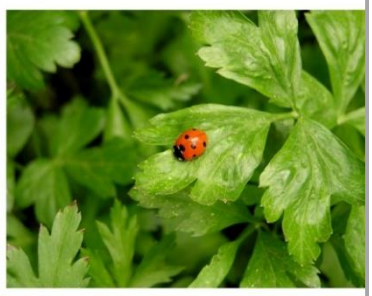
Review of the Radiological Assessment Report for the ESKOM Transient Interim Storage Facility



Assessing Radiological Impact on People & the Environment

Date: 7 October 2016

Prepared by: Dawid de Villiers, Ph.D. (Pr.Sci.Nat, Pr.Phys.)

Radiation Protection Specialist (NORM)

Document No: SR-REP-007/2016, Rev. 0

SciRad Consulting (Pty) Ltd
Reg. No: 2012/210743/07

P.O. Box 843, Hartbeespoort, 0216, Tel: +27 12 253 1507, Cell: +27 82 339 0254, Email: dawid@sciradconsulting.com

DISCLAIMER

Although SciRAD Consulting (Pty) Ltd exercises due care and diligence in rendering services and preparing documents, SciRAD Consulting (Pty) Ltd accepts no responsibility and liability for any and all losses, expenses, costs, damages, demands and claims arising out of or in connection with illness or injuries to or the death of any person and/or damage to the property of any person, in any way sustained or allegedly sustained in connection with or by reason of the services rendered by SciRAD Consulting (Pty) Ltd or the use of the information contained in this document.

TABLE OF CONTENT

1.0 BRIEF INTRODUCTION

ESKOM proposes to construct a Transient Interim Storage Facility (TISF) on a portion of vacant land within the Koeberg Nuclear Power Station (KNPS) security protected area. The facility will be used for the temporary storage of dry metal or concrete casks. These casks will store used nuclear fuel generated at the KNPS up to the end of operational life of plant. The TISF will meet the National Nuclear Regulator (NNR) requirements and will be built and managed according to International Atomic Energy Agency (IAEA) guidelines.

A *Radiological Assessment* was commissioned by ESKOM prior to commencement of the Environmental Impact Assessment (EIA) for the TISF. In order to meet the independence requirements as stipulated in the EIA Regulations, an independent review of the *Radiological Assessment* had to be undertaken to inform the EIA process.

This report represents the independent review undertaken by SciRAD Consulting (Pty) Ltd

2.0 TERMS OF REFERENCE

The Terms of Reference (ToR) for this review are as follows:

- Review the ToR and the radiation specialist's proposal for the Radiation Assessment;
- Recommend any changes required to the Radiation Assessment ToR to comply with South African legislation, by-laws and international best practice;
- Review relevant aspects of the Radiation Assessment including, as a minimum, the methodology, input data, findings, conclusions and recommendations of the Assessment relating to Public Dose Assessment and Worker Dose Assessment;
- Identify gaps in reporting and make recommendations to improve reports and processes so that they are aligned with international best practice and national legislation;
- Provide ad hoc advice to the EIA team (especially the health specialist) as and when required; and
- Compile and submit brief Review Reports following the review of each of the Draft and Final Radiation Assessment Reports, as well as a follow up report confirming compliance with legislation and best practice and whether relevant concerns have been adequately addressed.

3.0 METHODOLOGY

The aim of any radiological safety assessment is to assess or calculate a dose to either the worker or the public for a specific radiation exposure scenario. As such, the main components that need to be present in an assessment are:

- the radiation source (based on measured or generic data),

- the pathways whereby radiation can reach the receptor,
- the receptor (either worker or the public),
- the exposure scenario (e.g. exposure periods or detail on the actions to be undertaken),
- any assumptions used in the assessment and
- results and conclusions (based on radiation protection principles and guidelines).

It is also important to note that radiological safety assessments can be iterative as the assessed doses are dependent on assumptions if actual circumstances are not known or could not be measured. This means that when the assessed doses are higher than the dose limits, all the components of the assessment need to be reinvestigated. It also means that when the available data is adequate and the resulting doses are below the dose limit complicated dose calculations (e.g. modelling) are not needed to constitute an acceptable safety assessment.

