Eskom	Technical Requirement Specification	Nuclear Engineering

Title: **Spent Fuel Transient Interim Storage Facility Technical Requirements Specification**

Document Identifier:	**07147DPDRR014**
Alternative Reference Number:	**DSG-310-332**
Area of Applicability:	**Nuclear Engineering**
Functional Area:	**Functional Area**
Revision:	**0**
Total Pages:	**27**
Next Review Date:	**N/A**
Disclosure Classification:	**CONTROLLED DISCLOSURE**

Compiled by	Co-Compiled by	Reviewed by	Functional Responsibility	Authorised by
			Riana Aschmann Stand-in Manager	pp L Thomas
A Lawrence	**K Makhothe**	**J Venter**	**N Ntoko**	**R Goldstein**
Project Engineer	**Corporate Specialist**	**Chief Design Engineer**	**NTP Manager**	**DE Manager**
Date: **8 July 2022**	Date: **8 July 2022**	Date: 11 July 2022	Date: 2022-07-12	Date: 2022-07-12

ADDITIONAL CLASSIFICATION INFORMATION

Business Level:	**4**
Working Document:	**3**
Importance Classification:	**N/A**
NNR Approval:	**No**
Safety Committee Approval:	**No**
ALARA Review:	**No**
Functional Control Area:	**Engineering**

CONTENTS

FIGURES

TABLES

1. Introduction

1.1 Eskom Holdings (the Employer) will embark on the process of establishing a Transient Interim Storage Facility (TISF) for the storage of HI-STAR 100 spent fuel casks (hereafter referred to as casks) or similar. The TISF location has been pre-defined to be inside the existing security area of Koeberg Nuclear Power Station (Koeberg).

1.2 The TISF will be an open storage slab (hereafter referred to as a pad) that will allow for dry storage of the Koeberg HI-STAR 100 cask systems and/or other similar designs and associated infrastructure.

1.3 Construction of the TISF pads will be modular. The initial pad will accommodate the HI-STAR 100 casks while future pads will consider other options of the additional dry storage casks as required by Eskom.

2. Supporting Clauses

2.1 Scope

This technical requirements specification describes the requirements applicable to the compilation of a Holtec International HI-STAR 100 cask open storage pad detailed design for the licensing and construction of a spent nuclear fuel Transient Interim Storage Facility (TISF) within the Protected Area (PA) at Eskom Holding's, Koeberg Nuclear Power Station (Koeberg)

2.1.1 Purpose

The purpose of this TRS is to encapsulate all the technical requirements from the Employer for the development of the TISF.

2.1.2 Applicability

This document is applicable to KNPS.

2.1.3 Effective Date

This document is effective once authorized.

2.2 Normative/Informative References

The edition of the code, standard or document referenced to be utilised will be determined considering the following order of priority:

1. Republic of South African legal requirement
2. Latest edition required by the National Nuclear Regulator (NNR)
3. Latest edition approved by the Employer
4. Latest edition approved by the NRC and/or the IAEA
5. Latest approved edition available.

2.2.1 The Contractor will request clarification from the Employer, Eskom, if uncertain as to the correct edition to utilise.

2.2.2 For this specification and the referenced documents, where conflicts exist between site specific and these documents, the more restrictive will apply.

2.2.3 Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.4 Mandatory International Regulatory, Codes and Standards

[1] 10 CFR Part 72 - Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste.

[2] 10 CFR Part 73 - Physical Protection of Plants and Materials.

[3] ACI 349 – Code Requirements for Nuclear Safety Related Concrete Structures.

[4] AISC 326 – Detailing for Steel Construction, 3rd Edition

[5] ANSI/ANS 57.9 – Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type).

[6] ANSI N14.6 – Radioactive Materials-Special Lifting Devices for Shipping Containers Weighing 10,000 pounds (4500 kg) or More.

[7] ASCE 43 – Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities.

[8] ASME NQA-1 – Quality Assurance Requirements for Nuclear Facility Applications

[9] IAEA SSR-6 – Regulations for the Safe Transport of Radioactive Material

[10] N-71, Revision 1 – AZT – IAEA Design Information Questionnaire

[11] NFPA 78 – Safety Code for the Protection of Life and Property Against Lightning

[12] NUREG-0612 – Control of Heavy Loads for Nuclear Power Plants.

[13] NUREG-1536 – Standard Review Plan for Dry Cask Storage Systems

[14] NUREG-1567 – Standard Review Plan for Spent Fuel Dry Storage Facilities

[15] NRC Regulatory Guide 1.76 – Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants

2.2.5 Mandatory Domestic Codes and Standards

[16] 32-138 Vetting Administration

[17] 32-143 – Handling of classified items

[18] 238-54 – Radiological Protection Licensing Requirements for Koeberg Nuclear Power Station.

[19] 238-102 – Nuclear Safety Level 2 Supplier Quality Management Requirements.

[20] 240-120994091 – Design Extension Related Guidance for Modifications and Equipment – Flooding

[21] 240-121005755 – Design Extension Related Guidance for Modifications and Equipment – High Speed Winds and Tornadoes

[22] 240-121010217 – Design Extension Related Guidance for Modifications and Equipment – Seismic

[23] 240-121013197 – Design Extension Related Guidance for Modifications and Equipment – Severe Ambient Temperatures

[24] 240-89294359 – KSA-010 – Nuclear Safety, Seismic, Environmental, Quality, Importance and Management System Level Classification Standard

[25] 331-83 – KSA-113 – Standard for Plant Changes Affecting The Design Of Koeberg Nuclear Power Station

[26] 331-86 – KAA-815 – Design Changes to Plant, Plant Structures or Operating Parameters

[27] 331-87 – KGU-017 – Design Engineering Guide

[28] 331-195 – GGM 0907 – Koeberg Accident Analysis Manual.

