Condensation or dampness on the inside of the BST and bund shall be removed using dehumidifiers before commencement of the weather test.
- Following sufficient dehumidification, the inside of the BST and bund shall be inspected to ensure all inner surfaces are dry
- All connections on the BST roof and bund weather shroud shall be closed off prior to the weather test being conducted.
- Each BST roof and bund weather shroud shall be tested appropriately with water sprayed by a sprinkler head hose from above the tank curb angle level for a minimum period of 30 minutes.
- Following the weather test, the inner surfaces of the BST and bund shall be re-inspected to ensure that they remain dry.
- Should leaks be discovered in roofs or weather shrouds during weather testing, the defect shall be remedied (by the application of chemical resistance sealant) and the test repeated.

Hydrostatic Drop Tests

The Contractor shall carry out a comprehensive hydrostatic drop test on all installed tanks and bunds, to verify in advance of initial chemical fill, that no defects exist, and that leaks have not developed during transport or installation. While the Contractor shall submit a detailed procedure for their Hydrostatic Drop Tests as part of their Commissioning Plan, the following outline procedures must be followed for each test of this nature:

- Hydrostatic drop tests on chemical storage installations shall be completed using clean, potable water.
- All necessary precautions to prevent damage to the BST/DT or bund during hydrostatic drop testing shall be taken, particularly with regard to BST/DT flotation during bund testing
- BSTs, DTs, and bunds shall be cleaned, inside and out, and all connections below the maximum fill level shall be closed by valve isolation or by blank flanges
- Appropriate water disposal routes shall be established prior to commencement of hydrostatic drop tests
- As outdoor BSTs, DTs and bunds shall be enclosed there shall not be requirement for rainfall or evaporation monitoring.
- The BST/DT shall be tested first. Once filled, a visual inspection for leaks shall be completed

- Provided no visible leaks are identified, the water level within the BST/DT shall be noted by the level sensor and by manual measurement.
- The BST/DT shall be left for a minimum of 72 hours following recording of initial level. Regular monitoring of water levels shall be completed during this period, as well as further visual inspections for leaks
- The Bund shall be tested following successful completion of the BST/DT test. Once filled, a visual inspection of the bund for leaks shall be completed. **Note that the BST/DT shall remain full while the associated bund is tested to prevent flotation.**
- Provided no visible leaks are identified, the level within the bund shall be noted by manual measurement.
- The bund shall be left for a minimum of 72 hours following recording of initial level. Regular monitoring of water levels shall be completed during this period, as well as further visual inspections for leaks.
- The maximum allowable discrepancy between levels measured at the beginning of the test and levels measured after the test is 0.2%. This shall apply for BSTs, DTs and bunds.
- After successful testing the bund and BST/DT shall be drained (bund first, followed by BST/DT to prevent tank flotation) via the drainage valves at the base. All roof connections must be open during drainage to prevent the formation of a vacuum.
- All residual water, condensation or dampness on the inside of the BST/DT and bund shall be removed using dehumidifiers before filling with the proposed chemical is permitted

While water shall be used to complete the initial hydrostatic drop tests of the BSTs, DTs and bunds, all 'in service' tests shall be carried out by using the chemical proposed for storage. The dual tank installations as specified elsewhere in this document shall permit dosing to continue from one tank while the other is being tested.

Pipework Pressure Tests (Pressurised Systems)

The Contractor shall carry out a comprehensive pressure test on all pressurised chemical pipework systems, to verify in advance of initial chemical fill, that no defects exist in the installed pipework, or that no leaks have developed during installation. While the Contractor shall submit a detailed procedure for their Pressure Tests as part of their Commissioning Plan, the following outline procedures must be followed for each test of this nature:

- All pipework pressure tests shall be completed using clean, potable water. The water utilised during the hydrostatic drop tests on BSTs / bunds may be reused for this application
- A general inspection of the pipework shall be conducted in advance of each test to ensure that the condition of the pipework is adequate to accommodate safe completion of the test.
- The pipework system should be flushed out to remove any internal debris or unwanted material.
- Blank flanges or valves shall be used to seal of the section of pipework to be tested.