The aim of the reviews and the recommendations was to ensure that the *Radiological Assessment* has sufficient detail to address the above-mentioned aspects in order for the National Nuclear Regulator (NNR) and other stakeholders (e.g. public) to have confidence in the results.

The review process involved three documents:

1. Preliminary Draft Report: Methodology and Radiological Assessment: Spent Fuel Cask Loading; Transfer to On-Site Storage; Storage; and Transport Off-Site to Final Storage (referred to as the Preliminary Draft Report),
2. Radiological Assessment: Used Nuclear Fuel Cask Loading; Transfer to On-Site Storage; and Storage at the Koeberg Transient Interim Storage Facility (document number 07147DRR034), Draft (referred to as the Radiological Assessment Draft Report) and
3. Radiological Assessment: Used Nuclear Fuel Cask Loading; Transfer to On-Site Storage; and Storage at the Koeberg Transient Interim Storage Facility (document number 07147DRR034), Revision 0 (referred to as the Radiological Assessment, Rev. 0 Report).

4.0 FINDINGS

4.1 PRELIMINARY DRAFT REPORT

In brief, the preliminary draft report provided a background to the tasks to be performed, methodology employed to determine the doses for these actions, the assessed doses and conclusions. However, it did not mention the approach that was followed in the assessment. This meant that modelling results were expected as part of the submission to substantiate the presented dose values as they were not measured. Also, the report was vague in many descriptions or calculations, thus creating uncertainty in the obtained results. An example is the calculation of the highest dose during spent fuel cask loading. This report was inadequate as a radiological assessment and needed to be rewritten.

Table 1 tabulates the comments made on the *Preliminary Draft Report* together with the sections in the *Radiological Assessment Draft Report* that address these comments.

Table 1: Comments on the Preliminary Draft Report

Section	Comment	Section in Radiological Assessment Draft Report where Addressed
1. Introduction	Define radiological consequences as criticality of fuel can also be seen as a "consequence".	Better described in 5. Methodology
	Would one of the dosimeters placed at the boundary of the Koeberg Nuclear Site, be near the TISF?	The reference to dosimeters at boundary was removed. However, more info on boundary dose is presented in 6.4.4.1
	Although this study forms part of a larger project, many people will not read the other documents. A project description, albeit brief, is needed to provide the context of the study.	Brief description in 1. Introduction
3. Applicable Regulations and Legislation	NNR Act and its Regulations not mentioned	Added to 3.Applicable Regulations and Legislation
5. Methodology	"casks are used extensively... and deemed a safe storage…" – kindly expand on this section, provide references, include a table that presents the recorded dose rates as mentioned in the paragraph.	Done in 6.2.2
	How do the different cask types differ from each other, specifically in terms of radiation shielding?	It is mentioned in the text of 5. Methodology that the casks can either be concrete or metal, but it is unknown which type would be used
	"Operational experience data" is mentioned a few times in the report, but it is not described as to mean Koeberg experience or general nuclear experience.	5.Methodolgy indicates that it is from the nuclear industry
6. Method	In this paragraph, the exposure period is not mentioned. This makes the use of the terms "dose" and "dose rate" very confusing.	Clarified in all relevant sections