[29] 12010-D0001 – Establishment of a Transient Interim Storage Facility at Koeberg – Licensing Strategy

[30] Act No. 85 of 1993 – OHSA Occupational Health and Safety Act including but not limited to all the relevant Regulations of the Act such as the Construction Regulations.

[31] Act No. 8 of 2019 – Critical Infrastructure Protection Act

[32] Act No. 107 of 1998 – National Environmental Management Act (NEMA)

[33] Act No. 46 of 1999 – Nuclear Energy Act

[34] Act No. 47 of 1999 – National Nuclear Regulator Act

[35] DSG-310-211 – Spent Nuclear Fuel Transport and Storage Metal Casks

[36] DSG-317-094 – Specifications for Chemical Products and Materials Used at KNPS.

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

[38] EPRI 1003011 – Dry Cask Storage Probabilistic Risk Assessment Scoping Study.

[39] EPRI 1009691 – Probabilistic Risk Assessment (PRA) of Bolted Storage Casks: Updated Quantification and Analysis Report.

[40] 238-54 – Radiological Protection Licensing Requirements for Koeberg Nuclear Power Station.

[41] Eskom Corporate Identity Standard/Manual

[42] KAA-501 – Modifications to Plant, Plant Structures or Operating Parameters that affect the Design Base.

[43] KAA-637 – Access Control to Radiological Controlled Zones

[44] KAA-676 – The Management of the IAEA Surveillance Equipment on Site

[45] KAA-709 – Process for Performing Safety Evaluations, Screenings, and Safety Justifications.

[46] KBA-0000-G00-1001 – Koeberg Definitions Manual.

[47] KBA 00 A1 C00 002 – General code for reinforced concrete structures CCBA 68.

[48] KBA 00 A1 C01 001 – Site Data for Koeberg Site

[49] KBA 00 A1 C01 006 – Structural Design Criteria and Specific Rules for aseismic island superstructures.

[50] KBA 00 A1 C01 009 – Containment structural design rules.

[51] KBA 00 A1 C01 016 – Structural Design Criteria and Specific Rules for nuclear island buildings (located outside the aseismic island).

[52] KBA 00 A1 C01 026 – Design Criteria and Specific Rules for the use of NV 65/67 for the Koeberg Nuclear Power Station.

[53] KEP 088 – Transfer and Storage of Fuel Casks.

[54] KGA-018 – Safety Case Preparation

[55] KGA-025 – Screening and Safety Evaluation Guide

[56] KWH S-001 – Radiation, Surface Contamination Surveys Sign Posting of Controlled Zones

[57] KWH S-015 – Airborne Contamination Surveys

[58] Koeberg Safety Analysis Report

[59] Koeberg Site Safety Report, ESKOM

[60] NIL-44 – Nuclear Installation Licence

[61] PP-0008 – Design Authorisation Framework

[62] PP-0012 – Manufacturing of Components for Nuclear Installations

[63] PP-0014 – Considerations of External Events for New Nuclear Installations

[64] RD-0016 – Requirements for Authorisation Submissions involving Computer Software and Evaluation Models for Safety Calculations

[65] RD-0022: Radiation Dose Limitation at Koeberg Nuclear Power Station

[66] RD-0024 – Requirements on Risk Assessment and Compliance with Principal Safety Criteria for Nuclear installations

[67] RD-0034 – Quality and Safety Management Requirements for Nuclear Installations

[68] RG-0006 – Guidance on Physical Protection Systems for Nuclear Facilities

[69] SANS 9001 – Quality Management Systems Requirements.

[70] SANS 10100-1 – The structural use of concrete Part 1: Design.

[71] SANS 10100-2 – The structural use of concrete Part 2: Materials and execution of work.

[72] SANS 10160-1 – Basis of structural design and actions for buildings and industrial structures Part 1: Basis of structural design.

[73] SANS 10160-2 – Basis of structural design and actions for buildings and industrial structures Part 2: Self-weight and imposed loads.

[74] SANS 10160-6 – Basis of structural design and actions for buildings and industrial structures Part 6: Actions induced by cranes and machinery.

[75] SANS 10161 – The design of foundations for buildings.

[76] SANS 10162-1 – The structural use of steel Part 1: Limit-state design of hot-rolled steelwork.

[77] SANS 10162-2 – The structural use of steel Part 2: Limit-states design of cold-formed steelwork

[78] SANS 2001-CC1 – Concrete Works: Structural

[79] SANS 2001-CC2 – Concrete Works: Minor Works

[80] SANS 2001-CS1 – Construction Works: Structural Steel Works

2.3 Informative Documents

[81] 0007/04Q – Design, Procurement, Manufacturing, Inspection, Testing, Transportation, Storage and Installation of CSR and SR SSCs

[82] 0012/14C – Cask Storage Building Classification

[83] ASME B&PV Code, Section II, Materials

[84] ASME B&PV Code, Section III, Division 1, Subsections NB, NC and ND for Class 1, 2 and 3 Components respectively

[85] ASME B&PV Code, Section III, Division 3, Containment Systems and Transport Packagings for Spent Nuclear Fuel and High Level Radioactive Waste.

[86] ASME B&PV Code, Section IX, Welding and Brazing Qualifications.

[87] IAEA NSS No. 13 – Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225 Revision 5)

[88] INFCIRC/394 Agreement of 16 September 1991 between the Government of the Republic of South Africa and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons

[89] ISG-11 Rev. 3, Cladding Considerations for the Transportation and Storage of Spent Fuel

[90] ISG-18 Rev. 1, The Design and Testing of Lid Welds on Austenitic Stainless Steel Canisters as the Confinement Boundary for Spent Fuel Storage

[91] KAH-010 - Radiation Protection, Cask Decontamination and Cask Cleaning.

