Eskom	TECHNICAL REQUIREMENT SPECIFICATION	NUCLEAR ENGINEERING

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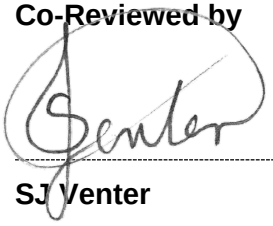	
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Note: The classification information supplied on this page is only applicable to this Technical Requirement Specification (TRS) document itself. The classifications of the systems, structures, components and services described in this document are supplied in section 3.6 of this document.

Content

Figures

1. Introduction

Koeberg Nuclear Power Station (KNPS) requires an adequate water inventory to provide cooling to the nuclear cores and spent nuclear fuel following a design extension conditions (DECs) event. DECs can be caused by flooding as a result of a tsunami, high speed winds and tornadoes, seismic events and severe ambient temperatures. Such events can cause the loss of existing water sources and thus the ability to fulfil the required cooling functions.

KNPS thus requires new Hardened Water Supply Tanks (HWSTs) to store sufficient water to fulfil its cooling requirements. Also, the HWSTs must be able to withstand the DEC events.

2. Supporting Clauses

2.1 Scope

2.1.1 Design

This Technical Requirement Specification (TRS) defines the requirements for the detailed design of the HWSTs, supporting systems and infrastructure. See detailed scope in section 3.1.

2.1.2 Documentation

As part of the design the *Contractor* shall be responsible to supply all documentation to allow the *Employer* to issue a tender(s) to the market for construction.

2.1.3 Oversight

The *Contractor* shall perform oversight of the construction process and ensure compliance to the design. The *Contractor* shall also update the design in the event that changes are required during construction.

Note: The successful tenderer for the design phase of the project may be excluded from tendering for the construction phase of the project due to conflict of interest and unfair advantage.

2.2 Normative/Informative References

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs, unless an edition is specified by, or agreed to, by the *Employer*.

2.2.1 Normative

[1]	10 CFR 50.55(a)	Domestic Licensing of Production and Utilisation Facilities – Codes and Standards.
[2]	113249-G2-01	Geotechnical Investigation for the proposed Koeberg 400kV Gas Insulated Substation.
[3]	238-103	Quality and Safety Management Requirements for Nuclear Suppliers Level 3
[4]	240-106192541	Chemistry Standard for Auxiliary Cooling Water

[5]	240-110745414	Standard for In-Service Inspection at KNPS (KSA-021)
[6]	240-120994091	Design Extension Related Guidance for Modifications and Equipment – Flooding as a Result of a Tsunami
[7]	240-121005755	Design Extension Related Guidance for Modifications and Equipment – High Speed Winds and Tornadoes
[8]	240-121010217	Design Extension Related Guidance for Modifications and Equipment – Seismic Event
[9]	240-121013197	Design Extension Related Guidance for Modifications and Equipment – Severe Ambient Temperature
[10]	240-127002040	Procurement Quality Engineering Requirements (KSA-089)
[11]	240-131063677	Koeberg Post-Fukushima Response Strategy
[12]	240-143604773	Process for Performing Safety Evaluations, Screenings, and Safety Justifications. (KAA-709)
[13]	240-143890978	Detailed Design Template
[14]	240-153364501	Safety Case Preparation.
[15]	240-84495295	Hardened Water Supply Feasibility Study.
[16]	240-86973501	Engineering Drawing Standard – Common Requirements
[17]	240-89294359	Nuclear Safety, Seismic, Environmental, Quality, Importance and Management System Level Classification Standard. (KSA-010)
[18]	293-QWR-013	Maintenance Basis Update Request Process
[19]	331-170	Requirements for Protective Coatings for Use at Koeberg Nuclear Power Station.
[20]	331-172	Standard for Repair / Replacement of Installed Mechanical Components (KSA-031).
[21]	331-378	Hardened Water External Connection Points Functional Requirement Specification
[22]	331-396	URS 12005 & 12008
[23]	331-433	Detailed Design Review Report
[24]	331-554	SEP Hardened External Water Connection Points for the Nuclear Island
[25]	331-86	Design Changes to Plant, Plant Structures or Operating Parameters (KAA-815).
[26]	331-87	Design Engineering Guide
[27]	331-93	Guide for Classification of Plant Components, Structures and Parts. (KGA-003).
[28]	36-943	Drawing Standard

[29] ACI 350.3-6 — Seismic Design of Liquid-Containing Concrete Structures and Commentary.

[30] Act No. 85 of 1993 — Occupational Health and Safety Act and Regulations.

[31] Act No. 93 of 1996 — National Road Traffic Act No. 93 of 1996

[32] ANSI N18.2 — American National Standard - Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants.

[33] ANSI/ANS 51.1 — American National Standard – Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants.

[34] ASCE 7-22 — Minimum Design Loads and Associated Criteria for Buildings and Other Structures

[35] ASME B16.34 — Valves - Flanged, Threaded and Welding End

[36] ASME B16.5 — Pipe Flanges and Flanged Fittings.

[37] ASME B16.9 — Factory-Made Wrought Buttwelding Fittings

[38] ASME B31.1 — Power Piping.

[39] ASME Code Case N-755 — Design of Buried High Density Polyethylene (HDPE).

[40] ASME NQA-1 — Quality Assurance Requirements for Packaging, Shipping, Receiving, Storage, and Handling of items for Nuclear Power Plants.

[41] ASME Section IX — Welding and Brazing Qualifications.

[42] ASME Section V — Non-Destructive Examination.

[43] ASME Section XI — Rules for In-service Inspection of Nuclear Power Plant Components, 2001 Edition with 2003 Addenda.

[44] ASTM F2164-18 — Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure.

[45] BS 336 — Specification for fire hose couplings and ancillary equipment

[46] BS 8007 — Code of practice for design of concrete structures for retaining aqueous liquids

[47] C0003/22C — Classification: Component classification for Hardened Water Supply Tanks.

[48] D0001/22C — Classification: Design of hardened water supply tanks and all supporting systems for EERI (Project 12008).

[49] DSG-310-087 — Generic Service Specification

[50] DSG-311-104 — Power, Control and Measurement cables (NSF Applications)

[51] DSG-317-094 — Specification for Chemical Products and Materials used at KNPS

[52] DSG-318-087 Quality Requirements for the Procurement of Assets, Goods and Services

[53] EERT-11-015 Rev 3 Seismic Hazard Report (KNPS)

[54] EPRI Code Case 1013549 EPRI Non-destructive Evaluation: Seismic Design Criteria for Polyethylene Pipe Replacement Code Case.

[55] ISO 9001:2015 Quality Management Systems.

[56] JN306-NSE-ESKB-R-3973 Seismic Margin Assessment of Koeberg Nuclear Power Station.

[57] JN385-NSE-ESKB-R-5337: Koeberg Earthquake Site Response off the Nuclear Island

[58] JN683-NSE-HOL-P-7052: Factual Geotechnical Report for CSB And ISFISI At Koeberg Nuclear Power Station

[59] KAA-501 Project Management Process for Koeberg Nuclear Power Station Modifications.

[60] KAA-648 Administration and Responsibilities for Requalification Testing

[61] KAA-709 Process for performing safety screenings, safety evaluations, safety justifications and safety cases

[62] KAA-719 Integrated Equipment Reliability Process

[63] KAA-751 Chemical Restrictions and Controls at Koeberg (CRACK) Programme

[64] KAA-815 Design changes to plant, plant structures or operating parameters

[65] KAA-913 Integrated Equipment Reliability Process

[66] KAE-012 Hazardous and Non-hazardous Waste and Scrap Disposal.

[67] KBA0015M00007 Technical Specification – Earthing Circuits.

[68] KBA0022E01020 Floor Response Spectra for the Design of Equipment and Piping Systems

[69] KBA1215K00007 Technical specification for cable installation

[70] KBA1215K00037 Technical specification for the local cable trays installation.

