Eskom	**PUBLIC INFORMATION DOCUMENT**	**Nuclear Engineering**

Title: **Public Information Document in Support of the Establishment of the First Spent Fuel Cask Storage Area on the Koeberg Transient Interim Storage Facility**

Unique Identifier:	**12010TISF-0005**
Alternative Reference Number:	**N/A**
Area of Applicability:	**Nuclear Operating Unit**
Functional Area:	**Nuclear Engineering**
Documentation Type:	**PID**
Revision:	**2**
Total Pages:	**53**
Next Review Date:	**N/A**
Disclosure Classification:	**Public**

Compiled by:	**Reviewed by:**	**Reviewed by:**	**Functional Responsibility:**	**Authorised by:**
…………………	Lawrence …………………	…………………	…………………	pp …………………
K Makhothe	**A Lawrence**	**K Jonnalagadda**	**I Sekoko**	**S Touffie**
Corporate Specialist Nuclear Spent Fuel	**Senior Design Engineer**	**Project Manager**	**Middle Manager: Nuclear Analysis and Siting**	**Senior Manager Nuclear Engineering**
Date: 2024-11-13	Date: 2024-11-13	Date: 2024-11-14	Date: 2024-11-14	Date: 2024-11-11

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

1. PURPOSE

The purpose of this Public Information Document (PID) is to provide members of the public with sufficient information regarding Eskom's license application to the National Nuclear Regulator (NNR) for an authorisation to site, construct, operate, and decommission a spent fuel Cask Storage Area on the Koeberg Transient Interim Storage Facility (TISF) with a maximum storage capacity of fourteen (14) loaded HI-STAR 100 casks.

The existing Cask Storage Building (CSB) at the Koeberg site can accommodate a maximum of sixteen (16) spent nuclear fuel casks (Refer to Section 6 for more details on the description of the facility).

This PID provides information from engineering safety analyses documented in the Eskom TISF detailed design in support of the establishment of the first spent fuel Cask Storage Area on the Koeberg TISF. The safety arguments are also derived from some of the work completed for the installation of the Original Steam Generator Interim Storage Facility (OSGISF) which is located on the TISF site.

Accordingly,

i. The PID provides assurance that the Koeberg first TISF spent fuel Cask Storage Area is designed, and will be constructed, operated and decommissioned safely in accordance with existing Regulatory requirements and safety standards.

ii. The TISF detailed design and implementation safety case for the civil construction activities of the first TISF spent fuel Cask Storage Area. This PID is therefore also in support of the amendment of the existing OSGISF / TISF site licence NIL-044 [13], to grant permission for the construction of the first Cask Storage Area on the Koeberg TISF.

Construction of the first TISF Cask Storage Area is planned to commence in 2025.

2. INTRODUCTION

Koeberg is procuring spent fuel dry storage casks as part of the plant spent fuel storage management strategy to alleviate the congestion in the spent fuel storage pools. The initial batch of fifteen (15) spent fuel casks have been loaded and stored in the CSB. The CSB has a storage capacity of sixteen casks. Once the CSB is filled, the casks will be stored on the proposed TISF to be established at Koeberg. The Koeberg spent fuel dry storage casks will later be transferred to an off-site interim Centralised Interim Storage Facility (CISF) for final disposal. The National Radioactive Waste Disposal Institute (NRWDI) focuses on the establishment of the CISF for the safe storage of Koeberg's spent fuel and other high-level waste.

Spent fuel management is a key policy / strategy for almost all nuclear power utilities across the world. Interim storage of spent fuel provides a safe flexible and cost-effective option for utilities while the decision on final disposal is still being pondered by different countries. For instance, countries like France consider spent fuel as an energy source that can be re-utilised by recovering some of the remaining fuel in the form of Uranium and Plutonium (Refer to Section 6.2) for additional energy production (i.e., reprocessing and recycling). Other countries like Sweden, the United States of America and South Africa, consider spent fuel as waste that should be disposed (direct disposal). The different views are largely based on the cost, environment and non-proliferation hazards attached to the two options depending on the perspective by the respective country.

Therefore, interim dry storage facilities provide safe storage of spent fuel while countries decide and implement the preferred final disposal policy. Spent fuel remains retrievable from dry storage facilities for countries that decide on the policy to reprocess and / or recycle. For countries that decide on direct disposal, the interim dry storage facilities provide space for repository designs to be generated and constructed.

The Radioactive Waste (Radwaste) Management Policy and Strategy for the Republic of South Africa (2005), allows utilities to employ dry and / or wet spent fuel storage mechanisms on the reactor site. Accordingly, the Eskom Spent Fuel Management Strategy is currently employing both storage methods (see **Figure 1**), while also considering the construction of the CISF by the State, i.e., NRWDI.

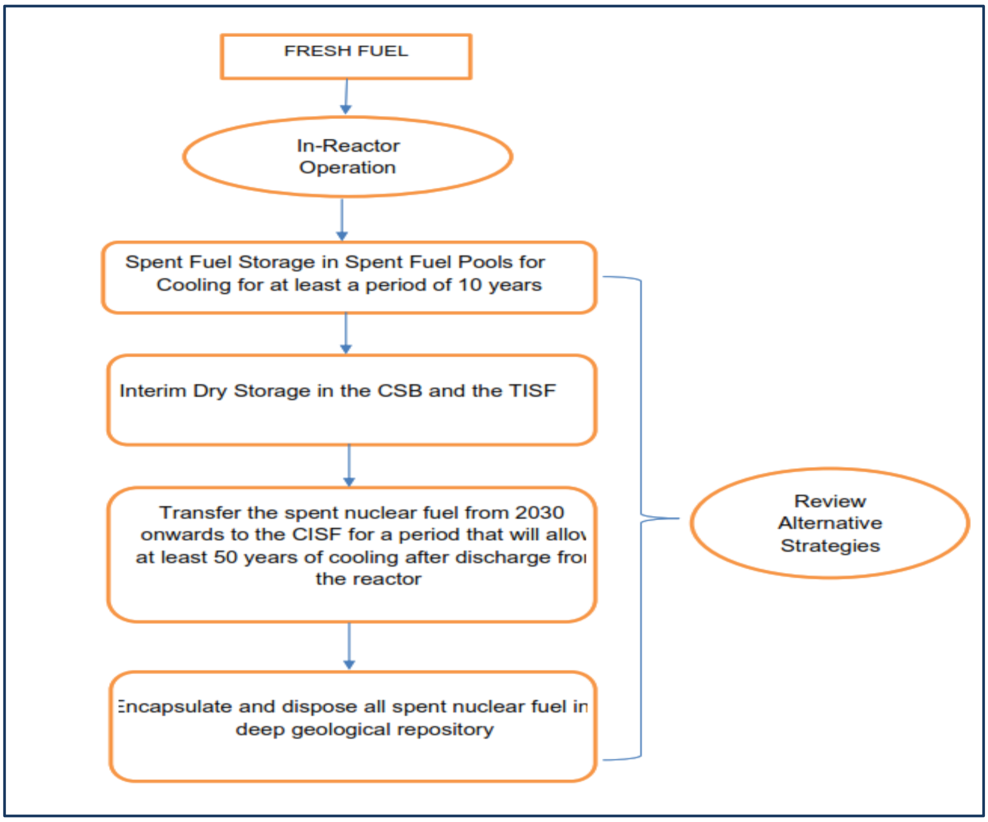

Figure 1: Eskom Spent Fuel Management Strategy

Note that the decision by Eskom to load spent fuel into dry storage casks is also in line with the Koeberg decommissioning strategy which requires the SFPs to be evacuated before the plant is decommissioned.

2.1 History of Compliance with Regulatory Requirements

Koeberg operates two 945 MWe pressurised water reactor (PWR) generating units, each of which has a spent fuel pool (SFP) for underwater storage of spent nuclear fuel assemblies for cooling before disposal. The original design of the Koeberg SFP racks had 285 cells per unit. These original racks were subsequently replaced in 1988 with high-density racks with 728 cells per unit. The capacity of the high-density racks was expected to be exhausted by 1998. The pools were re-racked further in 2001, with super high-density racks with 1 536 cells per unit to accommodate spent fuel for the remaining plant lifetime of 40 years, coinciding with 2024 and 2025 for Unit 1 and Unit 2 reactors, respectively. As a result, the pools have been re-racked to their maximum and thus cannot be modified further. During the SFP re-racking project, four (4) CASTOR X/28F spent fuel dry storage metal casks, each with a storage capacity of twenty-eight (28) fuel assemblies, were loaded (**Figure 3** shows a cask being loaded underwater) with spent fuel from both Koeberg reactors and stored in the site Cask Storage Building (CSB), to create space for the manoeuvring of storage racks in the pools. The casks are stored in a horizontal orientation on transport cradles on pre-determined storage locations (**Figure 2**). The CSB was licenced initially to temporarily store the casks for three years and thereafter extended every 5 years.

Figure 2: CASTOR X /28F Cask Storage in the Koeberg CSB

In the early 2010's, Koeberg identified that the station SFPs were filling up faster than originally anticipated. This was due to the then adopted nuclear fuel management strategy that demanded an increase in the fresh fuel assembly reload sizes to achieve an increased energy output from both station reactors. Consequently, additional spent fuel storage capacity was required sooner to accommodate the revised fuel management strategy and production plan. Note that the SFPs are also utilised to store fresh fuel assemblies to be loaded into the reactors during refuelling outages.

In addressing the imminent loss of storage space in the Koeberg SFPs, for the short-medium term, Eskom procured fourteen (14) HI-STAR 100 spent fuel dry storage casks from Holtec International (located in United States). Eleven (11) of these casks have been loaded with Koeberg spent fuel and stored horizontally on transport cradles in the CSB (**Figure 5**). Each cask has a storage capacity of thirty-two (32) fuel assemblies.

The current Koeberg spent nuclear storage license as issued by NNR, grants Eskom permission to store twelve (12) HI-STAR 100 casks in the CSB until 2034. An additional HI-STAR 100 cask will therefore be loaded and stored in the CSB to utilise the maximum capacity as approved by the NNR and the remaining two casks will be stored on the yet to be established TISF.

The CSB floor was modified to enhance its seismic capability and robustness in supporting the loads from the four (4) CASTOR X/28F and twelve (12) HI-STAR 100 casks (**Figure 6**).

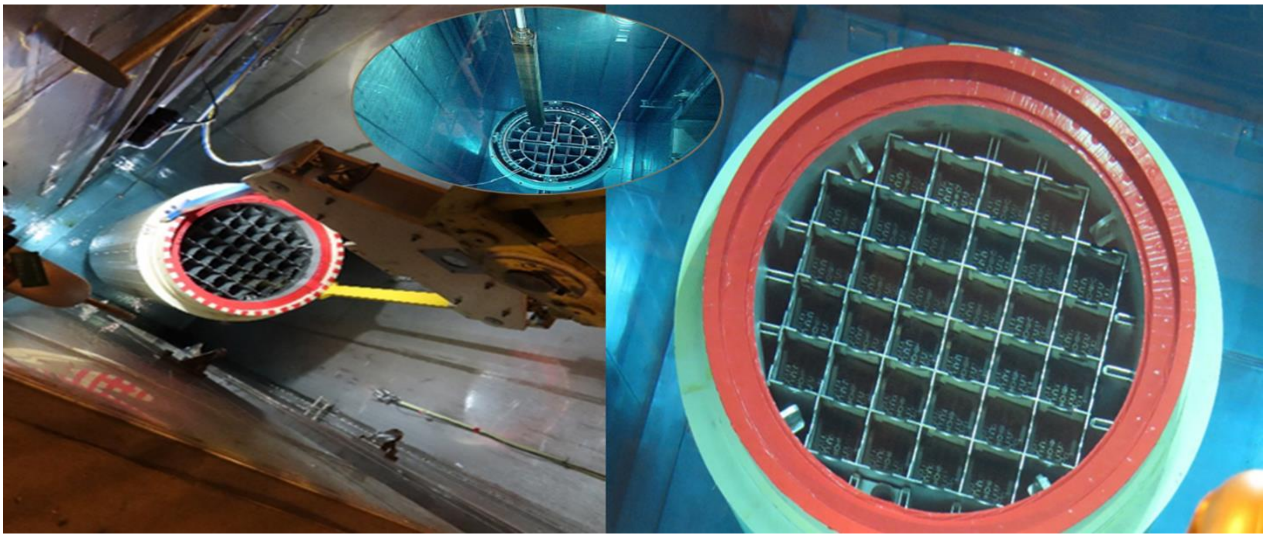

Figure 3: Cask Loaded with Spent Fuel Underwater

Figure 4: Transfer of a Loaded HI-STAR 100 Cask from the Fuel Building to the CSB

Figure 5: Placement and Storage of Casks in the Koeberg CSB

Figure 6: Reinforcement of the CSB Storage Pad

2.2 Similar Projects Worldwide

There is vast experience globally related to spent fuel dry storage facilities.