- Test gauges, if used, shall be installed at appropriate locations along the test section.
- Air pockets in the pipework system shall be removed in advance of pressure testing.
- The system should then be pressurised to the required test pressure (which shall be 1.3 times the operational test pressure of the pipework system).
- The test pressure should be maintained in the system until leak inspection procedures have been conducted. The system should be completely drained and purged after test completion.
- For pneumatic testing, the Contractor should consult Appendix G of the following EPA document - Guidance Note on Storage and Transfer of Materials for Scheduled Activities.
- Testing should be documented by suitable personnel and any leaks / defects repaired upon detection. Test should be repeated to ensure the integrity of the repairs.

In circumstances where pressure testing of chemical pipework systems is not feasible, alternative non-destructive tests (NDTs) may be proposed as an alternative by the submission of a Derogation Application as outlined in **TEC-600-06**. Should approval be granted by Uisce Éireann, NDTs shall be carried out at critical points on the piping system such as pipe elbows and tank connections. Due to the technical nature of NDT equipment, all NDT procedures should be performed by specially trained personnel and may consist of:

- Ultrasonic and x-ray testing techniques.
- Dye penetration techniques to highlight surface defects
- Wall thickness measurement to determine system wear rate.

Pipework Pressure Tests (Non-Pressurised Systems)

The Contractor shall carry out comprehensive test on all non-pressurised chemical pipework systems, to verify in advance of initial chemical fill, that no defects exist in the installed pipework, or that no leaks have developed during installation. While the Contractor shall submit a detailed procedure for their Pressure Tests as part of their Commissioning Plan, one of the following outline procedures must be followed for each test of this nature, and the Contractor shall make an informed decision as to which testing procedure is most appropriate for each application:

Water Tightness Test

For a water tightness test, the section of pipeline shall be filled with water to a maximum pressure of 50kPa measured at the top of the pipe (a minimum pressure of 10kPa is recommended by the EPA). Testing should ideally begin approximately an hour after filling of the pipe section. The pressure in the pipe is maintained by topping up with water over a half hour time period.

Air Tightness Test

For an Air tightness test, air is pumped into the pipeline so that a pressure of 1.1kPa is achieved. Airtight plugs

or other appropriate mechanisms must be used at either end of the pipeline. The pressure is maintained for 5 minutes and then let to drop down to a 1kPa testing pressure. After another five minutes has passed the pipeline pressure is measured once again. If the pressure reading is less than 0.75kPa, then the pipeline has failed and remedial action must be adopted.

Pre-Commissioning Test Report

Following completion of all Pre-Commissioning Tests, the Contractor shall submit a test report for each test carried out. This suite of test reports shall together constitute the Pre-Commissioning Report. Each test report shall give full details of the test completed, and shall at a minimum include:

- Dates and times of the commencement and completion of each test
- A detailed procedure of how each test was carried out
- A detailed record of all conditions under which each test was carried out
- A detailed record of all results obtained from each test carried out
- Details of remedial action taken (if necessary) and details of all retests
- A test completion certificate, signed off by all personnel responsible for the completion of each test
- Copies of completed and signed Commissioning Sheets for all installed plant and instruments

11.3 COMMISSIONING TESTS (SITE ACCEPTANCE TESTS)

Commissioning Tests (Site Acceptance Tests) shall be carried out by the Contractor in accordance with the requirements set out in **TEC-600-05**, in the presence of the Employer's Representative, to demonstrate that the functionality of the chemical storage system is in compliance with this specification and with the approved Control Philosophy as previously submitted by the Contractor.

The Contractor shall allow for all consumables which may be required for completion of the SAT and shall allow sufficient time to rectify any defects which may occur on the day of the test, and subsequently any retesting if necessary. The Contractor shall be liable for all expenses incurred on Uisce Éireann or their Representative should the SAT be interrupted and consequently rescheduled due to any system failure which was declared as operational in the Contractor's previously submitted Pre-Commissioning Test Report.