[71] KBA1222F00001 Equipment Marking

[72] KFA-006 Testing Procedure For Plant Modifications

[73] KNM-001 Maintenance Welding Programme

[74] KSA-011 Requirements for Controlled Documents

[75] KSA-037 Qualification and Certification Requirements for Personnel Performing NDT at the Nuclear Portfolio

[76] KSA-069 Foreign Material Exclusion

[77] KSA-105 Requirements for Station Cleanliness Control of Systems, Equipment and Components

[78] KSA-119 Management and Control of Supplemental Workers Koeberg Nuclear Power Station

[79] KSA-132 Lifting and Rigging Program

[80] KWM-MW-WEL-005 Storage, Handling, Control and Preservation of Stainless Steel

[81] NIL-01 Var 19 (KNPS) Nuclear Installation Licence No. NIL-01 (Variation 19).

[82] NNR RD 0034 Quality and Safety Management Requirements for Nuclear Installations.

[83] NUREG-0612 Control of Heavy Loads at Nuclear Power Plants.

[84] P-09 Civil Maintenance Repair Manual.

[85] PER Pressure Equipment Regulations.

[86] QFR-026 PM Strategy Input Sheet.

[87] RG-0016 Guidance on the Verification and Validation of Evaluation and Calculation Models used in Safety and Design Analyses.

[88] SANS 10100 The structural use of concrete.

[89] SANS 10142 South African wiring code.

[90] SANS 10160 Basis of structural design and actions for buildings and industrial structures.

[91] SANS 10162 The structural use of steel.

[92] SANS 10252-2 1993, Water supply and drainage for buildings - Part 2: Drainage installations for buildings.

[93] SANS 10400 The application of the National building Regulations.

[94] SANS 1200 Standardized specification for civil engineering construction.

[95] SANS 121 Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods.

[96] SANS 347 Categorization and Conformity Assessment Criteria for All Pressure Equipment.

[97] SANS 3834-2 Quality requirements for fusion welding of metallic materials Part 2: Comprehensive quality requirements.

[98] SANS 677 Concrete Non-Pressure Pipes.

[99] SAR Koeberg Safety Analysis Report.

[100] URS-EERI-12-001: Back-up Water Resources and Connections for mobile Accident Mitigation Water Pumps

[101] US NRC Guide 1.61	Damping Values for Seismic Design of Nuclear Power Plants.
[102] US NRC Guide 1.92	Combining Modal Responses and Spatial Components in Seismic Response Analysis.

2.2.2 Informative

[103] 1010/4/102	Nuclear Sites Site Safety Reports, Prestedge Retief Dresner Wijnberg (Pty) Ltd
[104] 238-5	Guide for the grouping of processes and requirements using the NEI Process Model (Guide for compliance to RD-0034 and Koeberg OE)
[105] 240-142639998	Safety Evaluation Process Guide (KGA-025).
[106] 240-55410927	Cyber Security Standard for OT
[107] 240-79669677	DMZ Designs for OT Systems
[108] 32-136	Contractor Health and Safety Requirements
[109] 331-85	Design Documentation Change Process (KAA-560)
[110] 331-94	Importance Category Classification Listing (KLA-001).
[111] DSG-310-306	Trailer Mounted Diesel Driven Mobile Fire Water Pump.
[112] DSG-310-328	Trailer Mounted Diesel Driven Water Pump, Reduced Flow Application.
[113] EERT-11-013	External Events Safety Re-assessment Interim Report
[114] EN 55032	Electromagnetic Compatibility of Multimedia Equipment - Emission Requirements.
[115] EN 55035	Electromagnetic Compatibility of Multimedia Equipment - Immunity Requirements
[116] EU Directive 2014/30/EU	Electromagnetic Compatibility (EMC) Directive
[117] EU Directive 2014/53/EU	Radio Equipment Directive
[118] IEC 61000-6-2	Electromagnetic Compatibility (EMC) - Part 6-2: Generic Standards - Immunity for Industrial Environments
[119] IEC 61000-6-3	Electromagnetic Compatibility (EMC) - Part 6-3: Generic Standards - Emission Standard for Residential, Commercial and Light-industrial Environments
[120] KBA 0917 SEP 001	Potable Water System (SEP) DSE.
[121] KBA0000G001000	Koeberg Nuclear Power Station Graphic Symbols.
[122] KBA0901G00256	Nuclear Island Room Identification.
[123] KGA-073	SHE Specification Guideline.
[124] KLA-023	Outage Preparation Milestone Checklist.
[125] KNC-001	Chemistry Operating Specifications.

[126] KNM-001 Maintenance Welding Programme
[127] PE17/058 Provision of a geotechnical investigation for the Hardened Water Supply site.
[128] Regulatory Guide 1.76 Design-Basis tornado and tornado missiles for nuclear power plants
[129] SANS 10252-1: 2012 Water supply and drainage for buildings - Part 1: Water supply installations for buildings.

2.3 Definitions

2.3.1 Confidential: the classification given to information that may be used by malicious/opposing/ hostile elements to harm the objectives and functions of Eskom Holdings Limited.

2.3.2 Contractor: Service provider, consultant or supplier that has been deemed successful (via a tender process) to provide the required service.

2.3.3 Client: ESKOM.

2.3.4 Design Extension Conditions (DEC): This term is used to describe postulated accident sequences or conditions that are possible but were not fully considered in the original design process because their probabilities of occurring were below the required value.

2.3.5 Equipment is items provided by the Contractor and used by him to Provide the Service and which the Service Information does not require him to include in the Affected Property.

2.3.6 Function: A task, action or activity that must be accomplished to achieve a desired outcome.

2.3.7 Graded Approach: A tool or method that can be used in determining the scope, extent, level of detail and the effort to be devoted to each hazard evaluation study.

2.3.8 Hardened: A SSC designed to resist DEC.

2.3.9 Inlet: Also referred to as upstream

2.3.10 May: Throughout this document, "may" to indicate a course of action permissible within the limits of this document.

2.3.11 Outlet: Also referred to as the downstream

2.3.12 Piping: Means pipes, valves, fittings, supports and all other components required for the conveyance of water.

2.3.13 Plant and Materials are items intended to be included in, and become part of the Affected Property of KNPS.

2.3.14 Platform Level: The platform level refers to the site 0.00m level which is +8.00m above General Mean Sea Level (GMSL).

2.3.15 Requirement:

a. A condition or capability needed by a user to solve a problem or achieve an objective.
b. A condition or capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification or other formally imposed document.
c. A documented representation of a condition or capability as in a. or b. above.

2.3.16 Shall: Throughout this document, "shall" is used to express a provision that is binding between two or more parties.

2.3.17 Should: Throughout this document, "should" to express a recommendation among other possibilities.

2.3.18 System: An interdependent group of people, objects and procedures constituted to achieve defined objectives or some operational role by performing specified functions. A complete system includes all of the associated Plant and Material, facilities, material, computer programs, firmware, technical documentation, services and personnel required for operations and support to the degree necessary for self-sufficient use in its intended environment.

2.3.19 Traceability Requirements: This follows the life of a requirement throughout the life of a system. Each requirement is traced to its parent requirement and to its allocated sub-system requirement.

2.3.20 The Structure: Describes the entire water tank structure, including the liner, all connections, piping, the roof, the foundation and valves required for the functionality of the Hardened Water Supply.

2.3.21 Will: Throughout this document, "will" to express a declaration of purpose or intent by one party.

2.3.22 Piping System: Includes pipe, valves, flanges, fittings, bolting, connectors, control and instrumentation and all ancillary equipment required for the successful operation of the system.

2.4 Abbreviations

Abbreviation	Explanation
ACI	American Concrete Institute
ASCC	Atmospheric Stress Corrosion Cracking
ASCE	American Society of Civil Engineers
BOM	Bill of Materials
CIDB	Construction Industry Development Board
DEC	Design Extension Conditions
DER	Design Extension Related
ECSA	Engineering Council of South Africa
EERI	External Event Review Initiative
EERT	External Event Review Team
EMC	Electromagnetic Compatibility
EOP	Emergency Operation Procedure
EPRI	Electric Power Research Institute

Abbreviation	Explanation
FB	Fuel Building
GMSL	General Mean Sea Level
GPR	Ground Penetrating Radar
GRP	Glass Reinforced Plastic
HDPE	High Density Polyethylene
HWST	Hardened Water Supply Tanks
HYB	Demineralised Water Production Complex
ICASA	Independent Communications Authority of South Africa
IEC	International Electrotechnical Commission
JPD	Fire Fighting Water Distribution
KNPS	Koeberg Nuclear Power Station
KORC	Koeberg Operations Review Committee
LOCA	Loss of Coolant Accident
NAB	Nuclear Auxiliary Building
PEE	Portable Emergency Equipment
PTR	Reactor Cavity and Spent Fuel Pool Cooling System
QADP	Quality Assurance Data Package
QCP	Quality Control Plan
SANAS	South African National Accreditation System
SEP	Potable Water System
SFP	Spent Fuel Pool
SG	Steam Generator
SSCs	Structures Systems and Components
TRS	Technical Requirements Specification

2.5 Roles and Responsibilities

N/A

2.6 Process for Monitoring

N/A

2.7 Related/Supporting Documents

This TRS is based on Feasibility Study (FS) 240-84495295, Ref [15].