Spent fuel dry storage facilities vary in design depending on the respective utility requirements and regional Regulatory requirements. Designs vary from enclosed concrete structures, underground vaults, above-ground concrete modular systems on open concrete storage pads. The proposed first Cask Storage Area on the Koeberg TISF consists of a Storage Area that includes three (3) open Concrete Pads, seven (7) ASMs and three (3) Approach Aprons (See more detailed discussion in Section 6.1).

Examples of utilities and countries that utilise the open concrete pad designs are:

i. Angra NPP Dry Storage Facility- Brazil

The onsite spent fuel dry storage facility at Angra is designed for 50 years of operation. Storage of spent fuel in the facility started in 2020.

ii. Cofrentes NPP Dry Storage Facility - Spain

Spent fuel dry storage at the Cofrentes started in 2021.

iii. North Anna NPP Dry Storage Facility - United States

Spent fuel dry storage at North Anna started in 1998.

Figure 7: On-Site Dry Storage at Angra *(https://www.world-nuclear-news.org)*

Figure 8: Aerial View of the Dry Storage Facility of Cofrentes in Spain *(https://www.revistanuclear.es)*

Figure 9: Aerial View of the Dry Storage Facility of North Anna in the US *(https:// www.admin.sc.gov)*

3. APPLICANTS INFORMATION

Table 1 below provides details of Eskom Holdings as the applicant.

Table 1:Applicants Information

The applicant's full name	Eskom Holdings SOC Limited
Physical address	Megawatt Park Maxwell Drive Sunninghill 2157
Identification number / Registration number/ Incorporation Number	2002/015527/30
Date of birth/date of incorporation	2002
Registered address	P.O. Box 1091 Johannesburg 2000
The address of the facility	R27 off West Coast Road, Melkbosstrand, Western Cape,7441 Koeberg is located approximately 27 km north of Cape Town on the Farm Duynefontyn 1552.
Details of any holding or subsidiary companies	Eskom Holdings SOC Limited is wholly owned by the state.
Details of any foreign involvement or control of facility by an alien, foreign corporation, or foreign government	None

4. ABRREVIATIONS AND DEFINITIONS

4.1 Abbreviations

ALARA	As Low As Reasonably Achievable
ACI	American Concrete Institute
ASM	Auxiliary Shielding Module
CISF	Centralised Interim Storage Facility
CSB	Cask Storage Building
CZB	Controlled Zone Boundary
DBA	Design Basis Accident
DEC	Design Extension Condition
DFFE	Department of Forestry, Fisheries and Environment
DMRE	Department of Mineral Resources and Energy
EC	Emergency Controller
ECC	Emergency Control Centre
EIA	Environmental Impact Assessment
EPD	Electronic Personal Dosimetry
EPRI	Electric Power Research Institute
FSAR	Final Safety Analyses Report
HWC	Heritage Western Cape
IAEA	International Atomic Energy Agency
KNPS	Koeberg Nuclear Power Station
IMS	Integrated Management System
ITS	Important to Safety
NEA	Nuclear Energy Act
NRHA	National Heritage Resources Act
NID	Notification of Intent to Develop

NIL	Nuclear Installation License
NNR	National Nuclear Regulator
NRWDI	National Radioactive Waste Disposal Institute
NRWDIA	National Radioactive Waste Disposal Institute Act
OEM	Original Equipment Manufacturer
OCA	Owner Controlled Area
OSG	Original Steam Generator
OSGISF	Original Steam Generator Interim Storage Facility
PPE	Personal Protection Equipment
PSA	Probabilistic Safety Assessment
PWR	Pressurised Water Reactor
QMS	Quality and Safety Management System
Radwaste	Radioactive Waste
RP	Radiation Protection
SAHRA	South African National Heritage Resources Agency
SA	South Africa
SFP	Spent Fuel Pool
NECSA	South African Nuclear Energy Corporation
SCC	Stress Corrosion Cracking
SSCs	Structures, Systems and Components
SSE	Safe Shutdown Earthquake
TISF	Transient Interim Storage Facility
TLD	Thermo-Luminescent Dosimeter
USNRC	United States Nuclear Regulatory Committee
ZPA	Zero Period Accelerations

4.2 Definitions

Term	Definition
Accident Conditions	Infrequent events that could reasonably be expected to occur during the lifetime of the TISF system or events postulated because their consequences may affect the public health and safety.
Beyond Design Basis External Event	A postulated external event more severe than the design basis external event used in the design to establish the acceptable performance requirements of the structures, systems, and components.
Detailed Design	A design package that documents any proposed plant change, deletion or addition to structures systems or components or changes to operating parameters that affect the design base.
Design Extension Conditions	Specific accident conditions that are not considered as design basis accidents but are considered in the design process for Structures, Systems and Components (SSC) required for the prevention or mitigation of accidents that exceed the design basis requirements. Design extension conditions could include severe accident conditions.
Design Basis	Specific functions to be performed by a structure, system, or component and the specific values or ranges of values chosen for controlling parameters as reference bounds for design.
Design Specification	Documents providing the complete basis for manufacturing and construction of a component. Design specifications are part of the procurement documents and specify the required characteristics of a component.
Disposal	Emplacement of waste in an appropriate facility without the intention of retrieval.
Dose	The amount of ionizing radiation energy absorbed per unit time
Dose Rate	The quantity of radiation absorbed or delivered per unit time
Enrichment	Any process that artificially increases the fraction of U-235 in a mixture of uranium isotopes to levels higher than what is found in nature. Natural Uranium constitutes about 93% of U-238 and about 0,7% U-235.
External Events	Events originating outside the nuclear installation, including natural and manmade events with the potential to cause adverse conditions or even damage to safety important structures, systems or components.
Integrated Management System	A single coherent management system in which all the organisational processes are integrated to enable the organisation’s goals strategies, plans and objectives to be achieved. The Integrated Management System, integrates the Quality Management and Safety Management and shall consider Safety Culture aspects.

Term	Definition
Licensing Documents/ Application	Documents to be submitted to the NNR in support of license application, or variations to the license, or modifications of operating nuclear installations.
Manufacturing	Those actions required to manufacture source material, components, parts and accessories. These actions may include forming, machining, assembling, welding, brazing, heat treating, examination, testing, inspection, and certification.
IAEA Safeguards	The IAEA safeguards system, the objective of which is the timely detection of any diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons, other nuclear explosive devices, or for purposes unknown, and deterrence of such diversion by the likelihood of early detection. The IAEA safeguards system is based on the use of materials accountancy as safeguard measures of fundamental importance, with containment and surveillance as major complementary measures.
Reprocessing	A process or operation, the purpose of which is to extract radioactive isotopes from spent nuclear fuel for further use.
Spent Fuel (or Used Fuel)	Nuclear fuel that has been irradiated in a nuclear reactor to the point where the fuel is no longer useful in sustaining a nuclear reaction. The fuel is removed from the reactor core and stored underwater in storage racks in spent fuel pools
Spent Fuel Storage Cask System	All systems associated with the container in which spent fuel or other radioactive materials associated with spent fuel are stored in the TISF. The spent fuel cask performs the functions of confinement, radiological shielding, decay heat removal, and physical protection of spent fuel during normal, off-normal, and accident-level conditions

5. REFERENCES

The latest approved revisions of the documents below, unless otherwise specified.

[1] 14/12/16/3/3/2/947/AM1: DEA Amended Environmental Authorisation for the Construction of the Koeberg TISF: 2018-10-30

[2] 14/12/16/3/3/2/947: DEA Environmental Authorisation for the Construction of the Koeberg TISF: 2017-05-17

[3] ASME NQA-1: Quality Assurance Requirements for Nuclear Facility Applications (as approved by the USNCR)

[4] American Concrete Institute, ACI Code-349-13: Code Requirements for Nuclear Safety Related Concrete Structures and Commentary

[5] E/2/5/9/3: Department of Energy Letter: Koeberg Nuclear Power Station (KNPS): Transient Interim Used Fuel Dry Storage facility (TISF)

[6] HI-2012610 Revision 4, Final Safety Analysis Report on the HI-STAR 100 MPC Storage System (Non- Proprietary)

[7] IAEA SSR-6: Regulations for the Safe Transport of Radioactive Material- 2005 Edition

[8] ISO 9000: 2000 Series including ISO 9001:200

[9] NIL-01: Koeberg Nuclear Installation License

[10] NIL-44: Koeberg Nuclear Installation License – OSGISF

[11] PP-0008: Design Authorisation Framework

[12] PP-0009: Authorisations for Nuclear Installations

[13] PP-0012: Manufacturing of Components for Nuclear Installations

[14] PP-0014: Considerations of External Events for New Nuclear Installations

[15] PSA18-0043:, Seismic PSA for Metal Casks

[16] PSA-R-T15-08, Revision 4: Risk Assessment of Additional Metal Casks

[17] R266: Regulations on the Long-Term Operation of Nuclear Installations - NNR Act, 1999 (Act No. 47 of1999)

[18] R388: Regulations in Terms of Section 36, Read with Section 47 of the National Nuclear Regulatory Act, 1999 (Act No. 47 of 1999), on Safety Standards and Regulatory Practices

[19] R927: Regulations in Terms of Section 36, read with Section 47 of the NNR Act, 1999 (Act No. 47 of 1999), on The Licensing of Sites for New Nuclear Installations (Published in Government Gazette 34735 November 2011)

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

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

[22] RD-0024: Requirements on Risk Assessment and Compliance with Principal Safety Criteria for Nuclear Installations

[23] RD-0034: Quality and Safety Management Requirements for Nuclear Installations

[24] RD-013: Requirements on Public Information Document (PID) to be Procured by Applicants for New Authorisation

[25] RG-0006: Guidance on Physical Protections for Nuclear Facilities

[26] RG-0011: Interim Guidance for the Siting of Nuclear Facilities

[27] RG-0012: Interim Guidance on Construction Management for Nuclear Facilities

[28] RG-0019: Interim Guidance on Safety Assessments of Nuclear Facilities

[29] RG-0027: Ageing Management and Long-Term Operations of Nuclear Power Plants

[30] RG-0028: Periodic Safety Review of Nuclear Power Plants

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

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

[33] USNRC NUREG/CR-5741: Technical Bases for Regulatory Guide for Soil Liquefaction, 2000

[34] USNRC NUREG-2215: Standard Review Plan for Spent Fuel Dry Storage Systems and Facilities

[35] USNRC 10 CFR 71: Packaging and Transportation of Radioactive Material

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

6. PROJECT DESCRIPTION

6.1 Proposed Facility

Eskom proposes to construct the first spent fuel Cask Storage Area for the temporary storage of a maximum of fourteen (14) loaded HISTAR 100 casks on the Koeberg TISF subject to NNR amendment of NIL-44 [10]. These casks will store spent nuclear fuel discharged from the reactors of the Koeberg power station.

The construction of the first Cask Storage Area on the TISF consists of three modular reinforced concrete pads with seven ASMs and three approach aprons as described in the TISF detailed design. The general view of the TISF is shown in **Figure 10.**

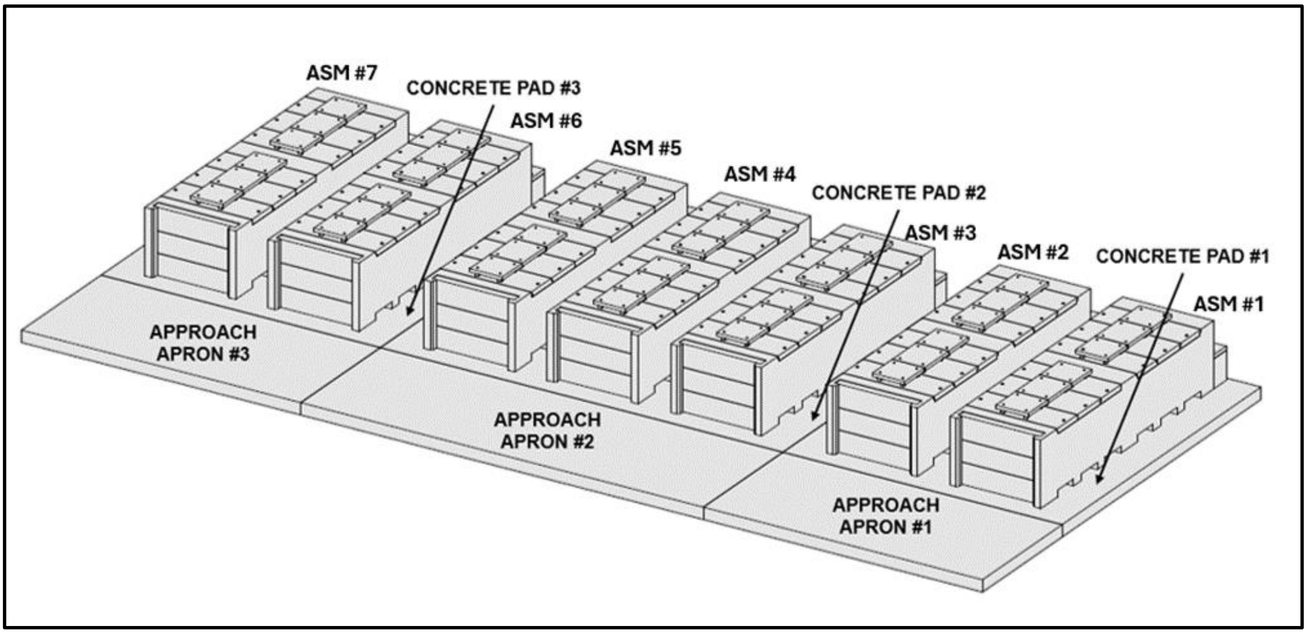

Figure 10: TISF ASMs, Concrete Pads and Approach Aprons

The ASM is designed for additional shielding to ensure compliance with the NNR controlled zone boundary dose rate requirements while also ensuring adequate cooling of the spent fuel stored in the casks. The ASM has lower and upper openings / vents to allow for ventilation. The ASMs have a capacity to each house two loaded HI-STAR 100 casks in a horizontal orientation, and each module has a lockable access door to allow for Radiation Protection (RP) monitoring, Inspection and Maintenance plant operations by plant personnel. The inside of each ASM will be fitted with lighting to provide visibility within the structures.

Figure 11 shows the general layout of the TISF including the OSGISF buildings. The Approach Aprons are reinforced open concrete slabs in front of the Storage Area and within the OSGISF Turning Circle that allow for operations to be conducted at the TISF using the cask transport and handling equipment, and serve as preparation/laydown area, when applicable.

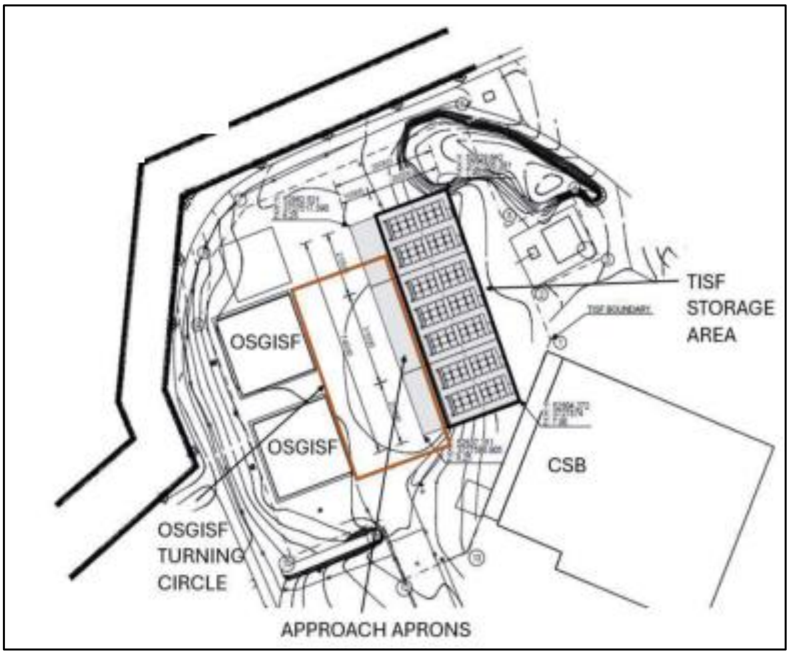

Figure 11: General Layout of the Koeberg TISF

The initial concept design for the TISF, as published in the Eskom Environmental Impact Assessment (EIA) [1] was to design an open storage pad within the available TISF area. The Eskom choice of an open storage pad, compared to other designs such as an enclosed concrete or a light building for the storage of spent fuel casks, considered safety including the fact that open storage pads provide the best passive ventilation during storage and easier means to retrieve spent fuel if or when required. The less complex design of the slabs also renders them more cost-effective.

However, the initial design shielding analyses results for an open storage pad loaded with fourteen (14) HI-STAR 100 casks did not comply with the NNR controlled zone boundary (CZB) dose rate limit of 0.5 µSv/h. The analyses considered placement of the storage pads at different locations within the TISF area.

Additional shielding in the form of ASMs was then introduced in the design to ensure compliance with the NNR dose rate limit at the boundary of the TISF.

Future cask storage pads will be designed to consider the later dry storage cask designs as required by Eskom and will be licensed separately. Preliminary calculations in the Eskom EIA estimate that up to 160 casks will be stored on the TISF on completion of the construction of the facility, pending the establishment of the CISF.

The latest site spent fuel inventory calculations estimate that a maximum of eighty-two (82) spent fuel casks need to be procured for placement on the TISF assuming a maximum capacity of thirty-two (32) spent fuel assemblies per cask (for continued storage on the TISF until 2045). The reduced number of casks in the latest calculations assumes that some of the spent fuel assemblies are stored in the plant SFPs and in the CSB.

Once the CISF is constructed, the Koeberg spent fuel casks will be transferred to the CISF. Based on this strategy, construction of the Koeberg TISF will be modular depending on the progress of the construction of the CISF.

The new cask technology required for future Koeberg cask loading campaigns is still under consideration and will be licensed by Eskom under a separate safety case.

Eskom will also submit a separate license application for TISF operations for NNR approval before casks can be loaded and stored on the TISF.

Note:

i. The construction of the TISF is also in support of Eskom extension of the Koeberg plant life until 2045, and

ii. The responsibility to site, design, construct and commission the CISF lies with the NRWDI. The objective is therefore for Eskom to continuously liaise closely with NRWDI on the Koeberg cask and TISF designs to ensure that the envisaged CISF can accommodate Koeberg casks and not to duplicate costs. Current plans by NRWDI project the establishment of the CISF by 2030.

6.2 Radioactive Material to be Utilised

The Koeberg TISF will be storing dry storage casks loaded with spent fuel from the station SFPs. Spent fuel (alternatively referred to as used fuel) is defined as nuclear fuel that has been irradiated in a nuclear reactor to the point where the fuel is no longer useful in sustaining a nuclear reaction. Koeberg fuel is made up mainly of low enriched Uranium-235 in the form of Uranium Oxide pellets (UO_2) that are stacked in rods made of Zirconium-alloys (also referred to Zircaloy). The rods are assembled in a 17 x17 array by means of spacer grids to make up a single nuclear fuel assembly (**Figure 12**).

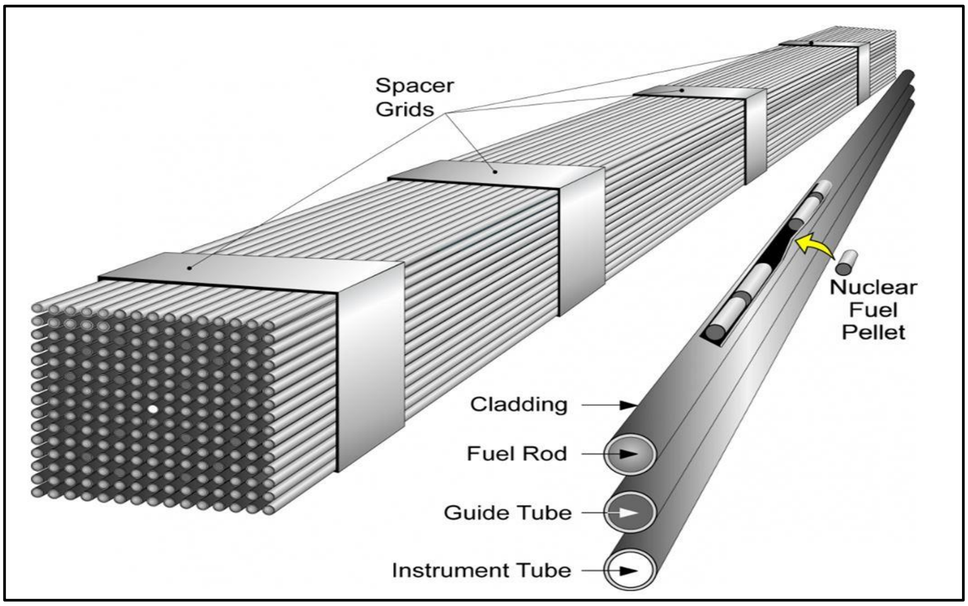

Figure 12: Schematic of a Nuclear Fuel Assembly

During reactor operation, a controlled fission process splits the Uranium-235 atoms followed by release of heat and other radioactive materials. This fission reaction is sustained in the reactor and the heat released as a result is utilised to generate steam that ultimately drives the station turbines to generate electricity.

Once the nuclear fuel is depleted, i.e., the nuclear fuel has been irradiated in the nuclear reactor to the point where the fuel is no longer useful in sustaining a nuclear reaction, the spent fuel is removed from the reactor core and stored underwater in the SFP storage racks. At Koeberg, typically 1/3 of the spent fuel is replaced with fresh fuel assemblies during a refuelling outage, following a reactor cycle energy production.

Storage underwater allows for adequate cooling of the fuel before it can be removed and placed into dry storage casks. At Koeberg, spent fuel assemblies are stored underwater for a period of typically not less than 10 years, before they are transferred into dry storage casks. Spent fuel is classified as high-level radioactive waste as it contains highly radioactive materials.