	What is "the dose rate influence"? Is it the same as "the casks influence on the dose received by the public and the environment?	6.2 rewritten to provide better descriptions and clarifications.
	Present the specific criteria that are to be met, alternatively do this at the start of the document.	
7.1 Spent Fuel Cask Loading	It is unclear whether this section describes actions already being performed at Koeberg or the processes to be followed.	These comments have been addressed in various places within 6.2. This section has been rewritten to provide better descriptions and clarifications.
	Data in table – are these doses per annum or a dose rate per hour?	
	An appendix with the measurements should be added to provide the proof that these values are not fabricated.	
	Exposure periods should be given.	
	If there are no measurements, perform dose calculations on the expected doses with the use of for example, MCNP*. In this case, detail on how doses were calculated should also be presented.	
	It is unclear how the "highest average radiological exposure" was calculated. Are the personnel used in this operation always the same persons? Is the RP Job Surveillance team also involved with the other activities? If this is the case, the surveillance team member will receive 1.7 mSv. The other members will receive 1.3 mSv and not 1 mSv. The total dose for handling all 8 casks also need to be revised based on the previous comments.	
7.2 Transfer to On-Site Storage	Provide information on how the doses were estimated e.g. MCNP calculations, manufacturing data (reference)	6.3.2 from manufacturer
	Collective dose calculated incorrectly as previous paragraph assumes 8 casks to be moved in a year.	Corrected and clarified in 6.3.2
7.3 Storage of Casks	This paragraph presents conflicting dose calculations. The "operating experience… 0.010 mSv per month", but the table indicate 0.15 mSv (per annum or hour?) on one cask. Provide clarification.	Rectified in tables in 6.4.3.2

	Note that during the year the total dose will increase as more casks are placed in storage.	6.4.3.2 clarify this indirectly by mention of most penalizing case and contact dose rates as 1m doses from manufacturer are not available.
7.4 TISF	Provide the "adequate shielding" information.	Addressed in 6.4.4
	Provide the calculations that prove that shielding of TISF is adequate for dose rates at outside of building to be comparable to background levels.	
7.5 Transport of Casks	Provide measurements or calculations to prove that doses to public will be acceptable.	Addressed in 6.4.4.1
8.0 Conclusion	Provide a summary of the doses for the various actions in table format or in the text.	Although not summarised in table format the doses are summarised in 7.Conclusion
	Why was criticality of the casks not discussed? If spent fuel is not a criticality hazard it should be mentioned, as it can be considered a radiological hazard.	Discussed in 6.4.1

* MCNP : Monte Carlo N-Particle Transport Code

4.2 RADIOLOGICAL ASSESSMENT DRAFT REPORT

The Radiological Assessment Draft Report introduced a description of the project and explain the terminology used. Of importance was the explanation that this radiological assessment utilises the accepted graded approach. The methodology (on how the graded approach was used) and assumptions (provided later in the report) were clearly presented. It was followed by concise exposure scenarios and the assessed doses for the various tasks to be performed. In each of these sections the radiation source, the pathway (that of external radiation) and the receptor (either worker or public) were described in a satisfactory manner. The conclusion summarised the main findings and concluded that both the worker and public doses are below the respective dose limits.

All the comments from Table 1 were adequately addressed or were no longer applicable due to better descriptions or explanations. This report is sufficient as a prospective radiological assessment.

Two findings were made to improve on the report. Firstly, it was requested that paragraph 6.4.4.1 Controlled Area Boundary Dose, be rewritten as the different dose rates and area boundaries were not clearly described/explained and the reader may therefore be confused with the content of this paragraph. Secondly, the report can mention that a retrospective radiological assessment will be performed after some data have been collected to verify the findings of the prospective report. This is an internationally and NNR accepted practice. The collected data and the assessment will also add value to the KNPS “operational experience”. Other comments related mostly to spelling errors or requests for references. These comments are tabulated in Table 2.

Table 2: Comments on the Radiological Assessment Draft Report

Section	Comment	How addressed in Radiological Assessment, Rev.0 Report
1. Introduction	Provide reference for DS 427 as this report is not only read by KNPS personnel.	Updated in 1.
	Provide reference for 1 mSv	
	Should also mention the 0.25 mSv/a dose limit applicable to KNPS operations.	
2. Abbreviations and Definitions	Change Becquerel's to Becquerel	Corrected in 2.1
	Technically the Gray (Gy), and not Sv, is the unit for absorbed radiation. Kindly add "taking into account the relative biological effectiveness of ionising radiation". This then means equivalent and effective dose for which Sv is the unit.	Updated in 2.7
5. Methodology	Provide reference for "casks…is deemed safe storage solution…"	This is a statement made taking into account regulatory documents and OE read by the author. There is no direct reference. An additional line has been included using a US NRC reference to substantiate this opinion of the author.
6.2.2 Collective Radiation Exposure…	Provide reference for "…manufacturer…"	The manufacturer is a current supplier of new casks for KNPS. Awaiting feedback from Manufacturer on use of their name in the report.
6.3.1 Used Nuclear Fuel…	Change hr to h	Corrected in 6.3.1
6.4.3.1 Cask Shielding	Change boron 10 to boron-10	Corrected in 6.4.3.1
6.4.3.2 Dose Rates on a Cask	Provide reference for "KNPS experience"	The survey number has been added to the paragraph.
6.4.4.1 Controlled Area Boundary Dose	Kindly rewrite this paragraph as it is confusing. For example: Where does the 5 uSv/h come from? A supervised area (max of 5 mSv/a) is a radiological area classification for workers. The	This paragraph has been reworded to better describe the two criteria that must be met.