3. Document Content

3.1 Detailed Scope

The scope of this TRS includes the detailed design of the HWSTs, supporting systems and infrastructure. The detailed scope of this project is defined below, technical requirements for the scope items are provided in Section 3.4:

3.1.1 Design

The *Contractor* shall provide a detailed design document, in accordance with the requirements of 331-86 Ref [25] & 331-87 Ref [26], on the prescribed *Employer's* template 240-143890978 Ref [13].

3.1.2 Existing Geotechnical study

An existing geotechnical study, Ref [2], is available for the preferred location of the HWSTs, this study shall form part of the inputs for the design of the HWSTs and associated supporting systems.

3.1.3 Structural design of the HWST structures

As described in the FS, Ref [15], the preferred option for the HWST structures are two round tanks located adjacent to each other with a usable water storage capacity of 10,500 m^3 in total, thus 5,250 m^3 per tank excluding freeboard.

3.1.4 Supply piping to fill the tanks from municipal supply

Supply piping shall be routed from the existing potable water system (SEP) to the HWSTs to fill the tanks. The supply piping shall be split near the tanks, and each tank shall have its own supply connection.

The water supply piping shall be able to maintain the level of the HWSTs automatically and manually.

3.1.5 Discharge piping and connection to project 12004 piping

The HWSTs shall discharge into a common supply pipe that will be connected to the tie-in point supplied by project 12004, see Figure 1. The physical connection to the 12004 project piping shall form part of the scope of this project (12008).

Filters shall be installed at the inlets of the discharge piping to prevent particles from entering the piping.

3.1.6 Connections and stations for existing KNPS Mobile pumps

Connection points for existing KNPS mobile pumps shall be installed to enable the pumps to be connected to the HWSTs piping, functional requirements are described in section 3.4.6.

Concrete slabs shall be provided to station the mobile pumps from where to connect the pumps to the connection points.

3.1.7 Water conditioning

A system shall be designed to condition the water in the HWSTs to maintain the water quality as specified in section 3.4.7.

3.1.8 Level indication

Both the HWSTs shall feature individual local mechanical level indicators.

Also, a remote alarm system for each tank shall be installed to alarm in the demineralised water production plant control room (HYB).

3.1.9 Drain piping

The HWSTs shall feature their individual draining lines discharging into a common header then into the nearest suitable stormwater drain to empty the tanks for maintenance.

3.1.10 Overflow

The HWSTs shall feature their individual overflow lines discharging into a common header then routed to the nearest suitable stormwater system.

A remote alarm system shall be installed to alarm in the demineralised water production plant control room (HYB) if the tanks overflow.

3.1.11 Stormwater System

A stormwater system shall be designed to tie into the existing KNPS stormwater system. It shall be designed to evacuate rain water runoff from the HWSTs and the surrounding paved site, overflow from the HWSTs and draining of the HWSTs.

3.1.12 Electrical supply

Electrical supply to the HWSTs shall be designed to provide lighting in any enclosed areas such as but not limited to the valve and water conditioning rooms.

Electrical supply to the water conditioning room shall be designed to supply any required electrical plant equipment for this project.

3.1.13 Rainwater management

The *Contractor* shall ensure that rainwater does not pose a risk to soil erosion around any structures. Rainwater management systems, such as gutters and downpipes, shall be installed where required. Water from these systems shall be drained to the stormwater system.

3.1.14 Access Roads

Access roads to and around the HWSTs shall be designed to accommodate tanker trucks to load or to unload water in the event that the HWSTs cannot be filled via the filling lines after a DEC or if the discharge line has become inoperable to extract water from the tanks and transport to the site connection points.

The *Contractor* shall evaluate the possible access roads from Access Control Point (ACP) 2 and determine suitability of these roads for tanker trucks. Any required upgrades shall be discussed with the *Employer* and upon acceptance from the *Employer,* form part of the design.

3.1.15 Preferred location of the new Hardened Water Supply Tanks

The site for the new structures is located at 33°40’22’’ S 18°25’51” E. The site is situated within the KNPS plant boundary, located North of the Low-Level Waste Building (HQB) and North-West of the High Voltage Yard (HVY). This is illustrated in Figure 1. This location is referred to as the preferred location. The preferred pipe route and tie-in point to the project 12004 piping is also indicated.

3.1.15.1 In the event that the *Contractor* identifies issues with the preferred location that would render the preferred location infeasible, such as but not limited to, flow head requirements, geological or soil issues, the *Contractor* shall notify and present the issues to the *Employer* who shall then make the decision to utilise the alternate location if deemed necessary by the *Employer*.

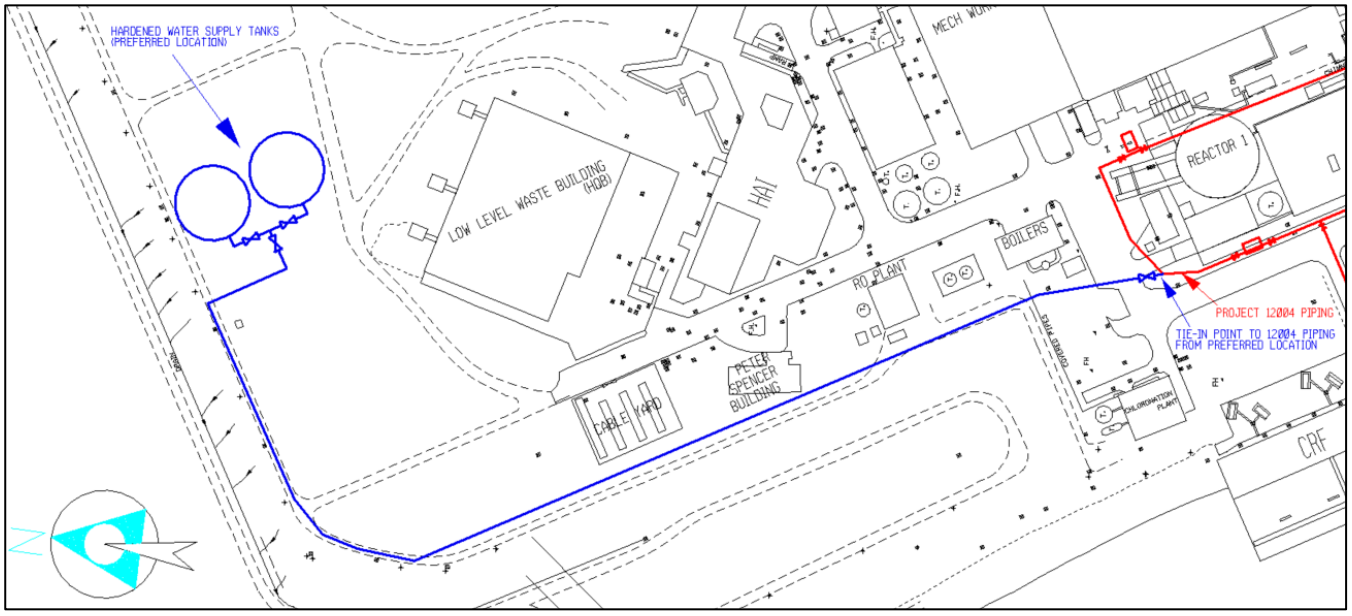

Figure 1: Preferred site and layout of the new structures

3.1.16 Alternative location of the new Hardened Water Supply Tanks

The alternative site being considered for the new Structures is located at 33°40’41” S 18°26’5 E. The site is situated within the KNPS plant boundary, located east of the Waste Holding Site (HFW), west of the Ekhaya Building (HAB) and south of the existing SEP tanks (HPB). This is illustrated in Figure 2. The alternative site may be investigated if the preferred site is found to be infeasible.