The main concern during spent fuel dry storage is the degradation of the spent fuel cladding due to oxidation, which could lead to release of radioactive material within the casks. Increased oxidation during dry storage decreases the effective load-bearing thickness of the cladding.

At Koeberg, cladding oxidation of fuel is precluded by backfilling the casks with Helium gas to ensure an inert environment for the fuel. Compared to the HI-STAR 100 cask design, air ingress could occur via the breach on the CASTOR X/28F cask sealing system which could lead to fuel cladding oxidation. Consequently, the CASTOR X/28F cask internal pressure is continuously monitored to verify the integrity of the seals. The HI-STAR 100 cask confinement is sealed by welding canister lid and therefore is not susceptible to air ingress.

The spent fuel Zircalloy cladding material is also designed not to fail due to other phenomena such as creep, hydride re-orientation and stress corrosion cracking (SCC) during storage.

6.3 Hazards Which Could Lead to Radiation Dose Exposure

While the selected TISF location ideally resides within the Koeberg Owner Controlled Area (OCA), the design of the concrete storage pads and ASMs to be constructed has been analysed to ensure robustness against external hazards.

The safety of nuclear power plants and their respective facilities with respect to natural as well as human-induced hazards can be enhanced by identification of hazards and use of proven design solutions to mitigate effects of these hazards. The NNR documents RD-013 [24] and RG-0019 [28], require that safety assessments be conducted to demonstrate nuclear safety against identified hazards for the Regulator to consider as the basis of issuance of a new or an amended site license.

The current CSB have been assessed for individual and a combination of the hazards identified in **Table 2** after screening out events that were not applicable or would not lead to public and /or personnel radioactive dose exposure. The assessment included a full Design Basis and / or Design Extension Condition (DEC) analysis for the screened-in events. A more detailed discussion is documented in Section 8.1.1.

Exposure to radioactive dose from loaded spent fuel casks stored on the TISF occurs during normal operations as discussed in Section 8.3.1 or from an external event that leads to a cask being breached and the residing radioactive material finding a leak path to the environment. Dry storage casks are designed to be inherently safe in that the casks are passively able to contain spent fuel, provide adequate radiation shielding and provide adequate cooling to the stored spent fuel inventory during storage. Nuclear regulations prescribe for casks designs to be robust against external events and casks are normally under continued surveillance and monitoring as discussed in Section 8. Radioactivity contained in spent fuel loaded into casks decays over time and therefore the dose impact decreases with time.

Table 2: List of External Events to be Considered for the TISF

Earthquakes	Tornadoes and Waterspouts
Volcanos	Extreme Winds
Landslides	Extreme Air Temperature
Subsidence/Upliftment	Extreme Precipitation
Permafrost	Extreme Hail
Shifting Sand Dunes	Lightning
Coastal Erosion	Fog (Mist)
Tsunamis	Dust / Sandstorms
Seiches	Snow
Storm Surges	Blizzards
Sea Temperature	Salts Storms
Ground Water Excursion	Corrosion and Salt Deposition
Snowmelt	Airborne Biological Phenomena
Drought	Solar Storms
River Diversion	Meteorites
Dam Failures	Satellite Re-Entry
Sea ice	Missiles
Intake Blockage	Explosion
Low Sea Level	External Fire
Sea Wate Corrosion	Manmade Flooding
Tropical Cyclones	External Chemical Release
Severe Storm	Radioactive Release
	Electromagnetic Interference

6.4 Proposed Development and Estimated Time Scales

The establishment of the first TISF Cask Storage Area at Koeberg will be implemented in a modular manner where the first of the three (3) Concrete Pads, seven (7) ASMs and three (3) Approach Aprons will be fully constructed by January 2026. Consistent with the process depicted in **Figure 13**, the TISF implementation major milestones include:

i) Compilation and submission of the TISF detailed design and the implementation safety case to the NNR, in support of the license application for the amendment of NIL-044.

ii) Review and approval of the TISF detailed design and implementation safety case by the NNR.

iii) Construction and commissioning of the TISF.

iv) Handover of the facility to the station.

Table 3 shows the estimated timescales for the completion of the major milestone.

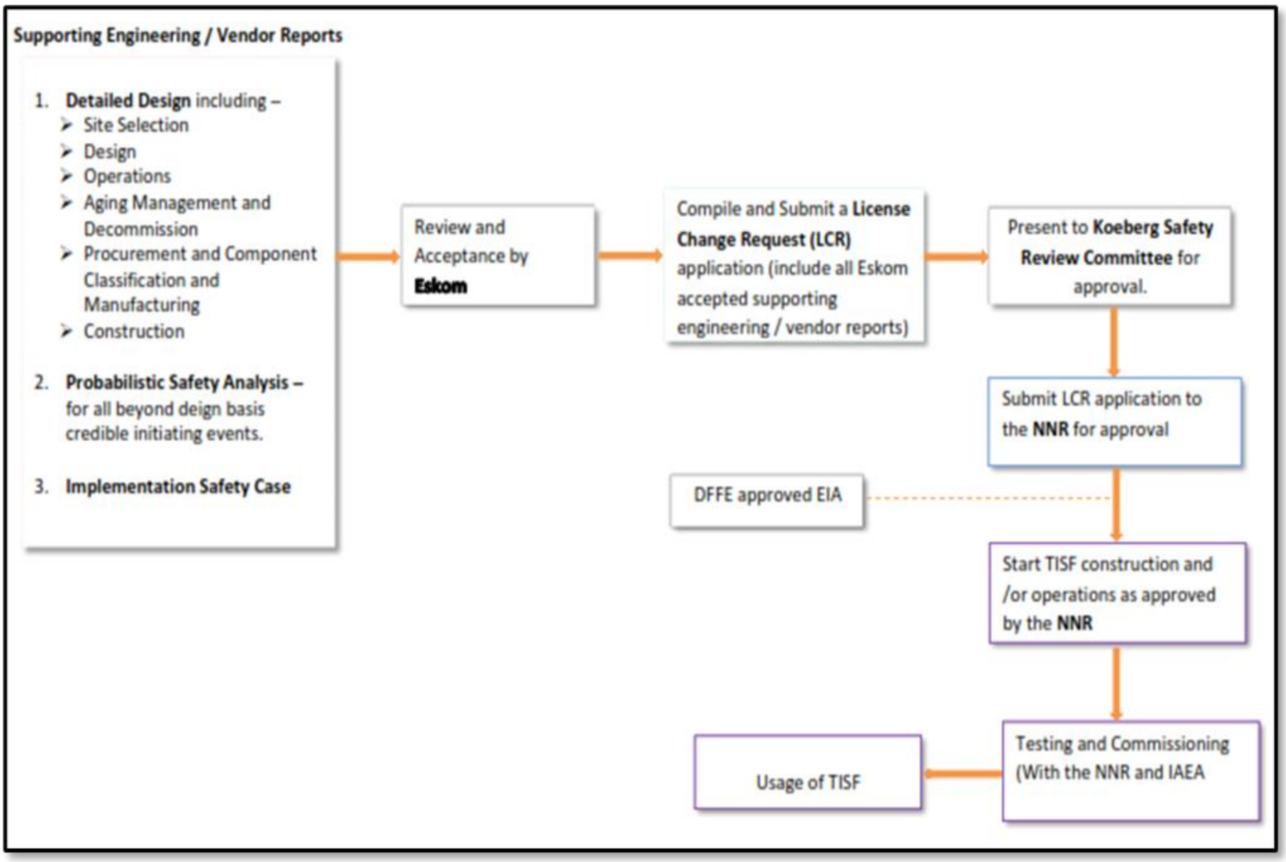

Figure 13: Proposed Development Stages for the Licensing and Construction of the Koeberg TISF

Table 3: Estimated Time Scales for the Licensing and Construction of the Koeberg TISF

Activity	Milestones	Scheduled Completion Date
Submission of the Vendor Detailed Design to Eskom	• Selection of Vendor • Vendor submits Detailed Designs and Supporting Safety Assessments to Eskom	May 2024
Submission of the Eskom Safety Case in Support of the License Application for the Amendment of NIL-44 for Construction Works	• Eskom reviews and accepts the Detailed Design with the Supporting Safety Assessments • Eskom compiles and submits a Civil Construction Safety Case for NNR approval, in support of a licence amendment for the Civil Construction of the first TISF Cask Storage Area • NNR reviews and approves the Eskom license application • Eskom amends the existing TISF license (NIL-44) to incorporate permission to construct the first TISF Cask Storage Area	July 2024
Submission of the Eskom Safety Case in Support of the License Application for the Amendment of NIL-44 for TISF Operations	• Eskom compiles and submits a Safety Case for NNR approval, in support of a licence amendment for TISF operations • NNR reviews and approves the Eskom license application • Eskom amends the existing TISF license (NIL-44) to incorporate permission to store up to fourteen (14) HI-STAR 100 spent fuel dry storage casks on the first storage pad	Feb 2025
Completion of the Construction Works	• Vendor submits procurement and manufacturing documents to Eskom • Vendor delivers construction materials on site • TISF Modular Construction completed • Commissioning and Testing activities completed with the NNR and IAEA	Jan 2026
Operational Period	TISF handed over to the Koeberg site	2026-2055
Closure	Decommissioning in accordance with the approved Koeberg site decommissioning plan	2056-2060

7. SITE DESCRIPTION

Six locations on Cape Farm 1 552 in Duynefontein (**Figure 14**) were identified for the possible development of a Koeberg TISF. Eskom assessments have subsequently identified the site adjacent to the CSB as the preferred option for the establishment of the TISF. The CSB site is located adjacent to the Low-Level Waste (LLW) Building on the northern boundary of the Koeberg site.

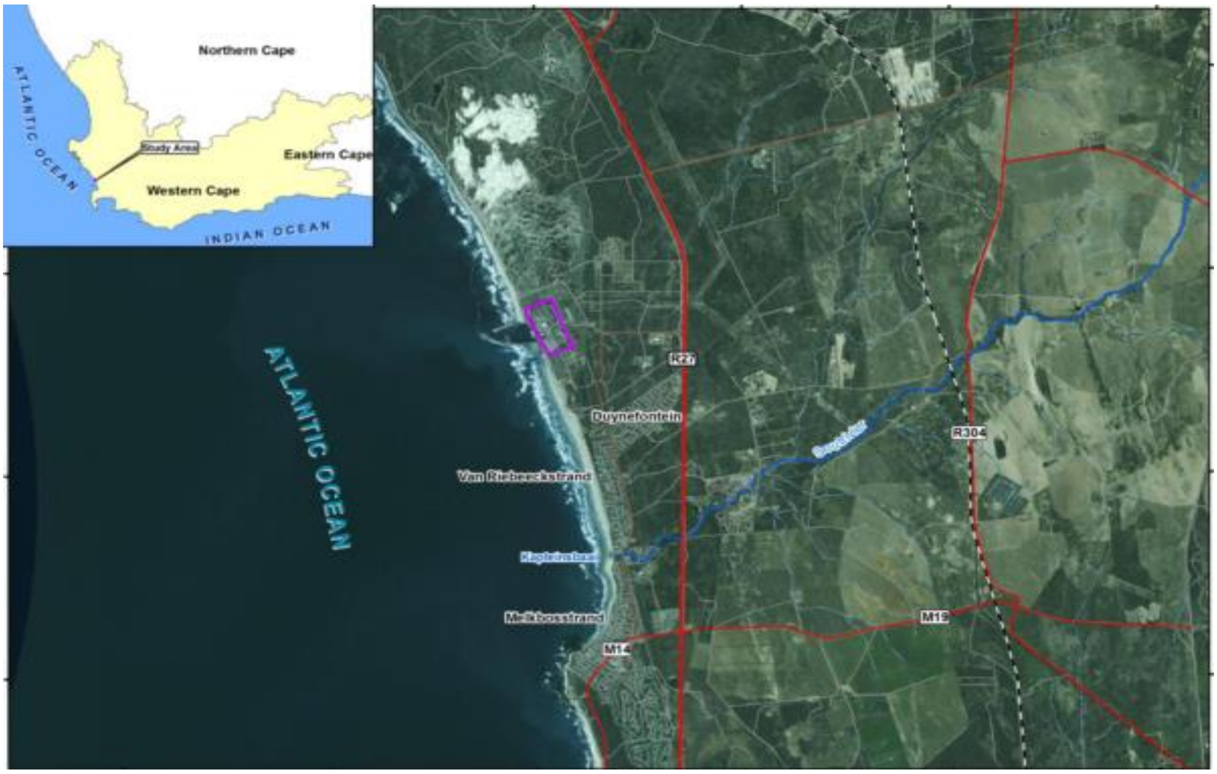

Figure 14: Duynefontein - Cape Farm 1 552

7.1 Site Location

The TISF location is an area of approximately 12 800 m^2 within the Koeberg OCA and will remain operational for an estimated 10 years beyond the end of the planned extended operation of the Koeberg plant which is 2044 for Unit 1 and 2045 for Unit 2. The area has also been recently identified to comprise an interim storage facility for six Koeberg original steam generators (OSGs). On the plant, the six OSGs have been replaced by six new steam generators. The positioning of the OSGISF in the TISF storage area is as per the layout in **Figure 15**.

The NNR has issued the nuclear installation license NIL-44 [10] , for the storage of OSGs on the OSGISF

Figure 15: Koeberg TISF Conceptual Aerial Layout

7.2 Site Characterisation

The TISF location is within the existing safe management and security control of the Koeberg site approved by the NNR in the station licence NIL-01 [9] and as characterised in the supporting site safety report which discusses the geography and demography of the Koeberg site including :

i. Population Distribution and Trends

Regarding the TISF Cask Storage Area, the deterministic analysis in Section 8.1.1, demonstrates that the design of the HI-STAR 100 assures that there are no credible design basis events that would result in a radiological release to the environment. The HI-STAR 100 overpack is designed to provide physical protection to the MPC during normal, off-normal and postulated accident and design extension conditions to assure that the integrity of the MPC is maintained.

The PSA study as discussed in Section 8.1.2 concludes that there is not a more than minimal increase (i.e., increase < 10% of the remaining margin between the NNR risk limit) and the baseline risk as calculated in the baseline current station PSA for dry storage metal casks. This complies with the Eskom nuclear safety evaluation acceptance criterion.

ii. Land and Water Use

Since the design of the HI-STAR 100 assures that there are no credible design basis events that would result in a radiological release to the environment, information about land use and bodies of water or aquifers used by humans, livestock or farms within the region surrounding the site is not included in the TISF deterministic safety analyses.

The TISF site characteristics were also considered in the Eskom EIA [1] conducted for the TISF site and are also briefly discussed in the NNR approved OSGISF design.

Geotechnical studies have been conducted in areas around the CSB for the design and construction of the upgraded CSB storage pad. Their applicability to the adjacent TISF location has been be confirmed in the TISF detail design (Refer to Section 8.1.1.2 (i)).

Like the CSB storage pad, the TISF Cask Storage Area is designed to be seismically stable and to remain functional following a seismic event with design and beyond design ground motions (Refer to Section 8.1.1).

8. SAFETY ASSESSMENTS

Regulatory guidance on safety assessments to be conducted by nuclear license holders for new license applications is provided in the NNR RG-0019 [24] guide. The guide requires that, i) a deterministic analysis be performed to assess the adequacy of the design under normal, off-normal, design basis accidents (DBAs) and design extension conditions (DEC) events, and ii) a probabilistic safety analysis (PSA) be performed to demonstrate compliance with the Regulatory risk criteria for beyond design basis events.

This section therefore provides a summary of the deterministic analysis and PSA results for the proposed first TISF Cask Storage Area under all postulated normal, off-normal, DBA, DEC and beyond design basis accident conditions.

8.1 Summary of Safety Analyses

The Eskom TISF detailed design report which includes the design and supporting safety assessment studies, and the associated construction have been submitted for review and approval by the NNR. **Table 4** provides an overview / summary of design safety analyses addressed in the design document.

The safety analyses were conducted in accordance with the United States Nuclear Regulatory Commission USNRC 10 CFR 72 spent fuel storage regulations and are performed to also comply with NNR approved standards, software codes and methodologies as stipulated in the Regulatory requirements in RD-0016 [20].

Table 4: Koeberg TISF Detailed Design Engineering Safety Topics

Chapter	Topic	Sub-Topic
1	**Introduction**	• The Existing Design • Problems with the Existing Design • The New Design
2	**Scope**	• Purpose • References • Definitions • Abbreviations • Roles and Responsibilities • Process Monitoring
3	**Design Change**	• Nuclear Licensing Requirements • Design Limitations • Assumptions • Feasibility and Preliminary Dose studies • Negative and Benefits of the Design Change • Location and Environmental Conditions • Functional Description • Operational and Maintenance Requirements and Changes • Nuclear Safety • Conventional Safety • Selection of Equipment • Technological Obsolescence • Ageing Management • Design Calculations and Analyses • Impact on the Operating Simulator • Environmental Impact and Energy Efficiency • Equipment and Qualification Requirements • Impact on Original Design bases • Risk Assessment
4	**Manufacturing and Installation Specification**	• Quality Assurance • Interface with Existing Plant • Manufacturing and Preparation • Installation • Marking and Identification • Verification and Tests • Documentation • Packaging, Shipping, Receiving, Storage and Handling

8.1.1 Deterministic Analysis

Dry storage casks are designed to be inherently safe in that the casks are passively able to contain spent fuel, provide adequate radiation shielding and provide adequate cooling to the stored spent fuel inventory during storage.

To ensure spent fuel retrievability, spent fuel dry storage casks are generally designed to perform the following primary safety functions under all credible normal, off-normal and accident conditions:

- Confinement - of all radioactive material to prevent their spread to the environment;
- Heat transfer - to prevent fuel cladding damage due to high temperatures;
- Prevention of criticality;
- Shielding - to control dose exposure to both plant personnel and the public; and
- Structural robustness - to prevent fuel damage due to cask and fuel loading accidents.

This section provides the deterministic assessment conclusions of the HI-STAR 100 cask and the TISF deigns to demonstrate adequacy of the spent fuel storage system in performing the above-mentioned primary safety functions under normal, off normal, DBA and DEC conditions as determined in the HI-STAR 100 licensing safety case for the current Koeberg station license NIL-01 [9], the Holtec Final Safety Analysis Report (FSAR) [6] and the Eskom TISF detailed design.

The HI-STAR 100 cask consists of a seal welded metallic multi-purpose canister (MPC), contained within a sealed overpack [6].

The HI-STAR 100 cask is designed to accommodate a wide variety of spent fuel assemblies in a single overpack by utilizing different MPCs. The external dimensions of all MPCs are identical to allow the use of a single overpack design. Each of the MPCs has different internal fuel baskets to accommodate distinct fuel characteristics. Each MPC is identified by the maximum quantity of fuel assemblies it is capable of storing. Thus, the MPC-32 can contain a maximum of 32 pressurised water reactor (PWR) assemblies and the MPC-68 can contain a maximum of 68 boiling water reactor (BWR) assemblies, etc. To date, Eskom has procured twenty-five (25) HI-STAR 100 casks (i.e., additional eleven (11) to the original fourteen (14)), with the MPC-32. Twelve (12) of the casks are stored in the CSB while the remaining thirteen (13) casks will be stored on the first TISF Cask Storage Area.

8.1.1.1 Normal and Off-Normal Conditions

The conclusions below are consistent with the assessments in the NNR approved Eskom detailed design.

i. **Confinement**

Confinement of nuclear fuel is provided by the fuel rod cladding. Furthermore, the HI-STAR 100 system maintains the spent fuel in an inert environment with fuel rod cladding temperatures below accepted design and Regulatory limits. Koeberg spent fuel assemblies are also visually inspected for debris and sip tested to verify leak-tightness before loading into dry storage casks.

The MPC provides confinement of all radioactive material under normal, off-normal and accident conditions. Following fuel loading the MPC lid is welded to establish its integrity.

The MPC is then dried and backfilled with Helium before the vent and drain ports are sealed. The helium backfill provides an inert, non-reactive atmosphere within the MPC cavity that precludes oxidation and hydride degradation of the spent fuel cladding. The inert helium atmosphere within the MPC contributes to the long-term integrity of the fuel cladding, reducing the potential for release of fission gas or other radioactive products to the MPC cavity during storage.

Helium also aids in heat transfer within the MPC and helps reduce the fuel cladding temperatures. The inert atmosphere in the MPC, in conjunction with the thermal design features of the MPC and storage cask, ensures that spent fuel assemblies are sufficiently protected against degradation, during storage.

Since the HI-STAR 100 system’s confinement function is credited only to MPC, the HI STAR 100 overpack as a helium retention boundary is considered an additional barrier in the defense-in-depth philosophy of the HI-STAR 100 design. The overpack is credited only for helium retention during storage.

ii. **Heat Transfer**

Adequate heat transfer is required to maintain spent fuel cladding and HI-STAR 100 cask component maximum temperatures below specified temperature design limits during storage. Transfer of heat from the interior of the HI-STAR 100 to its outer periphery is accomplished by a combination of conduction through the MPC basket metal grid structure, conduction and radiation heat transfer in the relatively small helium gaps between the fuel assemblies and basket cell walls, and radiation and conduction from the fuel basket periphery to the MPC shell.

The inclusion of ASMs on the TISF affects the HI-STAR 100 thermal analyses, and therefore required the TISF design to confirm that the ASM installation will not have an negative adverse effect on the allowable safety margins.

iii. **Subcriticality**

The system must provide reactivity control to maintain the spent fuel subcritical. This is achieved via the design of the cask storage basket which, i) maintains geometry of spent fuel assemblies through allocation of individual cells that separate the elements during storage, (ii). incorporates neutron absorbing materials to ensure reactivity control and thereby maintained the stored inventory subcritical.

iv. **Shielding**

The spent fuel casks are designed to provide adequate shielding to the workers during storage. Compliance with the NNR dose requirements in RD-0022 [21] prescribes a 1 mSv annual effective dose limit for visitors to the Koeberg site and those not deemed to be occupationally exposed. This equates to an TISF controlled zone boundary (CZB) dose rate limit of 0.5 µSv/h for an exposure of 2 000 hours. This exposure time is conservatively based on a 40-hour week stay for 50 weeks in one year.

For the Koeberg first TISF Cask Stare Area, the installation of ASMs on the storage pad is meant to provide additional shielding to ensure that the NNR CZB dose rate limits are respected. The ASM is designed with optimum thickness of the concrete shield, with openings to ensure ventilation. Each ASM will store two (2) loaded HI-STAR 100 casks in a horizontal orientation with a tilting plate attached to the bottom plate of each cask to provide additional dose rate reduction from the bottom end of the casks. A tilting plate bolted to the cask base surface assists in rotating the cask from vertical to horizontal and is left in place during storage to provide additional gamma and neutron shielding. Various configurations were evaluated to determine the optimum layout for the Koeberg TISF. The TISF boundary where the calculated dose rate is equal to 0.5 µSv/h is depicted with a dashed line in **Figure 11**

The TISF shielding analyses consider the impact of the dose rate emanating from the CSB and the OSGISF to preclude inadvertent dose exposures to both the plant personnel and the public.

v. **Structural Robustness**

Nuclear regulations prescribe for cask designs to be robust against external events and casks are under continued surveillance and monitoring to confirm their integrity.

The first TISF Cask Storage Area has a storage pad with seven (7) ASMs which are designed to each house two loaded HISTAR 100 casks. That is, seven (7) reinforced concrete ASMs will house the fourteen loaded HI-STAR 100 casks (Refer to **Figure 10**).

The ASM is classified as Important to Safety (ITS) and it needs to be anchored to the pad or to be constructed jointly with the pad, the concrete pad is classified as ITS, Safety Class 3.

For normal and off-normal storage conditions, the TISF structural analysis evaluates expected load and load combinations in accordance with NUREG-2215 [34].

The TISF storage area structural analysis determines the internal forces and moments in the storage pad, ASM, lifting embedments and fasters during normal and accident storage conditions and the results demonstrate that:

i. The design concrete reinforcements meet the required capacities in accordance with ACI-349-13 [4] and SANS 10100-1 [31] to withstand the demands for load combinations defined according to NUREG-2215.

ii. The structural embedments and fasteners and lifting embedments design demands following consistent with NUREG-2215 load combinations meet the load limit criteria in ACI-349-13 [4] and SANS 10162-1 [32].The

Therefore, the storage pad and ASM comply with the prescribed safety regulations and standards.

8.1.1.2 Accident Conditions

This section discusses the credible design basis accidents (DBAs) during storage of casks and their impact on the site emergency plan as documented also in the safety justification in support of the current Eskom spent fuel storage licence. An additional safety assessment is provided where additional safety arguments or deviations occur in the TISF assessment as documented in the TISF detailed design.

Any accident involving the casks will initiate the Integrated Koeberg Emergency Plan. This emergency plan is generic as it pertains to any nuclear emergency.

i. **Geological and Geotechnical Hazards**

The TISF location is within the existing safe management and security control of the Koeberg site approved by the NNR in the station licence NIL-01 [9], and as characterised in the Koeberg site safety report in support of the station licence.

The TISF site characteristics were considered in the EIA conducted for the TISF site [1] and are also briefly discussed in the NNR approved OSGISF design.

Geotechnical studies have been satisfactorily addressed for areas around the CSB for the design and construction of the upgraded CSB storage pad. Their applicability to the adjacent TISF location has been confirmed in the TISF detailed design.

In accordance with NUREG/CR-5471 [33], a preliminary liquefaction analysis was conducted to assess the impact of the loads from storage pad and the ASM on the layers where soil liquefaction should be considered. The bounding preliminary seismic results indicate that the maximum settlement consequent to liquefaction is expected to be approximately 120 mm.

ii. **Safe Shutdown Earthquake (SSE)**

The first TISF Cask Storage Area is designed to withstand the effects of seismic event using time histories generated based on the Dames and Moore response spectra linearly scaled to reach 0.5 g horizontal and vertical accelerations at bedrock level. These spectra envelope the Koeberg DBA earthquake / SSE spectra of 0.3 g Zero Period Accelerations (ZPAs).

The seismic analysis model in the detailed design assumes that the ASM is directly connected to the pad.

The TISF seismic calculations that for HI-STAR 100 casks horizontally stored, the cask does not topple during the seismic event and that there is no cask-to-cask or cask-to-ASM interactions due to the earthquake.

iii. **Cask Handling Activities**

To protect against fuel and cask damage, the HI-STAR 100 casks are lifted to respect their designed drop height limit for horizontal lifts of 1,83 m. Furthermore, the equipment utilised to handle casks both in the spent fuel building, the CSB and the TISF is single failure proof.

The risk associated with cask drop accidents and loading errors are discussed in more detail in the PSA Section 8.1.2, as the frequencies of these events fall within the beyond design basis accident frequency range.

iv. **Fire**

Although the probability of a fire accident affecting a HI-STAR 100 system during storage operations is deemed low due to the lack of combustible materials at the TISF, a fire resulting from an on-site transporter fuel tank contents is postulated and analysed.

The DBA fire exposes the HI-STAR 100 overpack to a temperature of 800°C, and the fuel source spreads to 1 metre for 5 minutes.

The fire accident calculation shows limited loss of the neutron shield on the cask exterior following the event. For conservativeness, it is assumed that a DBA fire will destroy the neutron shield. A neutron shield is the material used in the HI-STAR 100 overpack to slow down and absorb neutrons emanating from the radioactive spent nuclear fuel [6].

The fire emergency plan actions for casks at Koeberg therefore require that, if damage to the neutron shield is limited to a localized area, local repairs be performed to replace the damaged neutron shield material. If damage to the neutron shield is widespread and / or radiological conditions dictate, the overpack shall be unloaded in accordance with the approved site HI-STAR 100 100 unloading before the repair of the neutron shield.

The ASM could be damaged after a fire event, but it is a barrier that will reduce the radiation dose exposure that could result after this event in respect to the consequences of this accident without ASM.

v. **Extreme Environmental Temperature**

The Koeberg design basis extreme ambient temperatures are:

- DBA: (100 000-year return)
  - Baseline: 49.1 ± 5.5°C = 54.6°C (upper bound)
  - 2044 projection: 49.4 ± 5.7°C = 55.1°C (upper bound)

The analysis for horizontally-orientated HI-STAR 100 systems is performed for an extreme environmental temperature of 52°C which is not bounding for the Koeberg site extreme temperatures.

However, the Koeberg site specific analysis results show that even under the 55.1°C bounding extreme environmental temperature, the HI-STAR 100 system will continue to operate safely. There is however a possible consequence of a localised loss of the neutron shield effectiveness.

The emergency plan actions are the same as the fire emergency actions documented in KEP-088.

vi. **Tip-Over**

The cask tip-over DBA is not postulated as an outcome of any environmental phenomenon or accident condition. The cask tip-over is a non-mechanistic event.

Furthermore, for horizontally stored HI-STAR 100 casks, the side drop DBA is considered as bounding for the tip-over accident.

vii. **Burial under Debris**

The Koeberg TISF storage area will be designed to withstand both the SSE (0.3g) and DEC (0.5g) seismic events thereby rendering the burial under debris accident not credible.

Note however that, the CSB HI-STAR 100 cask evaluation concludes that in the event of a burial under debris accident of the casks, the casks must be retrieved within a maximum of 4.5 days to preclude loss of integrity of the casks thereby allowing for fuel retrievability.

Damage sustained by the neutron shield shall be repaired in accordance with the procedure steps following a fire accident.

viii. **Tornado Winds and Missiles**

High winds could lead to casks tipping over if stored vertically or shifting from their demarcated locations. Koeberg casks are stored horizontally and thus are not prone to a tip-over event. Shifting of casks can be corrected following the extreme high wind event.

Additionally, high winds could carry debris that could become wind-borne missiles. Three standard missiles are considered, i.e., a solid steel sphere, a section of schedule-40 pipe, and a light automobile as compared between the Koeberg and FSAR [6] specifications in Table 5 below.

Table 5: Design Basis Tornado Missiles

Missile Type	Koeberg Missile Velocities	HI-STAR 100 FSAR Missile Velocities	FSAR bounds TISF?
Steel Sphere	Horizontal: 8 m/s Vertical: 6 m/s	56 m/s	Yes
Rigid Sch. 40 pipe	Horizontal: 41 m/s Vertical: 28 m/s	56 m/s	Yes
Deformable 5 m automobile	Horizontal: 41 m/s Vertical: 28 m/s	56 m/s	Yes

A DBA tornado wind missile may cause localized reduction in the neutron shielding to a HI-STAR 100 cask stored on an open storage pad [6]. Damage sustained by the neutron shield shall be repaired in accordance with the procedure steps following a fire accident.

However, the ASMs on the Koeberg first TISF Cask Storage Area are designed to withstand the high winds and tornado forces thereby acting as a missile shield. Localised damage could appear on the concrete surfaces, but the ASM are designed as to guarantee the retrievability of the HI-STAR 100 cask following such an event.

ix. **Flood**

The HI-STAR 100 overpack does not tip-over due to a DBA flood. As postulated under USNRC 10 CFR 72 Regulatory requirements [6]. The design basis flood for the HI-STAR 100 cask is of a velocity of 4m/s, with a depth of 200 m.

The Koeberg design basis does not define DBA flood. Refer to Section 8.1.1.3

x. **Fuel Rod Rupture**

The maximum gas pressure in the MPC is considered for a postulated accidental release of fission product gases caused by 100% fuel rods rupture. The HI-STAR 100 thermal analysis demonstrates that the system's design pressure is not exceeded with 100% of the fuel rods ruptured.

xi. **Explosion**

There is no internal mechanism of causing an explosion within a sealed HI-STAR 100 cask. There are no explosive materials stored inside or in proximity of the CSB and the TISF. Therefore, the explosive event within the TISF is considered not credible.

xii. **Partial Blockage of MPC Basket Vent Holes**

The HI-STAR 100 system is designed to withstand reduction of flow area due to partial blockage of the MPC basket vent holes. As the MPC basket vent holes are internal to the confinement barrier, the only events that could partially block the vents are fuel cladding failure and debris associated with this failure, or the collection of crud at the base of the stored spent fuel assembly.

However, the HI-STAR 100 system maintains the spent fuel in an inert environment with fuel rod cladding temperatures below accepted design and Regulatory temperature limits. Koeberg spent fuel assemblies are also visually inspected for debris and sip tested to verify leak-tightness before loading into dry storage casks.

Therefore, there is no credible mechanism for partial blockage during storage in the HI-STAR 100 cask.

The installation of ASMs introduces the possibility of a blockage accident of the ventilation openings of the ASMs. The accident condition of ASM openings blockage is bounded by the burial debris accident for the CSB as discussed in Section vii.

Plant inspection procedures require regular inspections to maintain the vents free of debris. Additionally, the ASM ambient temperature monitoring alarm of 38º C will alert the Koeberg plant operators of the increased ASM ambient air temp and to physically confirm the air vents are free of obstructions / debris.

xiii. **Confinement Boundary Leakage**

The HI-STAR 100 confinement analysis concludes that there are no postulated environmental phenomenon or accident conditions identified that would cause failure of the MPC confinement boundary based on the selection of materials, methods of fabrication and inspections.

xiv. **Precipitation**

The HI-STAR 100 casks are designed for storage outdoors and thus there is no impact on the casks by rain.

Exposed external surfaces on the overpack (except seal areas, trunnions, and bolt locations) are coated with paint specifically selected for good performance (chemical or galvanic) in the open environment for long-term storage.

Materials used for other exposed surfaces are also specifically selected to provide good performance in the outdoor environment, e.g., stainless steel for bolts and inserts.

The first TISF Cask Storage Area is designed to withstand the Koeberg environmental conditions with a maximum rainfall of 200 mm/h and the casks are stored in the ASMs.

xv. **ASM Top Cover Drop**

The installation of the ASM introduces the possibility of a top cover drop accident when the top cover is moved over a cask during the installation of the ASM. The accident condition of tornado automobile missile in Section viii is considered to bound this accident.

The lifting of the top cover is done through four lifting embedments installed on each of the top covers. During lifting operations, the top cover will remain suspended even if one of the lifting embedments fails.

The fastening bolts that fix the top covers to the ASM structure are designed for design extension conditions including 0.5g earthquakes. The structural design of the ASM therefore eliminates the risk of top cover drop for design basis conditions.

xvi. **Lightning**

The HI-STAR 100 overpack contains many thousands of kilograms of highly conductive carbon steel over the external surface area. Such a large surface area and metal mass is adequate to dissipate any lightning which may strike the HI-STAR 100 system. There are no combustible materials on the overpack surface. Therefore, lightning will not impair the structural performance of components of the HI-STAR 100 system that are important to safety.

The ASM provides defence in depth by protecting the overpack from direct interaction with the lightning.

8.1.1.3 Design Extension Conditions

The current CSB DEC hazard analyses have been assessed for individual and a combination of the hazards identified in Table 1 after screening out events that were not applicable to the CSB or would not potentially lead to public and /or personnel radioactive dose exposure via structural damage, before a full DEC analysis for the screened-in events was performed and documented in the reports. An assessment of the screened-in DEC events is discussed in this section for the TISF.

i. Tsunami Flooding

The Koeberg DEC velocity is higher at 7 m/s with a depth of 6m than the FSAR specifications (Refer to Section 8.1.1.2 (ix)), meaning that the HI-STAR 100 analysis is not bounding for Koeberg.

However, the since HI-STAR 100 cask is stored inside the ASM on the TISF, the horizontal drag force produced by the flood will act on the ASM instead of the cask. The ASM therefore acts as a barrier during this DEC flooding accident by reducing the drag force exerted on to the stored casks.

Yet, due to the flooding, the HI-STAR 100 cask could eventually be submerged, by water entering through the ASM vents / openings with a maximum submergence depth of 6 m, which is bounded by 200 m depth level considered in the HI-STAR 100 flood evaluation and will not result in sliding and overturning in the ASM.

Operating experience from the Fukushima utility indicates that dual purpose metal casks similar to the Koeberg dry storage casks, can withstand flooding by Tsunamis and / or vibrations from beyond design basis earthquakes. The Fukushima incident in 2011, led to severe damage to SFPs at the Daiichi Nuclear Power Plant. Except for being wet, and the facility's storage building being damaged, none of the casks were moved from their storage locations nor damaged. The spent fuel casks at Daiichi are also stored horizontally.

Following the Tsunamis at the Daiichi Nuclear Power Plant, utilities worldwide are also opting to transfer their spent fuel into dry storage casks.

Koeberg has not experienced a Tsunami, to date.

ii. Tornado Winds and Missiles

High winds could lead to casks tipping over if stored vertically or shifting from their demarcated locations. Koeberg casks are stored horizontally and thus are not prone to a tip-over event. Shifting of casks can be corrected following the extreme high wind event.

The three standard missiles are considered, i.e., a solid steel sphere, a section of schedule-40 pipe and a light automobile, for a DEC tornado wind missile event are compared between the Koeberg and FSAR [6] specifications in Table 6 below.

Table 6: DEC Tornado Missiles

Missile Type	Koeberg Missile Velocities	HI-STAR 100 FSAR Missile Velocities	FSAR bounds TISF?
Steel Sphere	Horizontal: 35 m/s Vertical: 26 m/s	56 m/s	Yes
Rigid Sch. 40 pipe	Horizontal: 40 m/s Vertical: 26 m/s	56 m/s	Yes
Deformable 5 m automobile	Horizontal: 52 m/s Vertical: 26 m/s	56 m/s	Yes

HI-STAR 100 analyses indicate that missiles could penetrate the cask outer shell / overpack and cause localised damage on shielding material located on this area of a dry storage cask. These localised areas can be repaired to restore the cask design, with proper RP guidance to prevent radiation over-exposure to the workers, following a high wind event.

Assuming that the ASM is sheltering the HI-STAR 100 cask, the automobile tornado missile would impact the ASM. However, analyses show that the DEC seismic load on the ASM is 123 times higher than the automobile tornado missile load.

iii. Extreme Temperatures

The Koeberg casks are designed to withstand extreme environmental weather including snow and high temperatures. Horizontally orientated systems can operate at extreme temperatures between 52ºC and -40ºC. In both extreme cases the temperature must be sustained for at least 72 hours. Historically, Koeberg has not experienced these excessive temperatures, much less for a sustained 72-hour period.

iv. Heavy Aircraft Impact

The Koeberg plant risk assessment defines a heavy aircraft as large commercial (e.g. Airbus A340-600, Boeing 727, 737 and 747, etc) and military (e.g. C- 130 Hercules). It also conservatively assumes that 161 loaded dry storage casks are damaged in the event of a heavy aircraft crash induced fire. This risk assessment also assumes that all casks will be damaged in the event of a heavy aircraft fire. The calculated dose risk demonstrates that an aircraft crash contributes less than 1% to the overall risk introduced by loading and storing casks on the Koeberg site (Refer to Section 8.1.2.

v. Explosions

On-site explosion hazards in the vicinity of the CSB and the TISF were identified and screened-out in the current site spent fuel storage safety case. Furthermore, there are no explosive materials stored close to the CSB and / or the TISF location.

The design of the Koeberg casks allows for a cask to contain radioactive contents under the maximum internal pressure considering 100% fuel rod and maximum accident temperatures. There is therefore no internal mechanism of causing an explosion within a sealed cask.

vi. Off-site Missiles

Off-site missiles could cause damage to casks in storage on the TISF facility. The only permanent off-site facility that can generate a missile of this nature is the Ankerlig Power Station, which is located 9.45 km from the TISF, with a 5.3E-10 probability of the event occurring. The long distance of these turbines from the Koeberg site and the very low probability of the event occurring render the event improbable.

The Koeberg casks are designed to withstand design basis tornado and wind missiles. The station has in place procedures to retrieve, inspect and repair possible localised external defects following such events.

vii. Earthquake

The first TISF Cask Storage Area is designed to withstand the effects of seismic event using time histories generated based on the DEC Dames and Moore response spectra linearly scaled to reach 0.5 g horizontal and vertical accelerations at bedrock level. The DEC seismic analyses demonstrate that the HI-STAR 100 horizontally stored in a cradle is seismically stable (i.e., do not overturn) and cask-to -cask and cask to ASM impacts do not occur.

8.1.2 Probabilistic Risk Assessment

The original Koeberg risk assessment for additional metal casks PSA-R-T15-08, Revision 4 [16], considered a comprehensive and generic list of initiating events developed by Electric Power Research Institute (EPRI), and screens out seismic events and conservatively assumes that 161 metal casks with a capacity of 28 spent fuel assemblies, are stored in an open TISF storage pad without, i.e., without seismically qualified ASMs.

The initiating events considered for spent fuel dry storage in PSA-R-T15-08 include heavy aircraft crash and cask seal leaks, cask loading errors, cask drops with and without spent fuel liner (SFP) liner break.

A re-analysis of the risk assessment was conducted in PSA18-0043, Revision 6 [15] for cask storage in the CSB and screened-in the seismic event as an initiator. The PSA was subsequently updated for cask storage on the first TISF storage area and it screens-out seismic initiating events since the both the storage pad and the ASMs will be seismically designed to withstand the SSE (0.3g) and DEC (0.5g) earthquakes according to the proposed concept design.

The official PSA baseline in PSA18-0043 Revision 9 assumes, i) sixteen (16) casks being stored in the CSB, and ii) seven (7) cask movements per year which eventually leads to fourteen (14) casks stored on the TISF.

The PSA concludes that there is not a more than minimal increase (i.e., increase < 10% of the remaining margin between the NNR risk limit and the baseline risk as calculated in the baseline PSA18-0043 Revision 6. This complies with the Eskom nuclear safety evaluation acceptance criterion.

8.2 Quality Assurance

The scope of work for the TISF project is classified as Level 2 in accordance with NNR quality and safety management system (QMS) requirements documented in RD-0034 [23]. Therefore, the design, manufacturing, construction, commissioning, operation and decommissioning of the TISF are implemented in accordance with the NNR directive which requires licensees and Contractors to be in possession of a basic quality management system (QMS) ISO 9000/1 (or equivalent) and an additional QMS for processes, design codes and standards specific to nuclear installations for products/ processes that are categorised as important to nuclear safety, that is, Level 2.

The selected Contractor's QMS is based on the ISO 9001:2015 [8] and ISO 3834 systems. Further requirements as set out in the ASME-NQA-1 ('NQA-1') standard [3] are also applied to the project.

The Contractor's QMS was audited by Eskom to verify that the Contractor is sufficiently compliant with the NNR's RD-0034 [97] Level 2 requirements.

8.3 TISF Operations

Koeberg has a Radiation Protection (RP) program based on overarching NNR dose exposure requirements in RD-0022 [21] that limit the CZB dose rates to a maximum of 0.5 µSv/h with no mitigations. The TISF boundary where the calculated dose rate is equal to 0.5 µSv/h is depicted with a dashed line in **Figure 11**.

The ASM is designed for additional shielding to comply with the NNR controlled zone boundary dose rate requirements (**Figure 10**). The ASMs have a capacity to each house two loaded HI-

STAR 100 casks and each module has a lockable access door to allow for Radiation Protection (RP), Inspection and Maintenance plant operations within the modules. The inside of each ASM will be fitted with lighting to provide visibility within the structures.

The Cask Storage Area normal operations must be controlled to ensure that individual personnel dose exposures do not exceed 20 mSv/y. Furthermore, the TISF operations as discussed below, must also be conducted to ensure adherence to the As Low As Reasonably Achievable (ALARA) principle which demands the following actions from personnel in order to minimise dose exposures:

i. Minimise the time spent in the vicinity of a radiation source.

ii. Maximise the distance a person has from a radiation source.

iii. Wearing and using appropriate protective shielding when working close to a radiation source.

8.3.1 Radiation Protection Surveillances

A program to monitor the dose rate levels around the casks and the TISF boundary will be established to ensure that the NNR dose rate limits are not exceeded thereby also verifying the integrity of the casks and fuel stored within the facility. Radiation workers are consistently monitored for dose exposure using Electronic Personal Dosimetry (EPD) and Thermo-Luminescent Dosimeters (TLDs).

8.3.2 Placement of Loaded Casks

Using site approved procedures, HI-STAR 100 dry storage casks will be loaded with spent fuel from the Koeberg SFPs before they are transferred on the Goldhofer to the TISF Approach Aprons. (Refer to Section 2.1). Each cask is placed horizontally on a transport cradle (See **Figure 5**), and finally the cask and cradle are placed in the assigned ASM directly from transporter before the ASM top cover is installed.

8.3.3 Periodic Inspections and Maintenance

An inspection regime has been established to ensure regular visual inspection of the TISF including the ASMs and spent fuel casks in storage, to identify any defects and / or potential failures that could lead to unsafe and / or inefficient operations within the facility. The regular inspections will allow for preventative maintenance to be implemented.

The materials selected and used in the TISF design are considered to demonstrate adequate performance for at least 50 years, which is the usual design life for concrete structures.

8.3.4 Security

The TISF location has been pre-defined to be inside the existing security area of the Koeberg site. This means that the existing site security measures will also ensure all individuals on site complies with the requirements of the National Keypoint Act. In accordance with the NNR RG-0006 [25], Eskom will implement a security design to ensure compliance with Regulatory security controls around the facility. In the main the security measures will comprise of a minimum of:

- A Perimeter Barrier and Access Control Systems;
- Detection and an Alarm System;
- Surveillance CCTV;
- Lighting; and
- Warning Postings.

8.3.5 IAEA Safeguards

The following IAEA safeguard controls will be established for the TISF:

- The IAEA will inspect the Koeberg SFPs before and following a cask is loaded with spent fuel to ensure traceability.
- The cask containment boundary / overpack and ASMs will be fitted with seals by the IAEA inspector. The seals can only be removed by an IAEA inspector / representative.
- The TISF interior will be monitored via both Eskom Security and IAEA cameras to prevent diversion of nuclear material and sabotage.

8.4 Compliance with Safety and Regulatory Standards

This section lists the International and South African Legal and Regulatory requirements for the storage of spent fuel. Eskom will submit a license application that demonstrates compliance with the following Acts.

8.4.1 South African Legal and Regulatory Authorisations Requirements

8.4.1.1 Nuclear Energy Act, No. 46 of 1999 (NEA)

The NEA stipulates that the Minister of Department of Mineral Resources and Energy (DMRE) has the authority over the management and discarding / disposal of radioactive waste and the storage of spent fuel. In terms of these provisions Eskom has received written permission to store spent fuel not already covered by the existing permission [5].

8.4.1.2 Radioactive Waste (Radwaste) Management Policy and Strategy for the Republic of South Africa 2005

The radioactive waste management policy allows utilities to employ dry and /or wet spent fuel storage mechanisms on the reactor site. Koeberg is currently employing both storage methods. Therefore, the decision to continue with dry storage on the Koeberg site is consistent with the national radwaste management policy.

8.4.1.3 Department of Forestry, Fisheries and Environment (DFFE)

In accordance with the National Environment Management Act (NEMA), No. 107 of 1998, Sections 24 and 44 of NEMA make provision for the declaration of regulations that identify activities which may not commence without an environmental assessment issued by the competent authority, that is, DFFE.

The EIA for the Koeberg TISF was initially approved by DFFE in 2017 [2]. The application was later amended to include the placement of six OSGs in the OSGISF within the TISF area. The revised application was approved by DFFE in 2018 [1] **.**

8.4.1.4 National Nuclear Regulator Act, No. 47 of 1999

All spent fuel storage facilities fall under the regulatory authority of the NNR. The Regulator ‘s responsibilities include the siting, design, construction, operation, manufacture of component parts, and decontamination, decommissioning and closure of nuclear installations.

The licensee (Eskom in this case) is responsible for ensuring that all operational safety related programmes are implemented and maintained accordingly. In particular, the following sections of the Act need to be highlighted for the Koeberg TISF project:

1. Application for Nuclear Installation
2. Purpose and Scope of Regulations
3. Lodging Applications
4. Factors to be Considered when Evaluating Sites for Nuclear Installations
5. Requirements for Site Safety Report

8.4.1.5 National Water Act, No. 36 of 1998

In terms of the Act, a land user, occupier or owner of land where an activity that causes or has the potential to cause pollution of a water resource has a duty to take measures to prevent pollution from occurring. If these measures are not taken, the responsible authority may do whatever is necessary to prevent the pollution or remedy its effects, and to recover all reasonable costs from the responsible party.

Accordingly, Eskom applied to the Department of Water and Sanitation on 17 March 2015, for a Water Use License. The department's response on 10 May 2016 indicated that the proposed TISF water activities were not deemed to require a water use authorisation.

8.4.1.6 National Heritage Resources Act (NHRA), No. 25 of 1999

The protection and management of South Africa's heritage resources are controlled by the NHRA. The enforcing authority for this act is the South African National Heritage Resources Agency (SAHRA).

In the Western Cape, SAHRA has delegated this authority to Heritage Western Cape (HWC). In terms of the Act, historically important features such as graves, trees, archaeological artefacts / sites and fossil beds are protected. Similarly, culturally significant symbols, spaces and landscapes are also afforded protection.

Section 38(1) requires a notification of intent to develop (NID) for submission to the SAHRA or HWC for the certain developments / activities. The Koeberg TISF proposed project triggers a number of these activities, including:

(a) Construction of a road, wall, powerline, pipeline, canal or other similar form of liner development or barrier over 300m in length; and

(c) Any development or activity that will change the character of a site exceeding 5 000 m^2 in extent.

A NID was submitted to HWC on 29 February 2016. The proposed development will change the character of the project site, in addition to which transfer routes will be required to move casks to the TISF. These are, however, likely to follow existing roads. Since there is no reason to believe that the proposed development will impact on heritage resources, HWC confirmed that further processes under Section 38 of NHRA will not be required.

8.4.1.7 National Radioactive Waste Disposal Institute Act (NRWDIA), No.53 of 2008

The NRWDIA provides for the establishment of a national radioactive waste disposal institute to manage radioactive waste disposal nationwide. The establishment of the CISF as a predisposal site by 2030, as mentioned earlier, is the responsibility of NRWDI.

Eskom has no control over the establishment of the CISF hence the decision by the utility to construct the TISF in a modular manner while monitoring the progress made in the construction of the CISF.

8.4.2 NNR Requirements

Table 7 below shows NNR requirements to be implemented in licensing the TISF on the Koeberg site.

Table 7:**NNR Requirements**

NNR Document	Title
R266	Regulations on the Long-Term Operation of Nuclear Installations - NNR Act, 1999 (Act No. 47 of1999)
R388	Regulations in Terms of Section 36, Read with Section 47 of the National Nuclear Regulatory Act, 1999 (Act No. 47 of 1999), on Safety Standards and Regulatory Practices
R927	Regulations in Terms of Section 36, read with Section 47 of the NNR Act, 1999 (Act No. 47 of 1999), on The Licensing of Sites for New Nuclear Installations (Published in Government
RD-013	Requirements on Public Information Document (PID) to be Produced by Applicants for New Authorizations
RD-0016	Requirements for Authorisation Submissions involving Computer Software and Evaluation Models for Safety Calculations
RD-0022	Radiation Dose Limitation at Koeberg Nuclear Power Station
RD-0024	Requirements on Risk Assessment and Compliance with Principal Safety Criteria for Nuclear Installations
RD-0034	Quality and Safety Management Requirements for Nuclear Installations
RG-0006	Guidance on Physical Protections for Nuclear Facilities
RG-0011	Interim Guidance for the Siting of Nuclear Facilities
RG-0012	Interim Guidance on Construction Management for Nuclear Facilities
RG-0019	Interim Guidance on Safety Assessments of Nuclear Facilities
RG-0027	Ageing Management and Long-Term Operations of Nuclear Power Plants

Table 7:NNR Requirements

NNR Document	Title
RG-0028	Periodic Safety Review of Nuclear Power Plants
PP-0008	Design Authorisation Framework
PP-0009	Authorisations for Nuclear Installations
PP-0012	Manufacturing of Components for Nuclear Installations
PP-0014	Considerations of External Events for New Nuclear Installations

8.4.3 International Regulatory Requirements

As stated in Section 6.1, the initial construction of the TISF will consists of three modular reinforced concrete pads with seven ASMs and approach aprons and will store a maximum of fourteen (14) loaded HI-STAR 100 casks in a horizontal orientation.

8.4.3.1 USNRC 10 CFR 72

The Koeberg license requirements for spent fuel dry storage incorporate the United Sates USNRC 10 CFR 72. Note that the USNRC specifications are overarched by the NNR spent fuel storage requirements.

8.4.3.2 IAEA Safeguards

South Africa (SA) is part of the INFCIRC/394 agreement with the International Atomic Energy Agency (IAEA), for the application of safeguards to ensure non-proliferation of nuclear material within the country. Communication between Eskom and the IAEA regarding safeguards is via the South African Nuclear Energy Corporation (NECSA), as the appointed representative of the SA government.

The TISF will be provided with safeguards controls (e.g., seals on casks, IAEA surveillance cameras, etc.) pursuant to the non-proliferation agreement. The implementation of these controls will be effected by the IAEA.

8.4.3.3 IAEA SSR-6

In accordance with the Koeberg station license NIL-01[9], dry storage systems to be stored on site and therefore on the TISF, will be transportable pursuant to International Atomic Energy Agency (IAEA) regulations for safe transport of radioactive material documented in the IAEA SSR-6 [7] standard.

The HI-STAR 100 casks are certified for transport in accordance with the USNRC 10 CFR 71 [35] regulations for packaging and transport of radioactive materials. Eskom will therefore submit a separate transport licence application demonstrating compliance with IAEA SSR-6 regulations, for NNR approval before moving the loaded Koeberg HI-STAR 100 casks to the CISF.

9. EMERGENCY PLANNING

Koeberg has an established emergency plan and applicable procedures to ensure that the station can adequately respond to potential radiological emergency conditions that could lead to unacceptable dose exposures to the public. The emergency plan forms part of the site license issued by the NNR.

The plan is maintained and tested on a regular basis to verify the preparedness of the station in case of an emergency.

9.1 Emergency Classification

The following are progressive stages of response in the emergency plan, depending on the dose consequences and seriousness of an accident:

i. Unusual Event

An abnormal occurrence that indicates an unplanned deviation from normal operations, the actual or potential consequences of which require the partial or limited activation of the emergency plan.

ii. Alert

A situation exists that could develop into a Site or General Emergency and therefore requires notification of all emergency personnel to obtain a state of readiness to respond.

iii. Site Emergency

An emergency condition exists that poses a serious radiological hazard on-site but poses no serious radiological hazard beyond the public exclusion boundary.

iv. General Emergency

An emergency condition exists that involves, or potentially involves, a serious radiological hazard beyond the public exclusion boundary. The declaration of a General Emergency at Koeberg Nuclear Power Station must result in the declaration of a National Disaster under the Disaster Management Act.

The responsibility for the command and control of a nuclear accident lies with the Site Emergency Controller (EC) who is supported by staff in the Emergency Control Centre (ECC).

9.2 Spent Fuel Cask Emergency Plan

Koeberg has an emergency programme that describes the process and actions to be taken in an event of an incident or accident involving, i) loading and transfer of spent fuel casks on site and ii) loaded spent fuel casks stored in the CSB and the TISF.

The risk for loaded casks in storage, is the breach of cask integrity and heating up of fuel due to burial under debris following an external event. The heating up is due to poor cooling of the fuel contained and this could lead to melting of fuel which then dislocates and migrates to the environment through the breach on the cask. The burial under debris accident is considered not credible for the TISF since the design is seismically qualified.

The existing emergency plan for events affecting casks in storage requires in the main that:

- The site Radiation Protection (RP) personnel to perform radiation surveys of the CSB and TISF determine possible breach of the cask containment which would be indicated via significantly elevated dose rates compared to the normal routine survey results.
- Note that significant cask containment failure could result in a minor radiological release. If the release is of sufficient magnitude to pose a radiological risk on site, it requires the Site EC to declare a Site Emergency. The declaration of a Site Emergency requires the implementation of on-site protective actions, for example building relocation, evacuation and sheltering.
- Casks must be retrieved, with appropriate support by RP, from the covering debris within a specified amount of time depending on the cask design, to restore passive cooling of the casks and thereby prevent overheating of the fuel inventory.
- A recovery/ repair plan must be compiled and implemented with guidance from the cask Original Equipment Manufacturer (OEM).

Since, i) the proposed TISF design is seismically qualified and ii) spent fuel casks are inherently designed to withstand external events, the likelihood of breaching casks and dispersing radioactive material to the environment due to an external event on the TISF is significantly reduced.

10. WASTE MANAGEMENT AND DECOMMISIONING PLAN

Spent fuel in dry storage on the TISF will be transported to an off-site CISF which is yet to be constructed by the NRWDI on behalf of the DMRE. The Eskom plan is therefore to commence transporting Koeberg spent fuel dry storage casks to the CISF once the storage facility has been established.

After the plant is shut down, spent fuel from the Koeberg reactors will be left in the spent fuel pools for a period sufficient for cooling, depending on the dry storage technology to be employed. The TISF will remain operational for an estimated 10 years beyond the end of the planned extended operation of the Koeberg plant which is 2044 for Unit 1 and 2045 for Unit 2.

The Koeberg decommissioning scope does not include final disposal of casks or spent fuel at the CISF as the final disposal activities are strictly within the NRWDI domain.

The TISF is not expected to be contaminated and therefore will be demolished in line with the Koeberg decommissioning strategy for non-contaminated structures, while also considering the proposed decommissioning activities proposed by the construction vendor. Decommissioning of the TISF will be implemented following the removal of all spent fuel casks from the facility.