[92] NRC Information Notice 95-29, "Oversight of Design and Fabrication Activities for Metal Components Used in Spent Fuel Dry Storage Systems," June 7, 1995.

[93] NRC Inspection Manual Chapter 2690, "Inspection Program for Dry Storage of Spent Reactor Fuel at Independent Spent Fuel Storage Installations," May 3, 2007.

[94] NRC Inspection Procedure 60856, "Review of 10 CFR 72.212(b) Evaluations," November 1999.

[95] NRC Regulatory Guide 3.61, Standard Format and Content for a Topical Safety Analysis Report for a Spent Fuel Dry Storage Cask

2.4 Definitions

2.4.1 **Design –** Design refers to the design of all components/ aspects of the Scope of Supply

2.4.2 **Contractor –** Refers to the Person, Company, Entity, Joint Venture or similar, contracted by the Employer to conduct the scope of supply.

2.4.3 **Owner Controlled Area –**Designated area containing a nuclear facility and / or nuclear material to which access is limited and controlled for physical protection purposes.

2.4.4 **Protected Area –**An area inside a limited access area (such as the owner controlled area) containing nuclear material and/or sabotage targets surrounded by a physical barrier with additional physical protection measures.

2.4.5 **Transient Interim Storage Facility –**A complex or facility designed and constructed for the interim storage of nuclear spent fuel. The Koeberg TISF will be designed for dry storage of nuclear spent fuel.

2.5 Abbreviations

Abbreviation	Description
ALARA	As Low As Reasonably Achievable
CAS	Central Alarm Station
CCTV	Closed Circuit Television
CSB	Cask Storage Building
DBE	Design Base Earthquake
DSE	System Manuals (Koeberg)
DSSR	Duinefontein Site Safety Report
ECSA	Engineering Council of South Africa
EIA	Environmental Impact Assessment
IAEA	International Atomic Energy Agency
Koeberg	Koeberg Nuclear Power Station
LLW	Low Level Waste
NNR	National Nuclear Regulator
NRC	Nuclear Regulatory Commission (United States)
OBE	Operation Basis Earthquake
OCA	Owner Controlled Area
PA	Protected Area
PSA	Probabilistic Safety Assessment
PWR	Pressurised Water Reactor
QCP	Quality Control Plan
RP	Radiation Protection
SAR	Safety Analysis Report
SOC	Southern Office Complex
SSC	Structures, Systems and Components
SSE	Safe Shutdown Earthquake
SSR	Site Safety Report
TISF	Transient Interim Storage Facility
TRS	Technical Requirement Specification

2.6 Roles and Responsibilities

N/A

2.7 Process for Monitoring

N/A

2.8 Related/Supporting Documents

None

3. Scope of Supply

3.1 The Contractor's scope of supply is the compilation of a TISF (for the storage of the HI-STAR 100 casks or similar) design document. The design shall be conducted in accordance with the requirements of this specification, DSG-310-332, as well as with the Employer's procedures 331-83 [25] (KSA-113), 331-86 [26] (KAA 815) and 331-87 [27] (KGU 017).

The design shall be all encompassing and will include but not limited to, evaluating and addressing the following requirements for the envisaged TISF:

3.1.1 Detailed Requirements – Refer to §4

3.1.2 General Requirements – Refer to §0

3.1.3 Licencing Requirements – Refer to §6

3.1.4 Additional Design Requirements – Refer to §7

3.1.5 Additional Construction Requirements – Refer to §8

3.2 Furthermore, the following requirements are implied and are deemed binding:

3.2.1 All national laws, codes and standards applicable to the Republic of South Africa.

3.2.2 All other miscellaneous or general requirements throughout this TRS and in accordance with international best practice codes and standards guiding facilities of this nature.

4. Detailed Design Requirements

4.1 General Requirements

4.1.1 The detailed design document will comply with the applicable codes and standards referenced in §2.2 Normative/Informative References, and §0 Informative Documents .

4.1.2 The Koeberg TISF storage pad will

4.1.2.1 Be located on the Koeberg TISF site;

4.1.2.2 Be designed in accordance with the requirements an internationally recognised nuclear licensing authority's spent nuclear fuel storage requirements such as 10 CFR 72 [1] or equivalent licensing requirement(s);

4.1.2.3 Be designed and located on the TISF site so as not to interfere with future added storage pads and casks on the site;

4.1.2.4 Accommodate up to twelve (12) metal casks (HI-STAR 100 casks or similar design); and

4.1.2.5 Ensure the ability to accommodate manoeuvring of all related equipment.

4.1.3 A cask preparation/laydown area will be available.

4.1.4 The proposed TISF storage pad design will consider the required cask handling equipment.

4.1.5 The Contractor will design to maximise the use of the existing utilities, site features and equipment and to minimise the need for additions or modifications to the existing features and equipment, to the extent possible.

4.1.6 The Contractor will identify all electrical power required for the HI-STAR 100 dry storage system required at the TISF. Electrical services available for use are 230V AC 1P 50Hz and 380V AC 3P 50Hz supplies.

4.1.7 Software used for analyses by the Contractor will be approved by the NNR or an internationally recognised nuclear licensing authority. The Contractor will also demonstrate that the software is compliant with the NNR requirements as specified in RD-0016, Requirements for Authorisation Submissions involving Computer Software and Evaluation Models for Safety Calculations [64].

4.1.8 The Contractor will demonstrate that dose rates measured by Radiation Protection (RP) on the TISF after the placement of the loaded spent fuel casks will not exceed the plant or Regulatory limits in accordance with KAA-637 [43].