3.1.16.1 For the alternative site, in addition to DEC events, the HWSTs will be required to withstand flooding due to SEP tank rupture or collapse, as well as SGR building collapse.

3.1.16.2 The *Tenderer,* during the tender phase, shall add an additional section on costing to indicate the price impact on the project in the event that the preferred location is found to be infeasible and required to change to the alternative location.

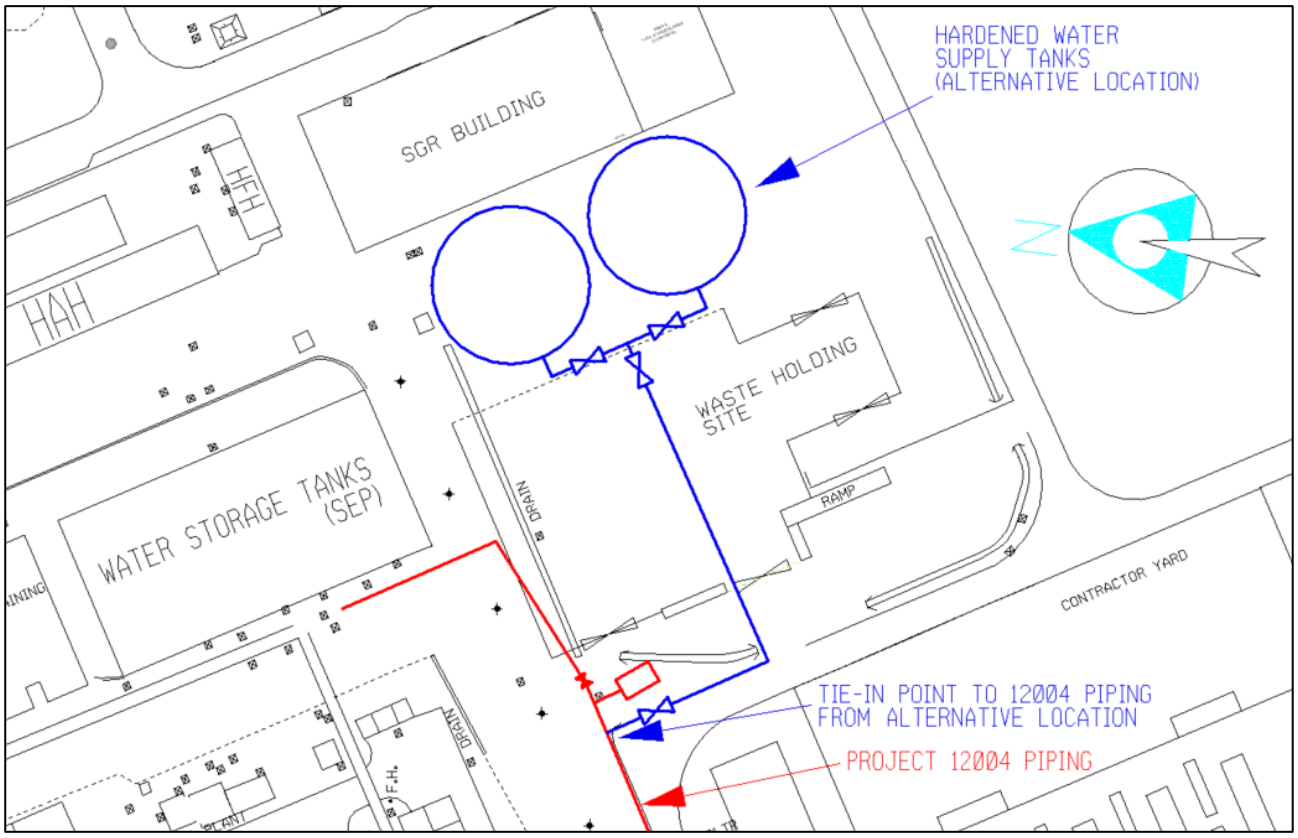

Figure 2: Alternative site and layout of the new structures

3.2 Existing Design

To supply water to the project 12004 piping to supply cooling water to the critical client systems during DECs, the onsite SEP tanks will be used in the interim as the source of water supply. These tanks have a capacity of 9056 m^3 per tank. Thus, when both tanks are full, an inventory of 18112 m^3 of potable water is available.

3.3 Problems with existing design

The SEP tanks are not designed to withstand DECs and cannot be relied on in DECs to supply water to the critical client systems. The tanks are also located on an embankment which makes it vulnerable to collapse in the event of an earthquake or due to soil erosion as a result of a tsunami or severe flooding.

3.4 Design Requirements

3.4.1 General Requirements

3.4.1.1 The Systems, Structures and Components (SSCs) for this project are divided into two design categories, Hardened and Non-Hardened, see Table 1 below. The *Contractor* shall demonstrate that the SSCs with a Hardened design category assigned shall be able to withstand DEC events as listed in the documents referenced below. The SSCs with a Non-Hardened category assigned are not required to withstand the DEC events as listed below, however, their failure may not cause damage, hinder, or affect the operation of the Hardened SSCs in any way.

- Flooding as a Result of a Tsunami – Ref [6]
- High Speed Winds and Tornadoes – Ref [7]
- Seismic Event – Ref [8]
  - The DEC guide for seismic, Ref [8], makes reference to the PC Rizzo derived 0.5g earthquake spectra, however, this spectra has not been accepted by KNPS and the NNR, thus the Dames and Moore derived 0.5g PGA earthquake spectra shall be used, unless the *Employer* replaces it with the new interim earthquake spectra currently under development.
  - There are concerns of ground liquefaction as a result of the seismic event. The forces and/or settlement introduced by ground liquefaction are to be considered when developing concepts and the resultant costing. Reference [15] may be consulted for more information.
- Severe Ambient Temperature – Ref [9]

Table 1 : Design Categorisation of SSCs

No.	SSCs	Design Category
1.	HWSTs main structures, including roof, walls, foundation, and any other structural supports	Hardened
2.	Discharge piping system from HWSTs to and including 12004 connection	Hardened
3.	Local level indication for each HWST	Hardened
4.	Water conditioning plant and associated piping systems	Non-Hardened, however structural integrity and leak tightness of piping shall be maintained up to the first isolation valve from the HWSTs during and after a DEC event.

5.	Connections for existing KNPS Mobile pumps	Hardened
6.	Tank drain lines	Hardened (Up to and including isolation valves)
7.	Concrete slabs for stationing mobile pumps	Hardened (Structural integrity of the slabs shall be maintained during and after a DEC event.
8.	Access roads	Non-Hardened (However, care shall be taken to reduce possible erosion of roads during DEC events)
9.	Supply piping system from municipal supply to HWSTs	Non-Hardened
10.	Electrical supply	Non-Hardened
11.	Remote overflow alarm system	Non-Hardened
12.	Low level alarm system	Non-Hardened
13.	Stormwater system	Non-Hardened
14.	Rainwater management system	Non-Hardened

3.4.1.2 Siphoning

All inlet and filtration return piping shall be designed in such a way to prevent siphoning in the event of pipe failure.

3.4.1.3 All SSCs shall be designed for a service life of 45 years.

3.4.1.4 Hardened steel piping shall be designed in accordance with ASME B31.1 Ref [38].

3.4.1.5 Non-hardened piping shall comply with applicable SANS standards.

3.4.1.6 Piping shall be designed to follow the shortest possible route.

3.4.1.7 Fire Risk shall be assessed and mitigated for in accordance with SANS 10400 [93].

3.4.1.8 Electrical lighting requirements shall be assessed and shall comply with SANS 10400 [93].

3.4.1.9 The *Contractor* shall use appropriate subsurface surveying techniques such as ground penetrating radar (GPR) to survey all locations where excavations are to be done. All underground indications and depth of indications are to be mapped on a site map. This map inclusive of the proposed pipe routing shall form part of the design package.

3.4.1.10 The Koeberg site plan shall be updated by the *Contractor* to indicate all structures and services added or altered by this project.

3.4.2 Geotechnical study

3.4.2.1 An existing geotechnical study, Ref [2], is available for the preferred location of the HWSTs, this study shall form part of the inputs for the geotechnical study of the HWSTs and associated supporting systems.