The Contractor shall ensure that the following personnel are in attendance on site during the execution of the SAT:

- Contractor's Representative to supervise completion of SAT and sign off
- Electrician or instrumentation technician to force signals where required

If any portion of the Works fails to pass the SAT, further tests of the said portion shall be repeated within a reasonable time upon the same terms and conditions save that all reasonable expense to which the Employer

may be put by the repetition of the tests shall be deducted from the monies due to the Contractor.

11.3.1 Site Acceptance Test (SAT) Requirements

The Site Acceptance Test shall consist of the following general inspections of the installation:

- A visual check of all works to verify installation is in accordance with Uisce Éireann specifications and submitted design proposals
- A visual check to ensure all equipment is safe to operate and all necessary guards, bunds, emergency showers, etc. are in place
- A visual check of all connections, pipework, valves, controls, etc. installed as part of the works;
- A visual check of all online instruments against reference instruments provided by the contractor (with calibration certificates for all reference instrument provided)
- A visual check of all process systems to ensure that all elements of the upgraded works are fully operational and operating within their design parameters

In addition to the visual inspection of the installation, all process elements shall be run through a series of simulations that represent the possible operating scenarios to confirm that system responses are appropriate, and are as described in the Control Philosophy.

Electronic signal simulations shall imitate the signals sent to the control system during normal operation. The control and automation logic programming shall be monitored during simulations to verify the programming is correct. These simulations shall be used to confirm that the upgraded chemical storage system, as well as all ancillary equipment and instrumentation, operate in a manner consistent with the requirements of this specification and the approved Control Philosophy. Simulated conditions shall include, but not be limited to:

- A check of all automated operating sequences and automated functionality of all devices to ensure that they are in accordance with the previously submitted control philosophy
- Simulation of all possible fault conditions to demonstrate the system response (alarm, alarm & shut down, etc.)
- Verification of system performance under current site conditions
- Auto-changeover between duty/standby equipment (pumps, BST systems, etc.)
- Shut-down and restart of all systems following interruption of power supply, including verification of UPS performance (if included in supply proposal)

11.3.2 Site Acceptance Test (SAT) Schedules

SAT Schedules for chemical storage systems (liquid chemicals) are presented in Appendix A of this document. Should a situation arise where Appendix A does not contain an appropriate SAT Schedule to allow the Contractor to demonstrate a particular system functionality, the Contractor shall develop their own, albeit in the same format as those presented in Appendix A.

Bespoke SAT schedules developed by the Contractor shall be submitted for approval as part of the Commissioning Plan as outlined in Section 11.1. All SAT Schedules shall incorporate a sign-off section for each proposed test to be carried out, which shall ultimately be signed by both representatives of Uisce Éireann and the Contractor upon satisfactory completion of the test.

11.4 TRIAL OPERATION PERIOD

The Trial Operation Period for the chemical storage system shall be executed in accordance with **TEC-600-05 Commissioning, Testing and Handover – General Specification**, and the Employer's Requirements for the specific works. Where there is a conflict between the TEC-600-05 and the Employer's Requirements for the specific works, then the Employer's Requirements shall take precedence.

Following satisfactory completion of the SAT, the Contractor shall utilise the Trial Operation to verify that that the chemical storage system operates in full accordance with the approved Control Philosophy for a prolonged period. For chemical storage systems, this period shall be a minimum of one week, and the operation of the system shall be monitored throughout by the Contractor.

Under no circumstances should alarms be disabled during the Trial Operation Period, and the Contractor shall make every effort to eradicate alarm generation at source in advance of commencing this stage of the Tests on Completion. While Uisce Éireann accepts that sporadic Low or Medium Priority alarms may still be generated during the Trial Operation Period for a variety of reasons, the Contractor shall not be permitted to advance to the Process Proving / Performance Testing stage if any High Priority alarms are generated during this period.