4.1.9 The proposed plant changes will not introduce additional risk to the plant integrity or conventional/nuclear risk to personnel and the general public.

4.2 TISF Site Safety Reports and Safety Case Topics

4.2.1 In accordance with the Koeberg TISF licensing strategy [29] the Contractor will compile the TISF detailed design document including the supporting engineering safety reports listed in the table below to support the license application to be submitted to the NNR for the storage of loaded HI-STAR 100 casks on the TISF to be constructed at Koeberg.

Table 1 – TISF Safety Case Topics

Chapter	Topic	Sub-Topic
1	**General Description of Installation**	• Introduction • General Description of Installation • General Systems Description • Identification of Agents and Contractors
2	**Site Characteristics**	• Geography and Demography of Site Selected • Meteorology • Surface Hydrology • Subsurface Hydrology • Geology and Seismology
3	**SSC Design Criteria**	• Materials to be Stored • Classification of Structures, Components, and Systems Structural • Safety Protection Systems. • Design Criteria for Safety Related SSC • Decommissioning Considerations • Retrieval • Design Criteria of other SSC
4	**Installation and Structural Evaluation Design**	• Summary Description • Confinement SSC • Reinforced Concrete Structures (including Cathodic Protection from Marine Environment) • Other Safety Related SSC
5	**Thermal Evaluation**	• Decay Heat Removal Systems • Material Temperature Limits • Thermal Loads and Environmental Conditions • Analytical Methods, Models and Calculations • Fire and Explosion Protection
6	**Shielding Evaluation**	• Contained Radiation Sources • Storage and Transfer Systems • Material Shielding Composition • Analytical of Shielding Effectiveness
7	**Criticality Evaluation**	• Criticality Design Criteria and Features • Stored material Specifications • Material Shielding Composition • Analytical Methods, Models and Calculations • Burnup Credit Analysis

Chapter	Topic	Sub-Topic
8	**Confinement Evaluation**	• Confinement Description • Radionuclide Confinement Analysis • Confinement Monitoring • Protection of Stored materials from Degradation
9	**Radiation Protection**	• ALARA Considerations • Radiation Protection Design Features • Dose Assessments • Radiation Protection Program
10	**Accident Analyses**	• Design Basis Accidents • Off-normal Operations • Other Non-Specified Accidents • Design Extension Conditions Events (PP-0014)
11	**Conduct of Operations Evaluation**	• Organizational Structure • Pre-Operational Testing and Start-up Operations • Normal Operations including Inspection and Test, Maintenance and Aging Management • Personnel Selection, Training and Certification • Emergency Planning • Physical Security and Safeguards Plans
12	**Site Generated Waste (not Spent Fuel) Confinement and Management**	• On-site Waste Source • Liquid Waste and Retention • Solid Waste • Radiological Impact of Normal Operation
13	**Quality Assurance**	• Contactor Organization • Contractor Quality Assurance Program • Design Control • Procurement Document Control • Instruction, Procedure and Drawing Development Process • Document Control

4.2.2 The Contractor will utilise the Engineering safety reports in Section 4.2.1 to compile safety screenings, evaluations, justifications and safety cases for the TISF, in accordance with Eskom procedures KAA-709 [45] and KGA-018 [54] as required in the table below.

Table 2 – Safety Reports for Different Phases of the TISF Project

Phase	Activity	Chapter in Table 1	KAA-709, KGA-018 Documents
1	Site Selection	Chapter 2	Safety Justification / Case (1)
2	Design	Chapters1,3,4,5,6,7 ,8 and 10	Safety Justification / Case (2)
3	Operations	Chapters 9,11 and 12	Safety Justification / Case (3)
4	Decommissioning	Chapter 3 Eskom will compile a decommissioning plan / strategy for the TISF. This is line with NNR decommissioning requirements in k10001429N.	Safety Justification / Case (2/3)
5	Procurement and Manufacturing - includes component manufacturing	Chapter 13	• Supplier Quality Assurance • Design Specification • Proposed PP-0012 Compliance Matrix
6	Construction • In accordance with the approved Detailed Design • Civil works • Installation of systems • Tests and Commissioning	N/A	• Safety Justification / Case (1-3) • Detailed Design • Proposed PP-0012 Compliance Matrix

4.3 Environmental Conditions

4.3.1 The important to nuclear safety storage pad and associated SSCs shall be designed to accommodate the effects of site characteristics and environmental conditions associated with normal and off-normal operation, maintenance, testing, and postulated accidents as well as the effects of natural phenomena at Koeberg.

4.3.2 Site Meteorology

4.3.2.1 Location – Highly corrosive marine environment

4.3.2.2 Relative Humidity – Mean Hourly Value in May, June & July: 83%

4.3.2.3 Maximum rainfall for plant safety: 200 mm/h

4.3.2.4 Snow Not to date

4.3.2.5 Frost Occasionally, 4 years out of 10

4.3.3 Air Temperature

4.3.3.1 Mean daily maximum in hottest month: 26.2°C

4.3.3.2 Highest recorded in 18 years: 37.9°C

4.3.3.3 Mean daily minimum in coldest month: 7.2°C

4.3.3.4 Lowest recorded in 18 years: 1.8°C

4.3.3.5 Site design base temperature – maximum: 40.2°C

4.3.3.6 Site design base temperature – minimum: 1.8°C

4.3.3.7 Design extension requirements are detailed in 240-121013197 [23] Design Extension Related Guidance for Modifications and Equipment – Severe Ambient Temperatures

4.3.4 Seismic Conditions (bedrock level)

	Horizontal Acceleration	Vertical Acceleration
4.3.4.1 ½ SSE	0.15 g	0.10 g
4.3.4.2 SSE	0.30 g	0.20 g
4.3.4.3 Design Extension	0.50 g	0.50 g

4.3.4.4 Design extension requirements are detailed in 240-121010217 [22], Design Extension Related Guidance for Modifications and Equipment – Seismic

4.3.5 Wind

4.3.5.1 Considering the effects of wind, the excess loads taken into account for buildings correspond to:

4.3.5.1.1 Normal dynamic pressure of 900 Pa corresponding to a maximum mean hourly wind speed of 138 km/h,

4.3.5.1.2 Extreme dynamic pressure of 1 575 Pa for non-safety related structures corresponding to a maximum 3 second gust of 184 km/h,

4.3.5.1.3 Extreme dynamic pressure of 2 396 Pa for nuclear safety related structures corresponding to a maximum 3 second gust of 225 km/h.

4.3.5.2 Tornados – See NRC Regulatory Guide 1.76 [15], for Region 1

4.3.5.3 Design extension requirements are detailed in 240-121005755 [21], Design Extension Related Guidance for Modifications and Equipment – High Speed Winds and Tornadoes

4.4 Radiation Protection

4.4.1 Calculated dose rates based on a TISF fully loaded with metal casks (HI-STAR 100 or similar), will not exceed the Koeberg or Regulatory limits.

4.4.2 The dose rates measured by RP at the TISF boundary and Access Control Points (ACP) will not exceed 0,5 µSv/h in accordance with KAA-637 [43].

4.4.3 The “As Low As Reasonably Achievable” (ALARA) principle must be adhered to. The TISF storage pad and related equipment design and operation will ensure that occupational and public exposures are maintained ALARA.

4.4.4 Information must be provided about methods for radiation protection and about anticipated radiation exposures to personnel during operation and facility maintenance. The following ALARA topics will also be addressed:

4.4.5 Policy considerations;

4.4.6 Design considerations; and

4.4.7 Operational experience regarding anticipated on-site radiation exposures during cask handling storage, facility operation and maintenance on the TISF storage pad.

4.5 Security Requirements for the TISF Pad

4.5.1 The Contractor will provide the requirements for security of a TISF in accordance with U.S. Code of Federal Regulations Title 10, Part 73.51 (10 CFR 73.51) [2], Requirements for the Physical Protection of Stored Spent Nuclear Fuel and High-Level Radioactive Waste, and NNR RG-0006 [68], Guidance on Physical Protection Systems for Nuclear Facilities.

4.5.2 The Contractor will propose security for the TISF that will include, but not limited to, the following:

4.5.2.1 Perimeter Barrier and Access Control Systems

4.5.2.1.1 The perimeter barrier will have a pedestrian and service gate.

4.5.2.1.2 A clear distance of eight (8) meters between the perimeter barrier and casks will be maintained around the facility. The TISF perimeter barrier will not be closer than ten (10) meters from the Protected Area barrier.

4.5.2.1.3 The service and pedestrian gates will be locked with two high grade security keyed locks. One set of locks will be controlled by site RP and the other by site Security.

4.5.2.2 Intrusion Detection System and Central Alarm Station

4.5.2.2.1 The entire TISF perimeter area will have detection. This includes the pedestrian and service gates.

4.5.2.2.2 The TISF security systems will be integrated with the plant security system. This is a requirement to enable the Central Alarm Station (CAS) to effectively monitor alarms and to activate the security response force to the TISF.

4.5.2.3 Surveillance CCTV

4.5.2.3.1 The entire TISF perimeter fence and inner area of the facility will be covered by a Closed Circuit Television (CCTV) surveillance system. All of the TISF perimeter and the fence will be visible on the CCTV.

4.5.2.4 Lighting

4.5.2.4.1 The perimeter fence and inner area will have dedicated illumination to enable optimisation of the CCTV surveillance system for alarm monitoring and assessment.

4.5.2.5 Warning Sign Postings

4.5.2.5.1 As appropriate warning signs should be placed on the perimeter barrier to indicate security and legal implications for trespassing or conducting malicious actions that may lead to the compromise of the physical protection system.

4.6 Decommissioning Considerations

4.6.1 The Contractor will propose a decommissioning strategy that will include, but not limited to, the following:

4.6.1.1 Radioactive levels of the TISF at end of life;

4.6.1.2 Requirements for the decontamination and removal of potentially contaminated components; and

4.6.1.3 Decommissioning and disposal requirements and processes.

4.6.2 The TISF will utilize materials which facilitate decontamination and the removal of contaminated materials.

4.6.3 The following will be considered and discussed:

4.6.3.1 Planned removal of casks from the TISF;

4.6.3.2 Provisions for the decontamination and removal of potentially contaminated components;

4.6.3.3 Decommissioning processes and requirements; and

4.6.3.4 Decommissioning procedures including security requirements.

4.7 Procedures

4.7.1 The Contractor will describe and/or supply as a minimum the following procedures:

4.7.1.1 TISF monitoring and surveillance;

4.7.1.2 Maintenance of the TISF and fixed equipment; and

4.7.1.3 Equipment handling at the TISF.

5. General Requirements

All the following requirements shall be adhered:

5.1 Compliance with spent nuclear fuel storage requirements of 10 CFR 72, 73 and off-site transport requirements of IAEA SSR-6 [9] or a document demonstrating equivalent licensing requirement(s).

5.2 Compliance with all the relevant national and local South African legislation as well as the requirements of the documents in §2.2, Mandatory Codes and Standards and §0, Other Mandatory Documents, of this specification.

5.3 The required detailed design packages supplied by the Contractor will contain all the requirements in this specification (DSG-310-332) and including:

5.3.1 Design Concept;

5.3.2 Design Specifications;

5.3.3 Detailed design;

5.3.4 Material specifications;

5.3.5 Material use justification;

5.3.6 Welding specifications;

5.3.7 Packaging specifications;

5.3.8 Coating specifications;

5.3.9 Transport and handling specifications and procedures;

5.3.10 Inspection and testing specifications and procedures;

5.3.11 Qualification of staff to perform intended functions; and

5.3.12 Manufacturing procedures.

5.4 Include the Environmental Impact Assessment (EIA) requirements.

5.5 Accommodate the highly corrosive marine environment at Koeberg; the design life of the TISF shall be until the end of 2055.

5.6 Fuel retrievability for normal, abnormal, accident and severe accident conditions.

5.7 Suitability of the haul path from the Koeberg Fuel Buildings and on the TISF site including, but not limited to, considering the above and below ground civil structures along the haul path.

5.8 There is a possibility of foreign material (concrete debris) below the ground surface of the site.

5.9 The Lessons Learned from the following events shall be incorporated into the design of the TISF:

5.9.1 Fukushima incident,

5.9.2 USA 9/11 incident,

5.9.3 US GEIS waste confidence rule update.

5.10 The Contractor will perform an evaluation of the radiological dose rates emanating from the stored HI-STAR 100 casks on the proposed TISF open storage pad taking into consideration the site dose exposure limits for both plant personnel and the general public in accordance with RD-0022 [65] with an on-site Protected Area dose rate of 0,5 micro Sv/h and negligible Owner Controlled Area Boundary dose rate.

5.11 TISF Site

5.11.1 The Contractor will prepare a design of the open storage pad and a description of the Site. The Site description will include a storage area for cask handling equipment, security lighting, fencing as well as a plant drawing showing the potential TISF layout.

5.11.2 The Contractor will perform an on-site review of the Employer's proposed TISF Site at Koeberg. The Employer's Site is located north of the current Cask Storage Building (CSB) and is illustrated in Figure 1.

Figure 1: Proposed TISF Layout at Koeberg

5.11.3 The TISF pad will be designed to include and accommodate the following:

5.11.3.1 To store not more than twelve (12) metal casks (HI-STAR 100 casks or similar), whilst ensuring that the casks stored are easily accessible.

5.11.3.2 To allow for the storage of twelve (12) metal casks (HI-STAR 100 casks or similar). The TISF shall allow cask storage in both the horizontal and vertical orientations.

5.11.3.3 A cask preparation area will be available where a single new cask, including the required ancillary equipment, may be maintained and prepared prior to being transferred to the spent fuel pool in the spent fuel building.

5.11.3.4 The ability to lift and move the casks on the TISF.

5.12 The design of the TISF will also include:

5.12.1 Plant interface requirements as applicable, including but not limited to, cask and ambient temperature and dose monitoring as well as alarms (where applicable) to the Operating Control Room;

5.12.2 Radiological controls such as shielding and ALARA considerations;

5.12.3 A radiological assessment including the gamma and neutron modelling which considers dose rates from spent fuel casks stored in the CSB and the old steam generators stored on the TISF area. The assessment will recommend the required shielding. Eskom will decide on the preferred supplier for the construction of the required shielding;

5.12.4 Facilities, including roads, lighting, water, fire protection and electrical requirements; and

5.12.5 Site preparation requirements.

5.13 The design basis requirements as defined in the Koeberg Safety Analysis Report (SAR), the current TISF nuclear installation license NIL-44 [60] , extreme natural hazards requirements as in the NNR document PP-0014 [63] and as defined in the Site Safety Report.

5.13.1 Geological hazards including:

5.13.1.1 Natural and induced seismic events;

5.13.1.2 Subsurface liquefaction;

5.13.1.3 The Contractor shall assess the suitability and adequacy of the existing single groundwater monitoring point (P2a), adjacent to the TISF, for the purpose of proving that the TISF Liquefaction analysis remains valid. If additional monitoring points are required, the Contractor shall be responsible for installation of any additional groundwater monitoring points

5.13.1.4 Ground stability and surface faults; and

5.13.1.5 Tsunamis and other floods.

5.13.2 Surface hydrology as defined in the DSSR, including:

5.13.2.1 Probable maximum flood;

5.13.2.2 Probable maximum surge and seiche flooding;

5.13.2.3 Probable maximum tsunami flooding;

5.13.2.4 Flood protection requirements; and

5.13.2.5 Design extension flooding requirements (240-120994091 [20])

5.13.3 Environmental factors including:

5.13.3.1 Wetlands and coastal zones;

5.13.3.2 Ground water; and

5.13.3.3 Protected species.

5.13.4 Meteorology including:

5.13.4.1 Regional climatology; and

5.13.4.2 Local meteorology.

5.13.5 Eskom / Koeberg Power Station requirements including:

5.13.6 Radiation monitoring (direct radiation and surface contamination run-off);

5.13.6.1 Fire detection and control;

5.13.6.2 Security requirements; and

5.13.6.3 Water management.

6. Licencing Requirements

6.1 National Nuclear Regulatory (NNR) and licensing requirements (NNR RD-0022 [65]).

6.2 Compilation of the licensing documents in accordance with Section 4.2 of this specification.

6.3 Other licencing requirements are spread over the TRS as they are integral to all components and sections of the TISF. All design aspects shall therefore apply to the relevant and applicable licensing requirements.

7. Additional Design Requirements

7.1 Haul Path Design

7.1.1 The Contractor will identify the cask haul paths from the Koeberg Fuel Buildings, to and on the TISF site by means of visual inspections, plant drawings and other means specified by the Contractor. Buried and above ground obstacles in the areas of the haul paths will be identified and their impact on the cask movements discussed. The Contractor will confirm if the underground features can handle the heavy loads and/or if the roads require improvements. Available Koeberg information describing the buried services will be made available to the appointed Contractor.

7.1.2 The Contractor will identify potential hazards along the haul paths and compile a risk mitigation plan.

7.1.3 A brief description of the proposed haul path to and on the TISF site will be prepared. Drawings of the haul path will be created showing the route, road grading and drainage. Recommended upgrades or relocations of underground or above ground utilities that are adversely impacted by the haul path will be shown on the drawings. Any new mitigation features to protect the casks from hazards will be shown on the drawings.

7.2 TISF Security Protected Area Design

7.2.1 The Contractor will provide a security design. The company will have to be vetted to provide the required security design and be registered with Private Security Industry Regulatory Authority (PSIRA) for the design, supply, and installation of security equipment. Note that all the input documents required to compile the security design for interfacing to the current systems on the Koeberg site are classified. The Contractor will have to be vetted to obtain this information.

7.2.2 The Contractor will provide the requirements for security of a TISF in accordance with U.S. Code of Federal Regulations Title 10, Part 73.51 (10 CFR 73.51) [2], Requirements for the Physical Protection of Stored Spent Nuclear Fuel and High-Level Radioactive Waste, and NNR RG-0006 [68], Guidance on Physical Protections for Nuclear Facilities. Note that the NNR and Koeberg security requirements take precedence over the USNRC requirements.

7.2.3 The discussion will also include but will not be limited to:

7.2.3.1 Secured power systems;

7.2.3.2 Intrusion detection systems;

7.2.3.3 Security camera systems;

7.2.3.4 Security lighting;

7.2.3.5 Security fencing; and

7.2.3.6 Vehicle barrier systems.

7.2.4 A description of the security system will be shown on drawings. The design will include positions of the intrusion detection components, camera positions, lighting, fencing and gates; all of the typical security related features within a TISF Protected Area.

7.2.5 The description will further include a layout for:

7.2.5.1 Normal power;

7.2.5.2 Backup power;

7.2.5.3 Uninterrupted power systems;

7.2.5.4 Power distribution;

7.2.5.5 Grounding or earthing; and

7.2.5.6 Lightning protection.

7.3 TISF IAEA Safeguard Controls

7.3.1 The design will include, but not limited to, the following:

7.3.1.1 An updated Design Information Questionnaire (DIQ) [10]; and

7.3.1.2 Monitoring of spent fuel casks during storage to prevent diversion of fissile material and sabotage in accordance with the safeguards agreement INFCIRC/394 [87], between the IAEA and the South African Government, KAA-676 [44].

8. Additional Construction Requirements

The Contractor's TISF Site design will include but not limited to the following:

8.1 The excavation, fill, and grading of the area around the facility including performing:

8.1.1 In-situ geotechnical tests including tests for liquefaction;

8.1.2 Existing services survey;

8.1.3 Topographical surveys; and

8.1.4 Specifying the concrete requirements.

8.2 The construction of the facility itself;

8.3 A construction fence will be required for the construction period. The Contractor will be responsible for the construction site regarding the monitoring and securing of the area.

8.4 Upgrade of an existing road or construction of a new road for the haul path as applicable;

8.5 Electrical duct banks, conduit, wiring, grounding associated with the cask monitoring system and security protected area;

8.6 The intrusion detection system, closed circuit TV, lighting and fencing for the security area; and

8.7 Water supply if required.

8.8 The description will include a step-by-step sequence of the construction activities matched to a schedule and a Quality Control Plan (QCP) so that each activity can be easily reviewed to determine the construction duration and placement within the project.

8.9 The Contractor shall:

8.9.1 provide budgetary cost estimates of the TISF design, construction including but not limited to, the TISF site, haul path, cask monitoring system, and security protected area.

8.9.2 provide a conceptual schedule of the construction activities.

8.9.3 provide a project risk assessment including the technical risks as identified by the Contractor and the controls in place to effectively manage the risks during the duration of the project.

8.9.4 provide support in responding to the NNR review comments.

8.9.5 provide oversight during construction activities to ensure that the TISF installed in accordance with the design. The Contractor shall have a representative or appoint a competent person(s) to be responsible for all duties as set out in the Occupational Health and Safety Act, 1993 Construction Regulations, 2014 [30].

9. ENGINEERING QUALITY REQUIREMENTS

9.1 Classification Technical Control

9.1.1 In accordance with 240-89294359 (KSA-010) [24] and with reference to the CSB classification in 0012/14C [82], the TISF is classified as follows:

9.1.1.1 Safety Class	Linked to Safety (LS) as it is a non-fluid retaining structure.
9.1.1.2 Importance Classification	Safety Related (SR) as it is required for the storage of spent nuclear fuel.
9.1.1.3 Seismic Classification	1 Passive (1P) as it is classified SR, the structural integrity thereof must be maintained during and after the design basis earthquake but the active operation thereof is not required.
9.1.1.4 Quality Level	Q2 as it is a safety related structure requiring comprehensive procurement controls.
9.1.1.5 Safety Level	L2 as it is classified SR and Q2.
9.1.1.6 Environmental Classification	0 as it is not in or part of containment neither will any part of it be affected by primary coolant or steam

9.1.2 The components and services classifications of the TISF in terms of safety class, seismic class, quality level and safety level are as follows:

9.1.2.1 Safety Class (Civil):	LS
9.1.2.2 Safety Class (Mechanical):	LS
9.1.2.3 Safety Class (Electrical):	NSF
9.1.2.4 Seismic Classification:	1
9.1.2.5 Quality Level:	Q1/2/3

9.1.2.6 The TISF will be designed to Q1 and manufactured to Q2 except for the security requirements which will be to Q3, in accordance with an internationally recognised quality management system.

9.1.2.7 Safety Level:	L2/3

9.1.2.8 The TISF will be designed to L2 except for the security design which will be to L3. The TISF and all related components will be manufactured to L3 in accordance with an internationally recognised quality management system.

9.1.2.9 The design service classification is in accordance with 240-89294359 (KSA-010) [24] and 0007/04Q [81]. The Contractor will meet the Employer's quality requirements in 238-102 [19] and

the detailed design will be compiled in accordance with an internationally recognised nuclear quality management system equivalent to ASME NQA-1.

9.2 Quality Assurance Programme

9.2.1 The Contractor will:

9.2.1.1 Meet the Employer's quality requirements as specified in DSG-318-087 [37].

9.2.1.2 Meet the Level 2 requirements as specified in 238-102 [19].

9.2.1.3 Ensure that their quality management system includes written procedures that control all aspects of the work to be performed.

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

9.2.1.5 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 will be adequately experienced in design of seismically qualified nuclear facilities.

9.3 Specific Process and Technical Control

9.3.1 The Contractor shall have an internationally recognised quality assurance program equivalent to ASME NQA-1 in place which controls all aspects of the supply cycle including:

9.3.1.1 Design;

9.3.1.2 Licensing;

9.3.1.3 Purchasing;

9.3.1.4 Construction;

9.3.1.5 Inspection and Testing;

9.3.1.6 Qualification; and

9.3.1.7 Commissioning.

9.3.2 A detailed quality plan describing the Contractor's quality programme and the work to be performed must be compiled by the Contractor and submitted to the Employer for acceptance.

9.3.3 The Contractor's detailed quality control plan (QCP) will be submitted to the Employer's Engineering, Quality Assurance and Quality Control for approval prior to the commencement of any work.

9.3.4 Prior to commencement of any work the Contractor will submit the QCP to the Employer and the NNR for their adding of the desired intervention points. The Employer's hold, witness and verification points will be signed by the relevant Employer appointed representative prior to continuation of work.

9.3.5 Compliance with all the Employer's standards, procedures and processes applicable to plant and personnel on the Koeberg site will be mandatory.

9.3.6 Software used for analyses by the Contractor will be approved by an internationally recognised nuclear licensing authority. The Contractor will also demonstrate that the software is compliant with the NNR requirements as specified in RD-0016 [64], Requirements for Authorisation Submissions involving Computer Software and Evaluation Models for Safety Calculations.

9.4 Quality Assurance Data Package

9.4.1 The Contractor will provide a Quality Assurance Data Package (QADP) on completion of the work that will include, but not be limited to, the following:

9.4.1.1 Detailed design and drawings;

9.4.1.2 Certificate of conformance to the purchase order and the specification requirements;

9.4.1.3 Copy of the Employer's order;

9.4.1.4 Copy of the procurement and other specifications;

9.4.1.5 QCPs;

9.4.1.6 Technical queries including employer waivers;

9.4.1.7 Non-conformance reports, including to this specification and the record of their resolutions and/or corrective actions; and

9.4.1.8 Final Quality Assurance (QA) release.

10. TRAINING

10.1 The Contractor will provide training to the Employer's personnel, as required, for all installed detection and surveillance equipment.

11. DOCUMENTATION AND CONFIGURATION MANAGEMENT

11.1 All documents and drawings will be signed and approved by an ECSA professionally registered qualified engineer or an equivalent as approved by Eskom in accordance with the ECSA guidelines.

11.2 All documents and drawings will be formatted such that it may be easily reviewed by Eskom and/or an Eskom appointed 3rd party.

11.3 All drawings, data and technical documents submitted to Eskom by the Contractor will be in the English language with the SI system of measurements. These requirements also apply to manufacturing drawings. The drawings, data and technical documents will be submitted in accordance with the requirements stated in this specification.

11.4 All documents shall be searchable.

11.5 Hard copies of documents submitted for review and approval will 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 will be in the form of three (3) sets of clear, legible, full-size paper copies of reproducible quality suitable for microfilming and/or scanning.

11.6 Electronic media will be in a format fully compatible with the following software (latest version in use by Eskom at the time of delivery):

11.6.1 Final computer-aided drafting (CAD) drawings (i.e. vendor equipment drawings) in order of preference:

1. Microstation (any Version).dgn
2. AutoCAD (Version 2002 and below).dwg
3. Drawing Exchange Format (any Version).dxf

11.6.2 The Contractor will demonstrate that the CAD drawings are clearly transferable in Eskom's system.

11.6.3 Processing:	Microsoft Word
11.6.4 Database:	Microsoft Access
11.6.5 Spreadsheets:	Microsoft Excel
11.6.6 Photogrammetry 3D drawings:	Electronic files compatible with MicroStation
11.6.7 Digital photographs:	JPEG format
11.6.8 Finite Element Analysis Models	Ansys
11.6.9 Structural Analysis Models	Staad.Pro

11.7 Drawings

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

11.8 Procedures

The Contractor will complete and submit procedures for Eskom'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.

11.9 Right to Reproduce Documentation

Eskom will have complete and unrestricted ownership rights to all technical reports, drawings, designs, (except computer codes that constitute a pre-existing program or method and are designated as proprietary to the Contractor), procedures and other written information developed solely for Eskom by the Contractor in the course of its performance under the contract.

12. Acceptance

This document has been seen and accepted by:

Name	Group
SJ Venter	Design Engineering
S Kiewitt	Design Engineering
S Pietersen	Radiation Protection
T Moila	Component Engineering
R Lavelot	Nuclear Project Management

13. Revisions

Date	Rev.	Compiler	Remarks
July 2022	0	A Lawrence	Reviewed and Accepted by all parties listed.

14. Development Team

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

N/A

15. Acknowledgements

N/A