3.4.2.2 The *Contractor* shall conduct a geotechnical programme of the structure area consisting of site-specific investigations, soil borings, necessary static, and dynamic testing to establish shear wave velocity, and laboratory testing of soil samples to establish necessary properties to be used in calculations which shall include characterization of sand, shear modulus and insitu soil density.

3.4.2.3 Koeberg Nuclear power station has performed several tests as part of the Duynefontein seismic hazard assessment which includes Standard Penetration tests (SPTs). The *Contractor* shall be required to conduct 3 Test Pits of 3-4m deep in the vicinity of the structure and to remove two borings so that the results of the testing can be used to infer the critical soil properties from the testing that has been done by Koeberg in the past. If the results from the two borings cannot be inferred to the previous studies, then the *Contractor* will be required to perform the additional site-specific investigations.

3.4.2.4 The proposed programme consists of drilling a total of 5 Standard Penetration Test (SPT) borings of the proposed structure location. Rock coring will be conducted in all the soil borings, minimum of 1 meter into competent bedrock. Bedrock Level is indicated as Elevation of -12.0 m GMSL according to the Koeberg SAR, however bedrock may be at different elevations at the drill sites, the *Contractor* shall account for this.

3.4.2.5 The *Contractor* shall conduct cross-hole seismic shear wave velocity testing in two deep locations beneath the proposed structure location. Additional boring shall be done, if necessary, for the cross hole seismic shear wave velocity measurements. Testing shall be done in general accordance with ASTM D4428 with depth of borings to conduct logging advanced to depth of the bedrock.

3.4.2.6 Soil liquefaction induced forces and/or settlement analysis shall be performed using an earthquake with PGA of 0.5g. SPT information is required as input to the settlement calculation. Suitable software shall be used to determine the expected settlement in each layer during a seismic event to determine the differential settlement that could occur.

3.4.2.7 The *Contractor* shall determine a conservative, site specific, ground water high level which shall accommodate seasonal changes.

3.4.2.8 The *Contractor* will perform those subsurface investigations, analyze the data, and document the results of these site characterization activities in a formal geotechnical report. The report shall include, as a minimum:

I. Written test plans;

II. Site description;

III. Subsurface exploration location plan;

IV. Logs of test borings;

V. Results of laboratory and field testing;

VI. A narrative interpretation of the subsurface soil and ground water conditions observed and their implication for the project.

VII. Bearing capacities of all strata, settlement, liquefaction potential and modulus of subgrade reaction.

3.4.2.9 A risk to be noted for the preferred site is that this site may have been used as a dump site in the past, thus may contain reinforced concrete waste which could cause potential drilling and excavation issues.

3.4.2.10 Subsurface services may be present at both tank locations as well as along pipe routes. Subsurface scanning shall be done prior to drilling and construction as described in section 3.4.1.9.

3.4.3 Structural design of the HWSTs

The HWST superstructures shall be designed to comply with the following requirements:

3.4.3.1 Two (2) round tanks with a usable water capacity of 5,250 m^3 (five thousand two hundred and fifty cubic meters) per tank.

3.4.3.2 The HWSTs shall have an elevation sufficient to supply the required flow volumes as stated in Table 5 of Appendix A under gravity feed.

3.4.3.3 The design of the HWSTs shall be done in accordance with the codes listed in Table 2, taking the DEC requirements into account as stipulated in section 3.4.1.1:

Table 2 : Design Codes

Application	**Design Code**
Conventional and Construction Loading	SANS 10160 [90]
Detailing and Construction rules	BS 8007 [46]
Seismic design and analysis rules	ASCE 7-22 [34] & ACI 350.3-6 [29]
Flooding and impact due to debris	ASCE 7-22 [34]

Wind Loads	ASCE 7-22 [34] procedure only
Tornado and Windborne Missiles	SAR 2CHP01-05 [99] procedure only for reinforced concrete. Finite Element Analysis (FEA) required for instances where the SAR procedure is inadequate, as well as for other components.
High Temperatures	SANS 10160 [90] procedure only

3.4.3.4 The HWST foundations and associated equipment foundations shall be designed to withstand DEC events taking into account the geotechnical conditions as specified in Ref [2] as well as the geotechnical studies undertaken by the *Contractor*.

3.4.3.5 The HWSTs structures shall be fully opaque to prevent algae growth due to sunlight penetration.

3.4.3.6 For the HWSTs roof structures design, care shall be taken for the following:

3.4.3.6.1 The HWSTs roof structures shall be designed to ensure that any waves and sloshing generated in the tank during a seismic event shall not lift or damage the roof structures. The tanks shall have a minimum freeboard of 500 mm.

3.4.3.6.2 The roof-wall connection shall be designed with sufficient strength to resist the roof inertia load during a seismic event.

3.4.3.6.3 The Roof shall be designed to withstand the same Significant Operating Conditions as stated under section 3.4.1.1.

3.4.3.7 The HWST structures shall be designed to limit crack width under severe loads to 0.25 mm.

3.4.3.8 The HWST shall be lined with a polymeric lining that will last the design life of the HWSTs.

3.4.3.9 A hydrophobic coating shall be applied to the exterior of the tanks to prevent chloride ingress.

3.4.3.10 The concrete shall be suitably durable to resist the marine environment at KNPS. The Concrete used shall have the durability indices as stipulated in Table 3 below.

Table 3 : Durability requirements for concrete

Index	Value
OPI (log scale)	>9.40
Sorptivity (mm/√h)	<9.00
Conductivity (mS/cm)	<1.00.

3.4.3.11 Apron slabs shall be provided for the HWSTs to allow for personnel access.

3.4.4 Supply piping to fill the tanks from municipal supply

The supply piping from the municipal supply shall comply with the following requirements:

3.4.4.1 The HWSTs shall be supplied from the SEP system. A 10” (DN 250) pipe shall be installed and tied into the SEP system at a suitable location, to be identified by the *Contractor* and accepted by the *Employer*.

3.4.4.2 The supply system shall be designed not to cause any other plant system being fed from the SEP system to be starved of supply when the HWSTs are being filled.

3.4.4.3 Each HWST shall have two filling lines:

- One large (12”, DN 300) filling line with a manual isolation valve used when filling the HWST when the level is low.
- One small (6”, DN 150) filling line with an automatic valve system to automatically maintain the water inventory level at full. The automatic valve shall also have the functionality to be manually closed or opened.

3.4.5 Discharge piping and connection to project 12004 piping

The discharge piping from the HWSTs to the project 12004 piping connection shall comply with the following requirements:

3.4.5.1 Each HWST shall have a discharge pipe with a manual isolation valve. These two pipes will discharge into a common discharge line which will convey the water from the HWST outlets to the project 12004 piping.

3.4.5.1.1 The discharge header shall allow the two HWSTs to be interconnected to allow the tank levels to be equalised when required.

3.4.5.2 The discharge piping shall be designed to supply the required flow rates for each scenario as stipulated in Appendix A, Table 5 to the project 12004 piping under gravity. The discharge nozzles of project 12004 are elevated at +1.00 m from the 0.00 m platform level. Site 0.00 m platform level is +8.00 m above the General Mean Sea Level (GMSL).

3.4.5.3 The discharge piping material shall be polymeric piping, such as High Density Polyethylene, Glass Reinforced Plastic (GRP), etc. The *Contractor* shall determine the material or combination thereof and the installation methods, which is best suited for the design requirements. The proposed materials and installation methods shall then be submitted to the *Employer* for acceptance. The *Employer* may influence the selection of materials and installation methods to align with project 12004. The *Contractor* shall describe, in the design, why the chosen materials are best suited for the application.

3.4.5.3.1 International standards, codes or code cases shall be used for the design of the pipeline.

3.4.5.3.2 Seismic design shall be done in accordance with international standards, codes or code cases such as but not limited to, Electric

Power Research Institute's (EPRI) Code Case 1013549 [54], for additional guidance, see ASME Code Case N-755 (limited to 10 bar design pressure), Ref [39].

3.4.5.3.3 ASME B31.1 [38] allowable stress limits and safety factors shall be used for the supply piping seismic design.

3.4.5.3.4 Soil samples shall be taken and tested to ensure that the soil chemical composition is compatible with the selected piping material to achieve the design life of the piping system. This shall be done at a minimum of five evenly spaced locations along the total length of the buried supply pipe sections.

3.4.5.3.5 Water samples shall be taken and tested from the SEP tanks to determine if the chemical composition of the water is compatible with the selected piping material to achieve the design life of the piping system.

3.4.5.4 The *Contractor* shall ensure that the connection of the 12008 piping to the 12004 piping shall not cause overstress conditions in the 12004 piping during a seismic event.

3.4.5.5 The *Contractor* shall ensure that shear failure between discharge piping and civil structure interfaces are mitigated for. This is a major risk for polymeric piping failure under seismic conditions.

3.4.5.6 Strainers shall be installed at the discharge piping inlets to filter out particles larger than 2.5 mm in diameter.

3.4.5.7 The discharge piping shall be pressure tested in accordance with ASTM-F2164-18 [44] to a test pressure of 1.5 x system design pressure. The system design pressure shall be 16 bar to accommodate the mobile pumps.

3.4.5.7.1 Buried piping shall be pressure tested and checked for leaks prior to trench backfill.

3.4.5.8 Drain lines including drain valves shall be installed on the discharge piping to ensure that the piping can be drained for maintenance.

3.4.5.9 Tombstones with brass nameplates shall be erected every 100 m along the buried piping and at T-joints to indicate the location and orientation of the pipe line route. The brass nameplates shall indicate the following information:

- Pipe line name: EERI Supply
- Project no.: 12008
- Pipe Nominal Diameter
- Maximum Flow
- Pipe Material
- Buried depth of pipe (pipe centreline)
- Arrows indicating pipe orientation

3.4.6 Mobile pump connections and stations

Connection points for mobile pumps shall be designed to enable the existing KNPS mobile firefighting pumps to be connected to the HWSTs piping, the connections shall allow the mobile pumps to perform the following functions:

3.4.6.1 Increase flow in the discharge piping when water levels are low in the HWSTs.

3.4.6.2 Extract water from the HWSTs to mobile tankers

3.4.6.3 Inject water into the HWSTs from mobile tanks.

3.4.6.4 Enable a minimum of two mobile pumps to be connected simultaneously in parallel.

3.4.6.5 Pump connections:

3.4.6.5.1 The existing Rosenbauer pumps at KNPS have two 2 ½" instantaneous couplings for suction as well as two 2 ½" instantaneous couplings for discharge.

3.4.6.5.2 The instantaneous coupling manifold can be removed from the suction side of the pump as it features a Storz coupling connecting to the pump suction.

3.4.6.5.3 The *Contractor* shall design the pump connections to the HWST piping to allow both instantaneous suction and discharge couplings to be connected per pump. The HWST piping connections shall also have a Storz coupling to allow the pumps' suction connections to be connected via the Storz coupling.

3.4.6.5.4 The *Contractor* shall verify the correctness of the pump connection types and sizes as stated above.

3.4.6.6 The *Contractor* shall ensure that the suction and discharge fittings are compatible with the KNPS pumps.

3.4.6.7 Concrete slabs shall be provided to station the mobile pumps from where to connect the pumps to the connection points.

3.4.7 Water conditioning

The water conditioning system (WCS) for the HWST inventory shall be able to perform the following functions:

3.4.7.1 Each HWST shall have an independent WCS loop. This is to ensure that the inventories of both tanks are sufficiently conditioned.

3.4.7.2 The system shall take suction near and at the same elevation as the main HWSTs discharge lines and return the water at the same elevation as the main supply line inlets at 180° opposite of the suction lines.

3.4.7.3 The WCS shall be designed to maintain microbiological levels in the HWST inventory below the values listed in **Table 4**.

3.4.7.4 The WCS shall employ either deep ultra violet (UV-C) sterilisation, or suitable chemical oxidant, as the method of microbiological control, with preference to UV-C. The technology recommended by the *Contractor* shall be presented to the *Employer* for acceptance prior to commencement of the design of the system.

3.4.7.5 The minimum design parameters shall include:

- Peak flow (litres per second).
- Full tank volume mixing and/or recirculation time.
- Minimum UV-C dosage of 40mJ/cm², should UV-C be used.
- Minimum UV-C transmissivity (%) requirements, should UV-C be used.
- Microbiological challenge posed by each of the target organisms.
- The required exposure time and minimum required UV intensity, should UV-C be used.
- The required oxidation residence time, should chemical oxidation be used.
- Microbe propagation rates for the target organisms, to ensure that the water quality in the HWSTs meets the requirements in **Table 4** at any given time.
- Optimum UV lamp operating temperature, should UV-C be used.
- Shielding of the UV lamps from direct contact with the water, should UV-C be used.
- Flow through the WCS shall be turbulent, and not laminar.
- Recirculation pump size should be sufficient to recirculate the complete tank volume in a reasonable amount of time, i.e. the recirculation pump and WCS should not need operate continuously to maintain water in a conditioned state.
- As far as practically possibly, variable chemical oxidant dosing, based on in-flow target organism concentration, shall be possible. Deviation shall be justified by the *Contractor* and accepted by the *Employer*.

3.4.7.6 The WCS shall operate automatically. If the cost of automatic WCS operation is prohibitively expensive in relation to the WCS required run time, the *Contractor* shall consult the *Employer* for approval to design the WSC to be manually put into and out of operation while posing no undue burden to operators.

3.4.7.7 Lamp function/failure monitors should be part of the system.

3.4.7.8 The wiring and electronic circuitry for monitoring systems should be protected from moisture and the surrounding environment.

3.4.7.9 Filters shall be used to improve the transmissivity of the water to ensure adequate operation of the UV-C sterilisation system.

3.4.7.10 The WCS filter function shall include a dual train of filters, which can be manually isolated such that filter cartridges can be manually cleaned or replaced.

3.4.7.11 WSC suction lines shall not take suction through the main discharge line strainers of the HWSTs.

3.4.7.12 Each suction line for the WCS shall feature an easily accessible sampling point for the KNPS chemistry department to take water samples.

3.4.7.13 Each main HWST discharge line shall feature an easily accessible sampling point for the KNPS chemistry department to take water samples.

3.4.7.14 Any deviation shall be justified by the *Contractor* and accepted by the *Employer*.

Table 4 : Required water chemical composition (Excerpt from ref [4])

Parameter	**Units**	**Limit or range**
Total aerobic bacteria	CFUs per ml	<10000
Total anaerobic bacteria	CFUs per ml	<1000
H_2S producers (Sulphate reducing bacteria)	CFUs per ml	<10
Legionella	CFU per L	<100

3.4.8 Level indication

3.4.8.1 Both the HWSTs shall feature hardened individual local mechanical level indicators.

3.4.8.1.1 The level indicators shall be located such that both can be read from an easily accessible single point of view.

3.4.8.1.2 The level indicators shall show major scale increments of 500m^3 and a minor scale increments of 250m^3. The available water volumes shall be indicated at the major scale increment markings in m^3.

3.4.8.1.3 The level indicators shall be designed to last and remain legible for the design life of the HWSTs.

3.4.8.2 A remote alarm system shall be installed to alarm in the demineralised water production plant control room (HYB) if the tanks are at 50% level or lower.

3.4.8.2.1 The link between the level gauge and the demineralised water production plant control room may be hard wired or wireless. If a wireless solution is used it shall be insured that it does not interfere with any other wireless system at KNPS.

3.4.9 Drain piping

3.4.9.1 The drain lines shall be sized to allow draining of a single tank within 48hrs.

3.4.9.2 The drain lines shall be hardened from the tank up to and including the isolation valves.

3.4.9.3 Each tank drain line shall feature two isolation valves for redundancy.

3.4.10 Overflow

3.4.10.1 The individual overflow lines for each HWST shall be sized to evacuate the highest achievable inlet flow of the tanks.

3.4.10.2 The overflow header shall be sized to evacuate the highest achievable inlet flow of both HWSTs combined.

3.4.11 Stormwater System

3.4.11.1 The stormwater system shall be designed to accommodate the greatest of the HWSTs simultaneous overflow, draining of both tanks simultaneously or rainfall requirements.

3.4.11.2 The stormwater system shall be designed in compliance with SANS 10400 [93] Part R, SANS 677 [98].

3.4.11.3 The *Contractor* shall investigate and confirm if the existing stormwater system, where the new system will tie into, is suitable for the purpose of this project to evacuate water to the sea.