11.4.1 Commissioning Test and Trial Operation Report

Following completion of all Commissioning Tests and the Trial Operation, the Contractor shall submit a Commissioning Test Report which shall at a minimum include:

- Signed and dated SAT Schedules for each Site Acceptance Test Completed
- Trended data demonstrating the satisfactory completion of the Trial Operation Period
- Details of all alarms generated during the Trial Operation Period
- A declaration to Uisce Éireann, accompanied by the evidence listed above, which states that:

- the Contractor is satisfied that all systems are operating in accordance with this specification, the site specific Employer's Requirements, and the approved control philosophy
- the Contractor is satisfied that they have successfully completed all required Commissioning Tests
- The Contractor is satisfied that they have successfully pre-qualified to commence the Process Proving / Performance Testing stage of the works
- The Contractor is now applying for approval to begin Process Proving / Performance Testing

Following issue and acceptance of this declaration, the Contractor shall be instructed to proceed with the Performance Testing stage of the works. The Contractor shall be liable for all costs associated with recommencement of Performance Testing which may result from subsequent failures of systems which have been declared as fully operational within the Commissioning Test Report.

11.5 PERFORMANCE TESTING

Performance Testing of the chemical storage system shall be executed in accordance with **TEC-600-05 Commissioning, Testing and Handover – General Specification**, and the Employer's Requirements for the specific works. Where there is a conflict between the TEC-600-05 and the Employer's Requirements for the specific works, then the Employer's Requirements shall take precedence.

Performance Tests of chemical storage system shall consist of both **Functionality Performance Testing** and **Process Performance Testing**, as defined in TEC-600-05. Specific requirements for Functionality Performance Testing and Process Performance Testing of chemical storage system are outlined in the following sections.

Unless specified otherwise in the Employer's Requirements, chemical storage system Performance Tests shall be carried out for a minimum duration of 28 consecutive days. During the tests, the Contractor shall demonstrate at a minimum, the chemical storage system functions as listed below. If the data required to demonstrate this performance is not recorded electronically, a written account of system performance shall be maintained.

- 'Per Design' operation of all pumps/motors/plant/equipment
- Continuous and accurate operation of all instruments
- Equal draw down on all dual tank installations
- Regular duty rotations in accordance with control settings
- Minimisation of nuisance alarms
- Eradication of High Priority Alarms

Under no circumstances should alarms be disabled during the Performance Test Period. The Contractor shall also note that they shall be liable for all costs associated with recommencement of Performance Testing which may result from failures of systems which have been declared as fully operational within the previously Commissioning Test Report. Whether such failures are significant enough to warrant recommencement of the Performance Testing Period shall be wholly at the discretion of Uisce Éireann or their representative.

11.5.1 Performance Test Report

The Contractor shall submit to Uisce Éireann, or their representative, an MS Excel spreadsheet on a weekly basis during the chemical storage system performance test. This spreadsheet shall be a downloaded account of all data recorded by the control system during the previous week, on a minute by minute basis, and shall demonstrate the performance efficacy of the chemical storage system in accordance with Section 11.5 above. If electronic data logging is not available at the site, the Contractor shall maintain a written account of system performance, and transfer this to a MS Excel spreadsheet in lieu of the downloaded account.

Following the successful completion of the 28 day Performance Test, the Contractor shall submit a Performance Test Report (this report may form a part of an overall Process Proving Report if the chemical storage system has been installed as part of a larger Level 6 Asset Upgrade). This Performance Test Report shall at a minimum include:

- A brief description of the installation
- Commencement and completion dates for the Performance Testing Period
- A list of all tanks, pumps, motors, plant installed as part of the works
- A list of all instruments installed as part of the works
- A list of all alarms that the system can generate, as well as their grades (Low, Medium, High Priority) and each associated set point at which alarms are triggered
- Analysis of all data recorded during the Performance Testing Period, including, but not limited to:
  - All raw data gathered during the 28 day period, included as an Appendix to the main report
  - Weekly trend graphs which illustrate system performance, i.e. BST levels, total BSVs, day tank levels, chemical temperatures, duty rotations, etc.
  - Plausible explanations for any trend irregularities
- Schedule of all alarms generated during the 28 day period, including, but not limited to:
  - Time and date of alarm (should correspond with times and dates of trend irregularities)
  - Alarm Class (Low, Medium, High)
  - Alarm Category (IMM, SD-U, SD-BE, ND, NWD, NW, NV)
  - Time and date of alarm eradication (should correspond with times and dates of trend irregularities)
  - Plausible explanations for all alarms generated

11 STANDARD OPERATING PROCEDURES

Not applicable

12 ON SITE DOCUMENTATION

Documentation for chemical storage systems shall generally be retained onsite as part of the Safety File and/or Operation and Maintenance Manual for a larger Level 5 (Site) or Level 6 (Process) Asset, e.g. an overall CFC System, Disinfection System, or Fluoridation System. The Contractor shall therefore refer to Uisce Éireann's Design Specifications for Level 6 Assets (***TEC-700*** Series for wastewater treatment, ***TEC-900*** series for water treatment), or the project specific Employer's Requirements, which set out the overall content requirements for Safety Files and/or Operation and Maintenance Manuals. In circumstances where a chemical storage system is installed as a Level 7 (Process Stage) Asset only, and not part of a larger process upgrade, then a standalone Safety File and/or O&M Manual dedicated solely to the chemical storage installation shall suffice

13.1 DOCUMENTATION TO BE INCLUDED IN O&M MANUAL

The Contractor shall include the documentation outlined below as part of the Safety File and/or O&M Manual for chemical storage systems:

- Signed copies of all approved **Derogation Applications** (TEC-600-06)
- Copy of all relevant **HAZOP Studies**, if completed during design stages (TEC-600-06)
- Copy of the finalised **General Risk Assessment** (TEC-600-06)
- Copy of the finalised **ATEX / PEAZ Assessment** (TEC-600-06)
- Copies of all relevant **SDS Sheets** (TEC-600-06)
- List of all **Recommended PPE** (TEC-600-06) as determined under the GRA
- All **Emergency Procedures** (TEC-600-06) as determined under the GRA
- List of all **Emergency Washing Facilities** (TEC-600-06)
- The **Chemical Compatibility Risk Assessment** (TEC-600-06)
- All major **Design Assumptions** made during equipment selection (TEC-600-06-01)
- **Factory Tank Spark Test Certificate** (TEC-600-06-01)
- **Factory Hydrostatic Drop Test Certificate** (TEC-600-06-01)
- **Design File** for pipework carrying corrosive substances (TEC-600-06-01)
- **Design File** for temperature control of chemicals stored outdoors (TEC-600-06-01)
- Copy of Contractor's final **Control Philosophy** (TEC-600-06-01), including;
    - Process & Instrumentation Diagrams
    - Motor Lists and Instrumentation Lists
    - I/O Lists
- Equipment manufacturer's **OEM Literature** for all installed components
- Copy of **Routine Test Schedule** (TEC-600-06-01)
- Copy of **Routine Maintenance Schedule** (TEC-600-06-01)

- All **Recording Documents** necessary to maintain a comprehensive record of the following activities:
  - Chemical Delivery and Replenishment (date of fill, volume of fill, number of tank cycles, etc.)
  - Routine Testing & Routine Maintenance (including instrument calibration)
  - Equipment Replacement (details of equipment, date of replacement, commissioning, etc.)

13.2 DOCUMENTATION TO BE HELD LOCAL TO INSTALLATION

For ease of reference during an emergency situation, or as a prominent guide to effective testing and maintenance of the chemical storage system, the following document shall also be held in a location adjacent to each chemical storage installation.

13.2.1 Stored Documents

The Contractor shall install a sealed file holder with a polycarbonate door, in a prominent location close to the relevant chemical storage system. The location of the file holder shall ensure that there is no ambiguity as to which chemical system the posted documentation refers. The door of the file holder shall not be lockable, as timely access to its contents may be required and outdoor file holders will be fully weather proof and as much as is reasonably practicable, protect the documents from degradation in damp or cold conditions. Documents shall be replaced at a frequency necessary to ensure that they remain legible and useful to the plant operator. Documents to be stored adjacent to chemical storage systems include the following:

- Copy of chemical specific **SDS Sheets**
- List of all **Recommended PPE** to be used when operating or maintaining the system
- Any necessary **Emergency Procedures**
- Copy of **Routine Test Schedule**
- Copy of **Routine Maintenance Schedule**

13.2.2 Posted Documents

As well as storage documents adjacent to each chemical storage system, certain documents shall also be laminated, and posted in a prominent location, which shall be highly visible during day to day operation and maintenance activities at the site. The location of the postings shall ensure that there is no ambiguity as to which process the posted documentation refers. Documents shall be replaced at a frequency necessary to ensure that they remain legible and useful to the plant operator. Documents to be posted adjacent to chemical storage system include the following:

- Copy of chemical specific **SDS Sheets**
- List of all **Recommended PPE** to be used when handling the chemical
- Any necessary **Emergency Procedures** as determined under the GRA

13 ROUTINE TESTING AND MAINTENANCE

All chemical storage systems shall be subjected to a programme of routine testing and maintenance for the duration of their design life. This is necessary in order to ensure performance reliability and to manage health, safety, quality and environmental risks, whose likelihood of occurrence may increase with system age. Routine testing and maintenance of chemical storage systems shall be completed by the organisation that is appointed to operate the facility (this may be a local authority, or a private Contractor).

14.1 ROUTINE TESTING

As chemical storage systems constitute a high risk asset, the system operator shall carry out routine testing of each system component in accordance with the following sections. Routine Testing should be carried out after each of the following events:

- At regular time intervals (as defined by a Routine Test Schedule – to be developed by the Contractor)
- After significant modifications have been made to the chemical storage system
- After any significant failure of the chemical storage system
- After any occurrence which may have compromised the integrity of the system (impacts, severe weather, etc.)

14.1.1 Routine Test Schedule

For regular time interval testing, the Contractor, as part of their Operation and Maintenance Documentation, shall develop a Routine Test Schedule which shall, at a minimum, incorporate all of the tests listed below, as well as any further testing that may be recommended by component manufacturers or suppliers.

- Bulk Storage Tank Integrity
- Day Tank Integrity
- Containment Bund Integrity
- Pipework System Integrity
- Seal & Gasket Integrity
- Emergency Washing Facilities Operation
- Instrument Tests
- Alarm Generation

Where a component manufacturer's test frequency recommendations are in conflict with those listed in this document, then the manufacturer's recommendations shall take precedence. The Routine Test Schedule shall also outline detailed procedures for each specified test.

14.1.2 Routine Tests and Frequency

Frequency of component testing may be established based on the findings of the General Risk Assessment as described in **TEC-600-06**. The frequency of testing conducted on chemical storage system components should be proportional to the level of risk associated with each component – the higher the risk, the more frequent and extensive the testing. Notwithstanding the findings of the GRA, time intervals between Routine Tests shall not exceed those listed in Table 19. The system Operator shall ensure that these tests, as well as further tests which the Contractor may specify, are completed at the intervals as indicated, and in accordance with the procedures

outlined in the Routine Test Schedule.

System Component	Routine Test	Maximum Interval Between Tests
Bulk Storage Tank Integrity	External visual inspection	Every 3 months
	Internal visual inspection	Every 24 months
	Hydrostatic drop tests	Every 48 months
	Weather Test (Outdoor Tanks Only)	Every 24 months
Day Tank Integrity	External visual inspection	Every 3 months
	Internal visual inspection	Every 24 months
	Hydrostatic drop tests	Every 48 months
	Weather Test (Outdoor Tanks Only)	Every 24 months
Containment Bund Integrity	External visual inspection	Every 3 months
	Internal visual inspection	Every 24 months
	Hydrostatic drop tests	Every 48 months
	Weather Test (Outdoor Tanks Only)	Every 24 months
Pipework System Integrity	Above ground pipework – visual inspection	Every month
	Above ground pipework – pressure test	Every 24 months
	Below ground pipework – pressure test	Every 12 months
Seal & Gasket Integrity	Pipework gaskets – above ground pressure test	Every 24 months
	Pipework gaskets – below ground pressure test	Every 12 months
	Manways and connections on BSTs and Bunds	Every 48 months
Emergency Washing Facilities	Test pressure and flow in accordance with ANSI Z358.1	Every week
Instrument Calibration	Instruments to be tested / calibrated in accordance with manufacturers recommendations	Manufacturer Recommendation
Alarm Generation	All alarms to be tested in accordance with procedures outlined in Site Acceptance Tests	Every 6 months

Table 19: Routine tests and minimum frequencies for completion

14.1.3 Routine Testing Procedures

The Contractor shall develop, as part of their Routine Test Schedule, the exact procedures for completion of all routine tests outlined in Table 19 above. In the case where a site acceptance schedule (see Appendix A) exists (i.e. for Alarm Generation and Control Option Tests), then the site acceptance schedule may be used in lieu of the Contractor's procedure.

14.2 ROUTINE MAINTENANCE

As chemical storage systems constitute a high risk asset, the system operator shall carry out routine maintenance testing of each system component in accordance with the following sections. Routine Maintenance should be carried out after each of the following events:

- At regular time intervals (as defined by a Routine Maintenance Schedule – developed by the Contractor)
- After significant modifications have been made to the chemical storage system
- After any significant failure of the chemical storage system
- After any occurrence which may have compromised the integrity of the system (impacts, severe weather, etc.)

14.2.1 Routine Maintenance Schedule

For regular time interval maintenance, the Contractor, as part of their Operation and Maintenance Documentation, shall develop a Routine Maintenance Schedule which shall, at a minimum, detail all the recommended maintenance procedures listed below, as well as any further maintenance that may be recommended by component manufacturers or suppliers.

- Bulk Storage Tank Maintenance
- Day Tank Maintenance
- Containment Bund Maintenance
- Pipework System Maintenance
- Emergency Washing Facilities Maintenance
- Instrument Maintenance and Calibration
- Dosing Pump Maintenance
- Transfer Pump Maintenance

The Routine Maintenance Schedule shall collate all recommended maintenance requirements from the Original Equipment Manufacturer (OEM) manuals into one centralised document which shall enable the system operators to clearly identify what maintenance activities are to be carried out, and at what time intervals. This document shall also include detailed procedures for each maintenance activity specified.

14.2.2 Routine Maintenance and Frequency

Frequency of component maintenance shall be established based on minimum OEM recommendations., however the Contractor shall also take cognisance that the frequency of maintenance conducted on chemical storage system components should be proportional to the level of risk associated with each component – the higher the risk, the more frequent and extensive the maintenance requirements. Precise maintenance intervals shall therefore be based on the OEM minimum recommendations in conjunction with the findings of the General Risk Assessment as described in **TEC-600-06**.

The system Operator shall ensure that the maintenance activities as described in the Routine Maintenance Schedule, are completed at the intervals as indicated, and in accordance with the procedures outlined. In addition to these requirements, all chemical storage instrumentation shall be calibrated at a frequency equal or greater to that recommended by the manufacturer.

14.2.3 Routine Maintenance Procedures

The Contractor shall collate, as part of their Routine Maintenance Schedule, the exact procedures from all OEM literature, necessary for the completion of all routine maintenance activities.

14 DATA CAPTURE & REPORTING

Not applicable

15 REPORTING (IF REQUIRED)

Not applicable

16 REFERENCED DOCUMENTS

Document Name	*Document Number*	*Location*
General Mechanical and Electrical Specification	TEC-200	
Instrumentation, Control and Automation Specification	TEC-400	
Piping & Instrumentation Diagram Standards	TEC-100-006	
Asset Hierarchy Rules and Definitions	TEC-100-011	
Asset Tagging Standard	TEC-100-013	
Commissioning, Testing and Handover – General Specification	TEC-600-05	
Chemical Storage Systems: General Specification	TEC-600-06	
Series for wastewater treatment	TEC-700	
Series for water treatment	TEC-900	
Derogation Procedure	UÉ-AD-EDS-SOP-005	
Signal Provision Standard	UÉ-RAM-SPEC-5000-001	

17 GENERATED DOCUMENTS

Document Name	*Document Number*	*Location*
Bulk Storage of Liquid Chemicals – Site Acceptance Test Schedules	**TEC-600-06-01-FM-01**	