Eskom	Specification	Nuclear Engineering

Title: **Refurbishment of Vertical Invar Wires and Pendulums on Containment buildings**

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Content

1. Introduction

The Containment structures at Koeberg Nuclear Power Station are equipped with monitoring equipment, similar to those installed on the containment structures of the reference station, Tricastin Nuclear Power Plant, in France.

Each containment structure is equipped with four observation stations, which is located on the external perimeter of the containment structure at the -6.7 meter level, approximately 90° apart. Each observation station consists of a vertical invar wire and three pendulums.

The vertical invar wires are fixed to steel anchor brackets that are fixed at +45.37 meter level to the containment structure. The vertical invar wires are protected from the elements by ducts. The vertical invar wires are used to measure the vertical deformation of the containment structures. Each Vertical Invar Wire station consists of:

- Mounting box
- Vertical ducts
- Reference pin and ruler
- Vertical invar wire

The pendulums are fixed to steel anchor brackets that are fixed at +10, +26 and 42 meter level to the containment structure. The pendulums are protected from the elements by ducts. The pendulums are used to measure the horizontal deformation of the containment structures. Each pendulum consists of:

- Mounting box
- Vertical ducts
- Measuring Table
- Pendulum wire

Civil inspection reports have revealed defects noted on the Invar and Pendulums wire stations for both Unit 1 and Unit 2 containment building. The defects include but not limited to water leaks, unrealistic increase in diameter at different levels on the pendulums stations, draft of wind at the invar wire conduits, pendulums wire off-centre relative to the centre of their conduits.

2. Supporting Clauses

2.1 Scope

The Scope of this User Requirement Specification (URS) is defined in section 3.

2.1.1 Purpose

The purpose of this document is to specify the technical requirements for the refurbishment of the Invar and Pendulum wires at Koeberg Nulcear Power Station Unit 1 & 2 Containment buidings.

2.1.2 Applicability

This document shall apply to Koeberg Operating Unit.

2.1.3 Effective date

This document is effective once authorised.

2.2 Normative/Informative References

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

2.2.1 Normative

[1] CE-18279 – Containment Online Monitoring System Requirements for its Continued Maintenance and Calibration to be included in the current procedures

[2] DSG-318-079 rev 0 – Vertical Invar Wires and Pendulums Repairs

[3] KBA 1201A70019 rev 2 - Technical Specification of the Pendulums

[4] KBA 1201A70020 rev 2 - Technical Specification of the Vertical Invar Wires

[5] KBA 1206C01012 - Reactor Building Upper Raft Unit 1 and 2 Location of Invar Wire

[6] KBA 0106C01013 - Reactor Building-Upper Raft-Unit 1 Instrumentation by Invar Wire And Pendulums

[7] KBA 1206D01007 - Reactor Building - Containment Cylinder - Units 1 and 2 - Pendulums Setting Out

[8] KBA 0206C01007 - Reactor Building-Upper Raft-Unit 2 Instrumentation by Invar Wire And Pendulums

[9] KBA 1201A70014 - Reactor Building - Auscultation of the Containment - Direct Pendulums - Setting Out - Hanging Plates – Equipment

[10] KBA 0106D01026 - Reactor Building-Containment Cylinder Unit 1 Sealings for Scales Pendulums Lightning Rods Rainwater Downpipes Guiding Rails, Sheet 1

[11] KBA 0106D01027 - Reactor Building-Containment Cylinder - Unit 1 Sealings for Scales Pendulums Lightning Rods Rainwater Downpipes Guiding Rails, Sheet 2

[12] KBA 0106D01028 - Reactor Building-Containment Cylinder Unit 1 Sealings for Scales Pendulums Lightning Rods Rainwater Downpipes Guiding Rails, Sheet 3

[13] KBA 0206D01013 Reactor Building-Containment Cylinder Unit 2 Sealings for Scales Pendulums Lightning Rods Rainwater Downpipes Guiding Rails, Sheet 1

[14] KBA 0206D01014 Reactor Building-Containment Cylinder Unit 2 Sealings for Scales Pendulums Lightning Rods Rainwater Downpipes Guiding Rails, Sheet 2

[15] KBA 0206D01017 - Reactor Building-Containment Cylinder Unit 2 Sealings for Scales Pendulums Lightning Rods Rainwater Downpipes- Guiding Rails, Sheet 3

[16] KBA 1206D01303 - Reactor Building Units 1 and 2 Shuttering Boxes and Support Brackets for Invar Wires and Pendulums - Key Drawing

[17] KBA 1206D01304 - Reactor Building Units 1 and 2 Fixed Brackets and Pipes for Invar Wires and Pendulums - Key Drawing

[18] KBA 1201A70010 - Reactor Building Vertical Inver Wires-Laying Out - Support – Equipment

[19] TLAA 301- Containment Reanalysis

2.2.2 Informative

[20] 32-727: Safety, Health, Environment and Quality (SHEQ) Policy

[21] Construction Regulations – 2014

2.3 Definitions

2.3.1 Classification: Generic term encompassing safety, seismic, quality, environmental, importance and management system level or the process of assigning these designations.

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

2.3.3 Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.3.4 Employer: Eskom Holdings SOC Ltd

2.3.5 Public domain: published in any public forum without constraints (either enforced by law, or discretionary).

2.3.6 Supplier: The *Supplier* appointed to perform the refurbishment, manufacturing, installation, and repairs related to the services stipulated in section 3.

2.3.7 Trigramme: Koeberg numbering and labelling system.

2.4 Abbreviations

Abbreviation	Explanation
ALARA	As Low as Reasonably Achievable
QCP	Quality Control Plan
ITP	Inspection and Test Plan
KNPS	Koeberg Nuclear Power Station
MM	Maintenance Manual
NNR	National Nuclear Regulator
NSA	Not Safety or Availability related
OHSA	Occupational Health and Safety Act, Act 85 of 1993
PPE	Personal Protective Equipment
QA	Quality Assurance.
QADP	Quality Assurance Data Package
QC	Quality Control
QCP	Quality Control Plan
SANS	South African National Standards
SHE	Safety, Health, Environment

2.5 Roles and Responsibilities

Activity	Responsible party
Compilation User Requirement Specification	*Employer*
Detailed assessment of the condition of the Invar and Pendulum equipment	*Supplier*
Refurbishment of the Invar and Pendulums Wires	*Supplier*
Training and Job shadowing to Eskom Maintenance group	*Supplier*
Environmental,OHS and Quality compilations and submissions to the Employer	*Supplier*

2.6 Related/Supporting Documents

2.6.1 CE 18279 - Containment Online Monitoring System Requirements for its Continued Maintenance and Calibration to be included in the current procedures [1]

2.6.2 TLAA 301 – Containment Reanalysis [19]

3. Scope of the *works*

3.1 Supplier's delivarables

The supplier is to perform a detailed assessment of the condition of the Unit 1 & 2 Containment building Invar and Pendulum wires equipment and compile a report for submission to the Employer. Further to this, the supplier is to reinstate the vertical invar wires and pendulums on Unit 1 and 2 at KNPS.

The work is to be performed in accordance with documentation provided in section 2.2.1, unless the supplier is aware of improved techniques or method statements specified by EDF. The supplier may propose these techniques or method statements as an alternative to the Technical Specification provided in section 2.2.1. However, these alternative techniques or method statements offered by the supplier would have to be reviewed and approved by KNPS before reinstating of the vertical invar wires and pendulums.

The work is to include, based on the detailed assessment report and if necessary, inter alia;

- Perform initial measurement and report readings.
- Removal of the existing shuttering boxes from the tops of all the pendulums and vertical invar wire stations.
- Removal of the existing shuttering brackets from the tops of all the pendulums and vertical invar wire stations.
- Modification of the new stainless steel anchor bracket.
- Replacement of the new stainless steel anchor brackets to the top of both the pendulums and vertical invar wire stations.
- Replacement of the shuttering boxes.
- Provide moisture-collecting chemicals in the shuttering boxes.
- Sealing of the shuttering boxes to prevent ingress of moisture.
- Removal of the existing carbon steel duct support brackets.
- Replacement of the new stainless steel duct support brackets.
- Alignment of the ducts.
- Installation of the new pendulums and vertical invar wires.
- Securing of the new pendulums and vertical invar wires.
- Supplying and securing the required weights for the pendulums and vertical invar wires.
- Reinstating of the sighting tables for the pendulums, which include inter alia sighting points, cursor, left and right scale.
- Alignment of the sighting tables for the pendulums.
- Installation of the new reading scales to the bottom of the vertical invar wires.
- Removal of all existing reference scales from the containment structures.
- Installation of new reference scale on the containment structure.

- The Supplier will be responsible for quality check and approval on the filling of the existing drums with water and top-up with oil which will be executed by the Employer.
- Check pipe joints and reseal.
- Check all brackets for U-bolt sagging.
- Perform assessment on the wires to conclude if it is necessary to replace the entire wire.
- Perform measurement after completion of refurbishment of the invar and pendulums wires.
- Perform verification checks to show that the work has been correctly performed. The Supplier is to be responsible for any defects arising after the completion of the scope within 12 months.
- The Supplier is to provide the Employer with drawings and documentation used for the reinstating of the vertical invar wires and pendulums.
- The Supplier is to supply all the documentation, equipment, material, access and labour necessary to reinstate the vertical invar wires and pendulums on units 1 and 2 at Koeberg Nuclear Power Station.
- The Supplier is to supply a quality programme for each phase on the reinstatement of the pendulums and vertical invar wire on units 1 and 2 at Koeberg Nuclear Power Station.
- The Supplier is to provide a report detailing the work undertaken. Furthermore, Datasheets of the materials installed and photographs of initial and final condition of the equipment.
- The time between the pre and post-installation readings shall be minimized as far as reasonably possible for each individual wire (invar wire and pendulum).
- All specialist Supplier's' CVs shall be submitted to Eskom for Acceptance.
- All inspectors measuring the pre and post-installation readings shall be Authorized by the Responsible Engineer.
- The Supplier is to provide the Employer with training and job shadowing during the execution of the works.
- Supply calibration equipment and services for the on-line monitoring equipment (EAU system).

3.2 Use of the *Supplier*'s design/reports/deliverables/drawings

3.2.1 All documentation that forms part of the Scope is supplied to the *Employer* by the *Supplier* and forms part of the services for which the *Supplier* has been compensated.

3.2.2 The *Employer* reserves the right to issue the *Supplier*'s design/drawings/reports/QADP to Others for purposes of maintenance, Construction, spares, verifications, modifications in future or any other purposes required by the *Employer*. The *Employer* has total rights to use the *Supplier*'s designs as the *Employer* requires.

3.2.3 All reports and documents submitted to the *Employer* should be provided in electronic format. Electronic copies of text files shall be in 'doc', 'pdf' and all drawings in 'DGN' format.

3.2.4 The *Supplier* notes that all drawings and other documentation supplied to the *Employer* become the property of the *Employer* upon final transfer. The *Supplier* disclaims upfront whether the use of his Intellectual Property is required to carry out services, for which case the *Employer* has permission to use the information forming part of the services without incurring any royalties.

4. Acceptance

This document has been seen and accepted by:

Name	Designation
Vickeshree Munsame	Chief Engineer
Leon Singh	E&S Manager

5. Revisions

Date	Rev.	Compiler	Remarks
July 2023	1	P Raliwedzha	Draft specification for review and first issue
August 2023	2	P Raliwedzha	Scope of work changes – Addition of "Supply calibration equipment and services for the EAU system."

6. Development Team

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

- Coco Fanie

7. Acknowledgements

- N/A