3.4.12 Electrical supply

3.4.12.1 All electrical installations shall comply with SANS 10142 Ref [89].

3.4.12.2 Cabling shall also comply with the KNPS specification DSG-311-104, Ref [50].

3.4.12.3 Earthing circuits shall also comply with KBA0015M00007, Ref [67].

3.4.12.4 Installation of cables shall comply with the KNPS specification KBA121500007, Ref [69].

3.4.12.5 Installation of cable trays shall comply with KBA1215K00037, Ref [70].

3.4.13 Instrumentation and wireless transmission requirements

3.4.13.1 Wireless transmission

3.4.13.1.1 Any wireless transmitters shall be limited to power ratings of 50 mW or less. In the event that transmitters with a higher power rating is required, assessment and permission shall be requested from KNPS Electrical System Engineering (ESE) department.

3.4.13.1.2 All wireless transmitters shall comply with all relevant Independent Communications Authority of South Africa (ICASA) rules and regulations.

3.4.13.2 Any flanged connections for instrumentation shall comply with ASME B16.5, Ref [36].

3.4.13.3 Instrumentation cabling shall comply with DSG-311-104, Ref [50].

3.4.13.4 Instrumentation shall comply with IEC or other internationally accepted standard.

3.4.13.5 Electromagnetic Compatibility (EMC) and Cyber Security shall be considered for instrumentation and wireless transmission. See informative references [106], [107],[116],[117],[118],[119],[115] & [114].

3.4.14 Rainwater management

Rainwater management systems shall be designed in accordance with SANS 10400 [93] Part R.

3.4.15 Access Roads

3.4.15.1 A mass concrete, surface bed type access road from the existing unpaved boundary road running along the ACP 1 site fence shall be constructed to provide access to the HWST site location.

3.4.15.2 A surface at the HWSTs to provide access for the KNPS existing tanker truck and staging areas for the mobile pumps shall be constructed of a mass concrete surface bed.

3.4.15.3 All roads and paved surfaces shall be constructed in accordance with SANS 1200 [94].

3.4.15.4 Access roads and surface beds to and at the HWST shall be designed to allow the *Employer's* existing Scania 500 tanker truck to be parked within 3m of the mobile pump connection points.

3.4.15.5 A turning bay shall be provided to allow all vehicles including the Scania 500 truck to effectively transverse the area in a forward motion only.

3.4.16 Normal Operating Conditions

Radiation:	Background
Pressure:	Atmospheric
Temperature:	-2° to 40°C
Relative humidity:	0% to 100%
Environment:	Extremely corrosive coastal environment

3.4.17 Codes and Standards

The codes and standards required for this project are referenced throughout the document. References listed in Section 2.2.

3.4.18 Maintenance and Testing Requirements

3.4.18.1 All SSCs shall be designed and selected for low maintenance.

3.4.18.2 All SSCs shall be designed in such a way as to be easily maintainable.

3.4.18.3 The *Contractor* shall develop a maintenance strategy and testing methodology for the design life of the system, see Ref, [43], [5] and [18].

3.4.18.4 The *Contractor* shall update the maintenance base of KNPS to include the new SSCs, see Ref [65] and [86].

3.4.18.5 Maintenance and spares requirements for all new SSCs shall be specified by the *Contractor*.

3.4.18.6 The system shall be designed in such a way that online maintenance and testing shall be achievable on as large a portion of the system as possible.

3.4.18.7 The system shall be designed in such a way that periodic testing can be done on the system to verify operability.

3.4.18.8 All equipment required to perform periodic testing shall be supplied to KNPS.

3.4.18.9 Testing of this modification shall be done in accordance with Ref [72].

3.4.19 Nuclear Safety

3.4.19.1 The *Contractor* shall prepare Safety Screenings, Evaluations and Safety Justifications as per Ref [12] and [105].

3.4.19.1.1 The *Contractor* shall prepare and submit to the *Employer* a Safety Screening to screen all implementation activities and to determine all Unresolved Safety Questions (USQs) prior to the acceptance of the Design Package.

3.4.19.2 The *Contractor* shall prepare an implementation safety case in accordance with [14].

3.4.19.3 The *Contractor* shall evaluate all heavy lifts (> 1000 kg) in accordance with KSA-132 [79], KAA-709 [12] and NUREG-0612 [83] .

3.4.19.4 The *Contractor* shall support the Koeberg internal safety review submissions (e.g. Koeberg Operations Review Committee (KORC) submissions)

3.4.19.5 The *Contractor* shall support all licensing related activities with the NNR, which includes responding to NNR questions raised.

3.4.19.6 The *Contractor* shall supply all documentation required for submission to the NNR, see KNPS Nuclear Installation Licence No. NIL-01 (Variation 19) Appendix 19 Section 4 [81].

3.4.20 Conventional Safety

3.4.20.1 This modification shall comply with the Occupational Health and Safety Act, Ref [30] as a result also Ref [85].

3.4.20.2 Categorization of pressure equipment shall be done according to Ref [96].

3.4.20.3 For hazardous and Non-Hazardous waste disposal see Ref [66].

3.4.20.4 Any existing slopes shall be protected against sliding by the *Contractor* during construction work.

3.4.20.5 This project will require personnel to work at heights. Workers shall be qualified to work at heights in accordance with the KNPS working at heights programme.

3.4.21 Design and Construction

This specification describes the overall requirements desired by the *Employer* to ensure that the final end product is of acceptable standard and quality.

3.4.21.1 The *Contractor* shall have an internationally recognised, and *Employer* approved, nuclear QA program in place, by which all activities relating to design, fabrication, installation and testing of Plant and Materials for nuclear safety class SSCs are controlled.

3.4.21.2 The *Contractor* shall, as part of the design, submit a manufacturing specification to the *Employer* for acceptance, which the *Employer* will use as part of the submission to tender for manufacturing. This shall consist as a minimum of:

- Material specifications;
- Welding specifications;
- Packaging specification;
- Coating specifications;
- Lining specifications;
- Concrete specifications;
- Re-bar specifications;
- Piping specifications;
- Valve specifications;
- Manufacturing drawings
- Transport and handling specifications and procedures;
- Inspection and Testing specifications and procedures;
- Qualifications of staff to perform intended functions; and
- Manufacturing procedures.

3.4.22 Equipment Marking

Equipment marking shall be done by the *Contractor* in accordance with [71].

3.5 Manufacturing Requirements

This TRS is applicable to design requirements only.

3.6 Engineering Quality Requirements

3.6.1 Quality Assurance Program

3.6.1.1 The classification assigned to the scope of work is Q2/L3 (see section 3.6.2.1.1), therefore the applicable quality specification is 238-103, Ref [3]. The quality management system of the supplier shall be certified to the requirements of ISO 9001:2015, Ref [55], or equivalent.

3.6.1.2 Preparation of the Quality Assurance Documentation Package (QADP) shall be performed by the *Contractor*.

3.6.1.3 Certification that all requirements of this specification and the design codes and standards as stipulated in in this specification have been met, shall form part of the QADP.

3.6.1.4 The QADP shall include, but is not limited to the following:

- Certificate of conformance;
- Certificate of manufacture;
- Copy of Eskom order;
- Copy of the specifications;
- QCPs;
- Material certificates;
- Welder qualification and certificates;
- Weld qualifications;
- NDE/NDT reports;
- PSI reports;
- Hydrostatic test procedures and reports;
- Dimensional tests;
- Eskom waivers (if applicable);
- Non-conformance reports;
- Final supplier QA release; and

3.6.1.5 The *Contractor* shall submit copies of his QA programme and Quality Control Plans for *Employer* review and oversight.

3.6.1.6 Plant, materials and services shall be classified in accordance with the requirements of Ref [17] and [27].

3.6.1.7 All analysis software used for this project shall be Validated and Verified (V&V) by the *Contractor* in accordance with the requirements of RG-0016, Ref [87]. The preferred analysis software to be used is: Caesar II, Flownex, Abaqus 6.9.4 and Staad.Pro.

3.6.2 Classification

3.6.2.1 This modification shall comply with the following classifications:

3.6.2.1.1 Design Service (Classification D0001/22C ref [48])

The design service classification for the scope of this project is indicated below:

Quality Level: Q2

Importance Level: DER

RD-0034: L3 (Requirements of 238-103, Ref [3] applies)

3.6.2.1.2 HWST Component Classification (Classification C0003/22C ref [47])

The component classification for the scope of this project is indicated below:

Safety Class: NSF

Seismic Class: 1A

Quality Level: Q2

Environmental Category: NEV

Importance Category: DER

RD-0034: L3 (Requirements of 238-103, Ref [3] applies)

3.6.2.2 The *Contractor* shall create all component and parts classifications for new components included as part of this project.

Note: This project does not require any Safety Class components.

3.6.3 Specific Process Control

The *Contractor's* detailed quality control plan (QCP) showing all recommended witness, hold and verification points shall be submitted to the *Employer* for acceptance and influence before commencement of any work.

3.6.4 Specific Technical Control

3.6.4.1 The *Contractor* shall comply with the KNPS procedures governing the use of chemicals at KNPS, see Ref [51] and [63].

3.6.4.2 The *Contractor* shall ensure that the KNPS Foreign Material Exclusion (FME) process is adhered to. See Ref [76].

3.6.4.3 The *Contractor* shall ensure that the KNPS station cleanliness control process of systems, equipment and components is adhered to. See Ref [77].

3.6.4.4 The *Contractor* shall comply with the KNPS lifting and rigging programme, see Ref [79].

3.6.4.5 The *Contractor* shall ensure the KNPS requirements for storage, handling, control and preservation of stainless steel is adhered to see Ref [80].

3.6.5 Quality Data List

N/A.

3.7 Experience, Personnel and Training

3.7.1 The *Contractor* shall ensure that all their engineering personnel required to sign and approve documents and drawings of this specification shall be registered professional engineers or an equivalent as approved by the *Employer* in accordance with the Engineering Council of South Africa (ECSA) guidelines.

As a minimum, the *Contractor's* registered professional engineers shall be required to fulfil the functions as described above for the civil/structural and mechanical scopes of this specification respectively.

3.7.2 The *Contractor* shall make available to the *Employer*, for their approval, documentation describing the experience of the personnel who will perform the requirements of this specification. The *Contractor's* personnel shall be adequately experienced to fulfil the requirements of this specification on a competent and professional level.

3.7.3 A civil engineer from the *Employer* shall form part of the design team and conduct engineering activities, with the focus on the structural engineering aspects, under an engineer from the *Contractor* who is registered as a Pr.Eng with the Engineering Council of South Africa.

3.7.4 The *Contractor's* Professional Engineer shall fulfil a mentorship role for the duration of the contract to the *Employer's* civil engineer to assist the *Employer's* engineer to register professionally.

3.8 Technical Documentation

3.8.1 General

3.8.1.1 The *Contractor* shall be responsible to verify the correctness of all information provided to the *Contractor* by the *Employer.*

3.8.1.2 All drawings, data and technical documents supplied to the *Employer* shall comply with the following:

- Compiled on approved *Employer* templates and formatted such that it may be easily reviewed by the *Employer* and/or a third party, see Ref [16];
- Signed and approved by an ECSA registered professional engineer or equivalent as approved by the *Employer* in accordance with the ECSA guidelines.
- In the English language with SI system of measurements.
- The requirements for controlled documents shall be complied with, Ref [74].

3.8.1.3 Hard copies of documents submitted for review and acceptance shall be in the form of two (2) sets of clear, legible, full-size paper copies of reproducible quality. Hard copies of the final submittal of *Contractor's* documentation shall be in the form of three (3) sets of clear, legible, full-size paper copies of reproducible quality suitable for microfilming and/or scanning.

3.8.1.4 The *Contractor* shall supply all drawings in an editable format compatible with Microstation.

3.8.1.5 Electronic media shall be in a format fully compatible with the following software (latest version in use by the *Employer* at the time of delivery):

- Final computer-aided drafting (CAD) drawings (i.e. *Contractor* Plant and Material drawings) in order of preference:
  - Microstation (any version).dgn
  - AutoCAD (version 2002 and below).dwg
  - Drawing Exchange Format (any version).dxf

3.8.1.6 The *Contractor* shall demonstrate that the CAD drawings are clearly transferable to the *Employer's* system.

- Processing : Microsoft Word
- Database : Microsoft Access
- Spreadsheets : Microsoft Excel
- Photogrammetry 3D drawings : Electronic files compatible with Microstation
- Digital photographs : JPEG format

3.8.2 Design Package

3.8.2.1 The *Contractor* shall comply with the KNPS modification process 331-86 [25] and KAA-501 [59].

3.8.2.2 The *Contractor's* design shall be compiled in the latest prescribed KNPS design template 240-143890978 [13].

3.8.2.3 The *Contractor* shall ensure that all items from 331-433, Ref [23] are addressed in the design document.

3.8.2.4 A comprehensive and detailed risk analysis shall be compiled in accordance with KGA-073, Ref [123] in the latest risk analysis template of the *Employer* for all stages of this modification as required by the *Employer's* design template.

3.8.3 Drawings

3.8.3.1 Initial design drawings shall be submitted for review and acceptance by the *Employer* as part of the design. Manufacturing and/or construction shall not proceed before these drawings are accepted by the *Employer*.

3.8.3.2 A complete set of post manufacturing "as built" drawings shall be provided as part of the final Quality Assurance Data Package (QADP).

3.8.3.3 All drawings including graphs and figures larger than A4 submitted for the *Employer's* review and acceptance shall be in the form of hard copies and electronic media (Adobe Acrobat format, pdf). Final hard copies of drawings shall be submitted using standard sizes.

3.8.4 Procedures

The *Contractor* shall complete and submit procedures and method statements for the *Employer's* review and approval in the form of hard copies and electronic media. This includes procedures for fabrication, inspection, testing, cleaning, storage, handling, packaging, coating and shipping. This also applies to requirements and guidelines for the installation, operation and maintenance procedures.

Procedures shall be integrated by the *Contractor* with current existing accident and severe accident procedures. This shall include procedures that are still under development.

3.8.5 Right to Reproduce Documentation

All documentation and software model files produced for this project shall become the property of the *Employer.* The *Employer* shall have the right to reproduce and use the documentation of this project to fulfil its business needs as required.

3.9 Preparation for Delivery

Packaging and delivery of parts, components and equipment shall be in accordance with ASME NQA-1 Ref [40] Subpart 2.2.

4. Acceptance

This document has been seen and accepted by:

Name	Designation

5. Revisions

N/A

6. Development Team

The following people were involved in the development of this document:

- Bienyamien Francis
- Sulaiman Van Der Schyff
- Robert Moffat

7. Acknowledgements

N/A

8. Appendices

Appendix A– Project 12004 Supply Piping Full Flow Criteria

Appendix A - Project 12004 Supply Piping Full Flow Criteria

Table 5 : Project 12004 Supply Piping Full Flow Criteria

Location	Supply to System	Min Req Flow (m3/hr)	Full Flow Scenarios									
			1		2		3					
			A	B	A	B	A	B	C	D	E	F
Staging Area - Unit 1 ASG Tank Room	U1 ASG Tank	70	X	X				X				
	Direct SG Injection via U1 ASG System	70			X					X		
	U1 Spent Fuel Pool	20	X		X			X		X		
	Fire Fighting Connection	90	X	X	X	X				X		
Staging Area - Unit 1 Western Wall	U1 RCV / RIS	70							X			
	U1 PTR Tank	70										X
	U1 EAS Containment Spray	370					X		X		X	
	Direct SG Injection via U1 ASG System	70				X	X				X	
	U1 Spent Fuel Pool	20		X		X	X		X		X	X
	Fire Fighting Connection	90	X	X	X	X	X				X	
Staging Area - Unit 2 ASG Tank Room	U2 ASG Tank	70	X	X			X					
	Direct SG Injection via U1 ASG System	70			X				X			
	U2 Spent Fuel Pool	20	X		X		X		X			
	Fire Fighting Connection	90	X	X	X	X			X			
Staging Area - Unit 2 Western Wall	U2 RCV / RIS	70								X		
	U2 PTR Tank	70									X	
	U2 EAS Containment Spray	370						X		X		X
	Direct SG Injection via U2 ASG System	70				X		X				X
	U2 Spent Fuel Pool	20		X		X		X		X	X	X
	Fire Fighting Connection	90	X	X	X	X		X				X
	Total supply flow required for each scenario (m3/hr)		540	540	540	540	640	640	640	640	640	640