	exposure period of 8760 hours /a is for public. Or is this a criteria set by KNPS? Is it the 5 uSv/h or the 0.25 mSv/a the criteria used to calculate the boundary?	
	Suggestion: rewrite "The owner controlled area…" to "This is within the owner controlled area at KNPS as it extends to approximately 1 500 m ..., and ~2 300 m..."	Updated in 6.4.4.1
8. Assumptions and Current Limitations	This paragraph fits in after 4. Scope	This suggestion has been considered, however this has not been updated as it is the current template used by Eskom. The ASSUMPTIONS AND CURRENT LIMITATIONS section has been left at the end of the report.
General	The report can mention that a retrospective assessment will be performed after some data have been collected to verify the findings of this report.	A brief statement of this nature has been placed in the methodology and the conclusion section.

4.3 RADIOLOGICAL ASSESSMENT, REV. 0 REPORT

The Radiological Assessment, Rev. 0 Report adequately addressed all the comments of Table 2. Additional information was also added to the report to further clarify certain aspects. This report is sufficient as a prospective radiological assessment.

Note that although the report discusses the worker doses in detail, the public dose is discussed as a limiting design criteria (see e.g. Section 6.4.4.1). As such, the dose limit will not be exceeded and can therefore be used by the Health Specialist in his/her report to inform the EIA on the risks of exposure to the public.

5.0 CONCLUSIONS

In conclusion, the report *Radiological Assessment: Used Nuclear Fuel Cask Loading; Transfer to On-Site Storage; and Storage at the Koeberg Transient Interim Storage Facility (document number 07147DRR034), Revision 0*, is satisfactory in its description and application of the chosen radiological assessment methodology to assess the respective doses for the loading, transfer and storage of used nuclear fuel at the Koeberg Transient Interim Storage Facility. The graded approach as used in the assessment, is an acceptable methodology. Since the assessed doses are below the respective dose limits, this approach negates the need for further mathematical modelling at this point of the assessment process.

Furthermore, the NNR, other authorities and stakeholders can rest assured that although the study was commissioned and performed by ESKOM, the findings of the report are reasonable and founded on sufficient detail to provide confidence in the results.

---

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

EIA for the Proposed Used Nuclear Fuel Transient Interim Storage Facility at Koeberg Nuclear Power Station

Specialist:	Dr. Dawid de Villiers (SciRAD Consulting (Pty) Ltd		
Contact person:	Dr. Dawid de Villiers		
Postal address:	P.O. Box 843, Schoemansville, Hartbeespoort		
Postal code:	0216	Cell:	082 339 0254
Telephone:	012 253 1507	Fax:	-
E-mail:	dawid@sciradconsulting.com		
Professional affiliation(s) (if any)	Pr.Sci.Nat, Pr.Phys.		

Project Consultant:	SRK Consulting (South Africa) (Pty) Ltd		
Contact person:	Sharon Jones		
Postal address:	Postnet Suite #206, Private Bag X18, Rondebosch		
Postal code:	7701	Cell:	082 876 0638
Telephone:	021 659 3060	Fax:	021 685 7105
E-mail:	sjones@srk.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Dewich de Villiers , declare that --

General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

SciRAD Consulting (Pty) Ltd

Name of company (if applicable):

04/12/2015

Date: