	<b>TECHNICAL REQUIREMENT SPECIFICATION</b>	<b>NUCLEAR ENGINEERING</b>
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Title: **Specification for the Procurement  
of Excitation Transformers at  
Koeberg Nuclear Power Station**

Document Identifier: **240-152358699**

Alternative Reference Number: **14011**

Area of Applicability: **Nuclear Engineering**

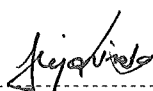
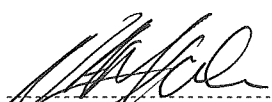
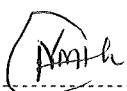

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Compiled by	Reviewed by	Functional Responsibility	Authorised by
			
S. Linose	N.A. Mgulwa	N. Mtoko	R. Goldstein
Technologist	Senior Engineer	NTP Manager	Design Engineering Manager
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## **1. Introduction**

This technical requirement specification (TRS) describes the client requirements in respect of modification number 14011. It is intended to describe the functional and technical requirements for the design; supply of material; manufacturing, delivery; removal and disposal of the existing excitation transformers; installation of the new excitation transformers; and, testing and commissioning of the plant changes.

## **2. Supporting Clauses**

### **2.1 Scope**

The contractor scope of supply for modification 14011 comprises of the following:

- A detailed design document according to 331-86 [14] populated in the latest detailed design template available from Design Engineering,
- Supply of material (8 x dry-type single phase transformers including all transformer auxiliaries). Three transformers shall be installed on each of the two units, with all associated auxiliaries. The additional two transformers to be used as strategic spares.
- Manufacturing,
- Factory Testing,
- Delivery to Koeberg Nuclear Power Station,
- Installation of the new dry-type generator excitation transformers and all associated auxiliary equipment,
- Testing and commissioning of the new generator excitation transformers on the GEX system,
- Compile and submit design documents and all new documents,

The contractor scope of supply does not include the following:

- NNR licensing activities
- Safety Screening and Safety Evaluation
- Removal of existing equipment,
- Disposal of existing equipment,

NNR license activities, Safety Screening, Safety Evaluation, removal and disposal of transformers will be the responsibility of Eskom.

#### **2.1.1 Purpose**

Provision of technical requirements associated with the replacement of Excitation Transformers at Koeberg Nuclear Power Station.

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### **2.1.2 Applicability**

This document is developed to detail technical requirements for the procurement of the excitation transformers for Koeberg Nuclear Power Station. This document shall apply throughout Nuclear Engineering.

### **2.1.3 Effective date**

This document shall become effective from the date of authorisation by the Design Engineering Manager.

## **2.2 Normative/Informative References**

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

### **2.2.1 Normative**

- |      |                               |  |
|------|-------------------------------|--|
| [1]  | <b>OHS Act:</b>               | Occupational Health and Safety Act No. 85 of 1993  |
| [2]  | <b>ISO 9001:</b>              | Quality Management Systems   |
| [3]  | <b>IEC 60137:</b>             | Insulated bushings for alternating voltages above 1 000 V  |
| [4]  | <b>IEC 60076-1:</b>           | Power transformers: General  |
| [5]  | <b>IEC 60076-2:</b>           | Temperature rise   |
| [5]  | <b>IEC 60076-3:</b>           | Insulation levels, dielectric tests and external clearances in air   |
| [6]  | <b>IEC 60076-5:</b>           | Power Transformers: Ability to withstand short circuit   |
| [7]  | <b>SANS 60076-11:</b>         | Power Transformers - Dry-type Transformers   |
| [8]  | <b>SANS 61378-1:</b>          | Converter Transformers –<br>Transformers for Industrial Applications   |
| [9]  | <b>SANS 12944:</b>            | Corrosion Protection of Steel Structures by Protective Paint Systems   |
| [10] | <b>IEC 60815-2</b>            | Ceramic and glass insulators for a.c. systems  |
| [11] | <b>BS 381c:</b>               | Colour Chart   |
| [12] | <b>KBA0022D02204:</b>         | Classification of Nuclear Safety and Related Equipment and Non-Nuclear Safety Related Equipment in CGEE ALSTHO Scope of Supply |
| [13] | <b>IEEE STD.C57.110-2008:</b> | IEEE Recommended Practice for establishing Transformer Capacity when supplying non-sinusoidal load current                     |

### **2.2.2 Informative**

- |      |                 |   |
|------|-----------------|---|
| [14] | <b>KAA-501:</b> | Project Management Process for KNPS Modifications                           |
| [15] | <b>331-86:</b>  | Design Changes to Plant, Plant Structures or Operating Parameters (KAA-815) |

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[16]	<b>331-93:</b>	Guide for Classification of Plant Components, Structures and Parts (KGA-003)
[17]	<b>331-94:</b>	Importance Category Classification Listing (KLA-001)
[18]	<b>331-170:</b>	Requirements for Protective Coatings for use at KNPS (KSA-106)
[19]	<b>240-127002040:</b>	Procurement Quality Engineering Requirements (KSA-089)
[20]	<b>240-86973501:</b>	Engineering Drawing Standard – Common Requirements
[21]	<b>240-86973501:</b>	Engineering Drawing Standard – Common Requirements
[22]	<b>GGSS1074:</b>	Specification for Large Power Transformers in Power Stations
[23]	<b>KSA-132:</b>	Lifting and Rigging Program
[24]	<b>KGA-025:</b>	Screening And Safety Evaluation Guide
[25]	<b>KSA-011:</b>	Requirements for Controlled Documents
[26]	<b>KFA-006:</b>	Testing Procedure For Plant Modifications
[27]	<b>KLA-023:</b>	Outage Preparation Milestone Checklist
[28]	<b>KBA1222F00001:</b>	Equipment marking
[29]	<b>KBA0000G001000:</b>	Koeberg Nuclear Power Station Graphic Symbol
[30]	<b>SOW:</b>	Scope of Works for Modification 14011
[31]	<b>DSE-KBA1217GEX000-1:</b>	Generator Excitation and Voltage Regulation
[32]	<b>SANS 60034-16-1:</b>	Rotating Electrical Machines: Excitation Systems for Synchronous Machines – Definitions
[33]	<b>SANS 60146-1-1:</b>	Semiconductor Convertors: General Requirements and Line Commutated Convertors – Specifications of Basic Requirements
[34]	<b>IEEE C57.110:</b>	Recommended Practice for Establishing Transformer Capability when Supplying Non-sinusoidal Load Currents
[35]	<b>WESTINGHOUSE:</b>	Koeberg Thermal Power Uprate Studies (Phase 2 Electrical Report)
[36]	<b>FRAMATOME:</b>	SGR KNPS LOT3 Package 7: Justification of Non-Reanalysis GEX Excitation Transformer
[37]	<b>GGG-1299:</b>	Guide for Technical Writing
[38]	<b>331-433:</b>	Detailed Design Review Report, (KFU-026)
[39]	<b>QFR-026:</b>	Maintenance Strategy Input Sheet
[40]	<b>KAA-913:</b>	Integrated Equipment Reliability Process

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## **2.3 Definitions**

- 2.3.1 Acceptance Criteria:** Specified limits placed on the performance, results, or other characteristics of an item, process, or service defined in codes, standards, or other requirements documents.
- 2.3.2 Certification:** The act of determining, verifying, and attesting in writing to the qualifications of personnel, processes, procedures, or items in accordance with specified requirements.
- 2.3.3 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.
- 2.3.4 Contractor:** service provider, consultant or supplier that has been deemed successful (via a tender process) to provide the required service.
- 2.3.5 Controlled disclosure:** controlled disclosure to external parties (either enforced by law, or discretionary).
- 2.3.6 Requirement:** A condition or capability needed by a user to solve a problem or achieve an objective.
- 2.3.7 Scope of Supply:** The sum of the products, services, and results to be provided as a project.
- 2.3.8 Shall, should, may:** “Shall” is used to denote a requirement, “should” a recommendation and “may” to denote permission.
- 2.3.9 System:** An interdependent group of people, objects and procedures constituted to achieve defined objectives or some operational role by performing specified functions. A complete system includes all of the associated equipment, facilities, material, computer programs, firmware, technical documentation, services and personnel required for operations and support to the degree necessary for self-sufficient use in its intended environment.
- 2.3.10 Testing:** An element of verification for the determination of the capability of an item or SSC to meet specified requirements by subjecting the item / SSC to a set of physical, chemical, environmental, accidental or operating conditions.
- 2.3.11 Trigramme:** Koeberg labelling system that consists of a unit number followed by three alphabetic characters identifying a system, followed by a three-digit number, followed by two letters (bigramme) indicating a component.

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## 2.4 Abbreviations

<b>Abbreviation</b>	<b>Explanation</b>
AR	Availability Related
DSE	System Description Manual (Dossier du Système Élémentaire)
FAT	Factory Acceptance Test
GEX	Generator Excitation System
KNPS	Koeberg Nuclear Power Station
MM	Maintenance Manual
OE	Operating Experience
OEM	Original Equipment Manufacturer
ORT	Operating at Reduced Temperature
OTS	Operating Technical Specification
QA	Quality Assurance
QADP	Quality Assurance Data Package
QC	Quality Control
QCP	Quality Control Plan
SSC	System Structure Component
SWP	Site Work Package
TRS	Technical Requirement Specification

## 2.5 Roles and Responsibilities

The Eskom-appointed Project Manager is responsible for the implementation of this specification in accordance with the project management process for Koeberg Nuclear Power Station, (KAA-501).

## 2.6 Process for Monitoring

The entire modification process from initiation to final handover is governed by KAA-501 and as such shall be used to monitor and ensure effectiveness and consistency throughout the implementation process.

## 2.7 Related/Supporting Documents

Not Applicable

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### **3. Existing Design**

The installed generator excitation system, supplies excitation current for the main generator, (GEX 001 GA) via three identical 3-phase Thyristor Bridges, (two auto-bridges and one manual bridge) that are used to produce direct current. The auto-bridge Thyristor Bridges are powered from three single phase transformers, (GEX001/002/003TR), coupled together to make a balanced three phase system. The manual-bridge Thyristor Bridge is powered from a separate 3-phase transformer.

Each of the installed excitation transformers supplying the auto-bridges are rated 28,9 kVA each or 86,7 kVA at 24kV/110V when coupled together. The primary windings of the excitation transformers are fed directly from the output of the main generator via a 24kV bus duct.

Refer to Appendix B for the basic layout of the Excitation system circuit.



**Figure 1: Existing Single Phase Excitation Transformer, (3 per unit)**

### **4. Problems with Existing Design**

The insulation of the existing excitation transformers is degraded and the transformers are suffering continuous oil leaks due to ageing and degradation of transformer material.

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## 5. Design Change Requirements

Replace the existing excitation transformers with dry type transformers. The new excitation transformers shall be capable of supplying the required ceiling current even if the stator voltage is depressed to a value of 80% Un. Ceiling current will be controlled by the excitation control system to a value of 1.6pu. Careful consideration shall be given to the electrostatic ground shielding to minimize the risk of high voltage capacitive coupling between primary and secondary windings.

The transformers shall be designed and manufactured to the appropriate k-factor rating for the Koeberg Nuclear Power Station excitation circuit requirements, (see table 1 below). [13]

<b>Converter</b>	<b>Full wave Thyristor Bridge, (6-Pulse)</b>
Exciter Voltage	467 V
Exciter Current	6029 A
Exciter ceiling Voltage	(1,54 x 467) V
Excitation Voltage	37
Excitation Current	391
Excitation Ceiling Voltage	75,5 V
Excitation Ceiling Current	803 A
Generator Power Factor	0,9
Generator Active Power	1008 MW

**Table 1:** Excitation Circuit Technical Requirements [35]

Each transformer shall be fully equipped with a minimum of two winding temperature sensors. The winding temperature signals are required for the purposes of monitoring and protection against excessive winding temperatures.

- Any 1 out of 2 high winding temperature signals shall initiate an 'ALARM' signal to the control room.
- And 2 out of 2 High winding temperature signals shall initiate a 'TRIP' signal.

Refer to the AB Schedule in Appendix A for further design change requirements.

### 5.1 Normal Environmental Conditions

Working pressure:	Atmospheric
Working temperature:	Ambient temperature not exceeding 40°C
Radiation:	Background
Humidity:	35% - 50%

### 5.2 Accident Environmental Conditions

Not Applicable.

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### **5.3 Classification**

The GEX transformers have no safety function but are essential to the Energy Availability Factor of Koeberg generating units, therefore the deterministic importance classification is as availability related, (**AR**). The Quality classification level is **Q2** in accordance with KBA 0022 D02204, [\[12\]](#)

### **5.4 General Requirements**

- 5.4.1 The Contractor shall provide a detailed design document, on the prescribed Employer template for review and acceptance. The design must describe the mechanical design, supply, installation, testing and commissioning aspects of the modified systems.
- 5.4.2 The Contractor must ensure that all design interfaces such as civil, mechanical, electrical control and measurement instrumentation connections are fully compatible with the existing plant and systems in use. Deviations shall be reported and presented to the Employer for acceptance.
- 5.4.3 The design shall comply with all references stated in this specification. The latest authorised revisions at the time of Contract award shall be used.
- 5.4.4 The equipment and components specified herein shall conform in all respects with applicable International and National laws and regulations.
- 5.4.5 As a minimum, the equipment and components specified herein shall be designed and manufactured in accordance with the edition and addenda of the codes, standards, and regulations identified in section 2.2 of this specification. The Contractor shall not adopt case rulings, code interpretations, or exceptions to requirements listed in the referenced standards unless authorized by the Employer.
- 5.4.6 The requirements of this specification shall take precedence if they are more stringent than the requirements specified in the codes, standards, and regulations
- 5.4.7 Initial design documents and drawings shall be submitted for review and acceptance by the Employer as part of the design. Manufacturing shall not proceed before these drawings are accepted.
- 5.5.9 A complete set of post manufacturing “as built” drawings shall be provided as part of the QADP.

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## 6. Quality Assurance and Inspection Requirements

### 6.1 Quality Assurance Program

- 6.1.1 The *Contractor*, and its subcontractors, shall have a Quality Management System that conforms to the applicable requirements of ISO 9001:2015.
- 6.1.2 The *Contractor* shall identify, in purchase documents to subcontractors, all applicable quality and QA requirements imposed by the *Employers* specification on the *Contractor* and shall ensure compliance thereto.
- 6.1.3 The *Contractor* shall provide Quality Control Plans (QCP's) as well as Inspection and Test Plans (ITP's) to the *Employer* for review and acceptance for various phases of all works carried out prior to commencement of the works. The *Employer* reserves the right to add hold and witness points.
- 6.1.4 The *Employer*, Quality Control (QC) representative and the *Contractor* shall review these QCP's jointly and the actual scope of quality control and inspection required for the *Contract* agreed upon.
- 6.1.5 The *Contractor* shall submit an updated copy of the QCP's and ITP's.
- 6.1.8 At least one of the *Contractor* engineering personnel required to sign as Compiler, Reviewer and Approver of documents and drawings, for the required processes in KAA-501 and 331-86, shall be a registered professional engineer or equivalent, as approved by the *Employer* in accordance with ECSA guidelines.
- 6.1.9 The Contractor is hereby informed that any work product arising from this specification may be submitted to the National Nuclear Regulator or other regulatory bodies as required by South African laws and regulations
- 6.1.10 *Contractor* personnel performing the design and installation work shall be qualified by means of formal technical qualifications and have sufficient experience with work of similar nature.
- 6.1.11 All test certificates and documentation shall be in English, using SI units.

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## **6.2 Inspections**

- 6.2.1 The *Employer* shall have the right to establish inspection and hold points for which the *Contractor* shall give advance notification. In addition, the *Employer* can establish temporary notification points to ensure resolution of temporary quality problems.
- 6.2.2 Mandatory hold points are considered to be those tests, inspections, and operations which require witnessing by the *Employer's* Quality Representative (EQR) and beyond which operations shall not proceed without written consent of the *Employer*.
- 6.2.3 Witness points are critical steps in manufacturing and testing where the *Contractor* and subcontractors are required to notify the *Employer* in advance of the activity so it can be witnessed. The *Contractor* and subcontractors can proceed with work past the activity if the EQR is not available at the designated time.
- 6.2.4 Shop inspection performed by the *Employer* shall not relieve the *Contractor* of its obligation to maintain an adequate test, inspection, and documentation program or any other obligation under this specification. Furthermore, the fact that the EQR might inadvertently overlook a deviation from some requirement of this specification shall not constitute a waiver of that requirement nor the *Contractors* obligation to correct the condition when it is discovered nor any other obligation under this specification.

## **6.3 Non-conformances**

- 6.3.1 No deviation from applicable codes and standards is acceptable. Furthermore, no deviation or departure from any requirement of this specification is acceptable without written approval from the *Employer*.
- 6.3.2 The *Contractor* shall promptly document and notify the *Employer* of all non-conformances from the specification and the *Contractor* shall document a proposed remedial action(s) to the *Employer* for acceptance.
- 6.3.3 Non-conformance shall be identified as correctable or uncorrectable. Uncorrectable non-conformances are considered to be conditions that cannot be corrected within the specification requirements by rework or replacement.
- 6.3.4 Requests for deviations from codes and standards are not permitted.
- 6.3.5 The *Employer* reserves the right to reject a component following the assessment of any Class A non-conformance.
- 6.3.6 The non-conformance register and all closed non-conformances, inclusive of all engineering work, justifications, corrective actions history, *Contractor* and *Employer* approvals, shall be part of the End of Manufacturing report.

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6.3.7 All subcontractor non-conformances shall be reported, addressed and managed as stated above.

## **7. Site Work Requirements**

### **7.1 Spares and Special Tools**

7.1.1 The *Contractor* is responsible for providing all the tools required to optimally perform the required scope of work.

### **7.2 Rigging Requirements**

7.2.1 The *Contractor* is responsible for all rigging and lifting requirements to implement the works as required in this specification.

7.2.2 All rigging and lifting operations of suspended loads shall be in accordance with and comply with requirements listed in the *Employer* Lifting and Rigging Programme.

7.2.3 The *Contractor* shall submit comprehensive Lift Plans in accordance with KSA-132 for each lift. The dimensions and masses of components / assemblies to be rigged shall be clearly indicated. The Lift Plans shall be compiled and documented in a Rigging File. Also included in the Rigging File should be the rigging personnel qualifications and certification and the rigging and lifting equipment inspection certificates.

7.2.4 The Rigging File must be submitted to the *Employer* for review and approval before any rigging and lifting activities commence.

### **7.3 Inspection and Testing Requirements**

7.3.1 The *Contractor* shall be responsible for the performance of all tests in accordance with Appendix A and other applicable Codes and Standards. The *Contractor* shall be responsible for providing all tools and facilities necessary for the performance the required tests.

7.3.3 Prior to the performance of any test, the *Contractor* shall submit copies of the test procedures to the *Employer* for review and approval. Testing shall not commence until the *Contractor* has received a copy of the procedure that has been approved by the *Employer* and all of the *Employer's* comments have been incorporated.

7.3.4 All instrumentation and equipment used for the performance of any test shall be calibrated. The calibration standard shall be traceable to the National Bureau of Standards. Furthermore, the instrumentation shall be of the appropriate range and shall be certified to have the accuracy required by the procedure. The calibration and accuracy shall be marked on the instrument, and full documentation shall be available for review.

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## 8. Commissioning and Performance Testing

### 8.1 Commissioning

- 8.1.1 It is the *Contractor's* responsibility to perform the commissioning in accordance with the agreed testing and commissioning procedures in the design document and must conform to this specification.
- 8.1.2 The *Contractor* shall submit a full commissioning plan in accordance with KFA-006 and KAA-648 and shall be submitted to the *Employer* for acceptance.
- 8.1.3 The *Contractor*, with the assistance of the *Employer's* commissioning team, is responsible for commissioning.
- 8.1.4 It is the *Contractor's* responsibility, with the assistance and input from the *Employer's* commissioning team, to establish project commissioning policies and plans which cover:
- a) Approval of commissioning programs and procedures.
  - b) The coordination of the *Contractor's* commissioning interfaces.
  - c) The scheduling and progressing of commissioning activities.
  - d) The availability of manpower, plant, material and equipment resources.
  - e) Safety assurance and statutory requirements.
  - f) The completion of contractual obligations.
  - g) Any other relevant commissioning issues.
  - h) Review and integration of the *Employer's* existing commissioning programs and procedures.
  - i) Development of appropriate check lists.
  - j) Plan, implement and control the applicable commissioning activities.
  - k) Conduct inspections necessary for the issue of a completion certificate.
  - l) Ensure that Defects are timely rectified.

## 9. Documentation

### 9.1 General

- 9.1.1 The *Employer* shall provide the *Contractor* with a sequence of drawing numbers that shall be used on any new drawings.
- 9.1.2 Drawings submitted to the *Employer* by the *Contractor* shall fulfil the *Employer* standard drawing practice as per 240-86973501.
- 9.1.3 All symbols shall be used as specified in reference KBA0000G001000.

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## **9.2 Detailed Final Design**

- 9.2.1 The *Contractor* shall provide the *Employer* with a detailed design document that includes all information relating to the design, supply, installation, testing and commissioning of the modified system as required in this specification.
- 9.2.2 It is the *Employer's* preference to concur with the scheme design (Part A) before work commences on the installation and procurement specifications (Parts B and C). This is done to ensure agreement is reached, between the *Contractor* and the *Employer* and other stakeholders, on important technical design and manufacturing aspects and to facilitate approval of the final and complete deliverable.
- 9.2.3 The *Contractor's* Detailed Design shall sufficiently address all the review comments submitted by the *Employer* before the final acceptance of the design.
- 9.2.4 The detailed design shall be presented to the *Employer's* Design Engineering (DE) Group at Koeberg. The *Employer* shall review all design and technical documents completed by the *Contractor* for acceptance and thus also reserves the right to forward any such documents to third party reviewers as part of the *Employer's* internal procedures.
- 9.2.5 For the modification, as described in this TRS, an Equipment Reliability (ER) Preventative Maintenance (PM) strategy input sheet QFR-026 must be populated by the *Contractor* in accordance with the *Employer* Integrated Equipment Reliability Process KAA-913. The *Employer* will use the populated QFR-026 form to initiate an ER change request in accordance with KAA-913.
- 9.2.6 The final design and design documents will be issued for review by the *Contractor*. Only after all review comments have been successfully resolved and the document updated will the document be accepted and signed by the *Employer*.
- 9.2.7 The *Contractor* will be informed by the *Employer* when the final design is accepted.
- 9.2.8 Manufacturing may only proceed after acceptance of the relevant design documents.

## **9.3 Calculations, Reports, Models, Drawings, etc.**

- 9.3.1 The *Employer* shall have complete and unrestricted ownership right to all calculations, technical reports, models, drawings, design documents, (except computer codes that constitute a pre-existing program or method and are designated as proprietary to the *Contractor*), procedures and other written information developed solely for the *Employer* by the *Contractor* in the course of its performance under the contract.
- 9.3.2 A complete set of post manufacturing "as built" drawings shall be provided as part of the Quality Assurance Data Package (QADP).

## **9.4 Operating and Maintenance Manual Requirements**

- 9.4.1 Installation, operation, and maintenance updates (mark-ups) contained in a maintenance manual and other relevant documents shall be submitted to the *Employer* as part of the detailed design.
- 9.4.2 The maintenance manual shall include spare lists and maintenance programs.

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## 9.5 Testing and Commissioning

9.5.1 The *Contractor* shall provide the *Employer* with a post-installation testing and commissioning plan which shall be submitted to the *Employer* as part of the detailed design.

## 9.6 Design for safety

The *Contractor* has a direct influence on safety. The *Contractor* shall provide evidence of risk assessment and mitigations to reduce the risk associated with the *Contractor* activities on Koeberg site.

## 10. Acceptance

This document has been seen and accepted by:

Name	Designation
Paul Emmanuel	Senior Advisor Electrical Maintenance Services
Bulelwa Tina	System Engineer – (GEX)
Andrias Mgulwa	Senior Engineer – (NTP Reviewer)
Thehrick Meyer	Senior Advisor - (PTM)
Noloyiso Mtoko	NTP Manager - (Functional Area Manager)
Ravid Goldstein	Design Engineering Manager – (Authoriser)
Byron Martin	Project Leader – (Nuclear Projects Management)

## 11. Revisions

Date	Rev.	Compiler	Remarks
January 2020	1	S. Linose	Original Document

## 12. Development Team

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

- Siyabonga Linose – Compiler
- Andrias Mgulwa – Reviewer

## 13. Acknowledgements

We would like to thank all the individuals who contributed with their comments through the review and acceptance process.

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**APPENDIX A**

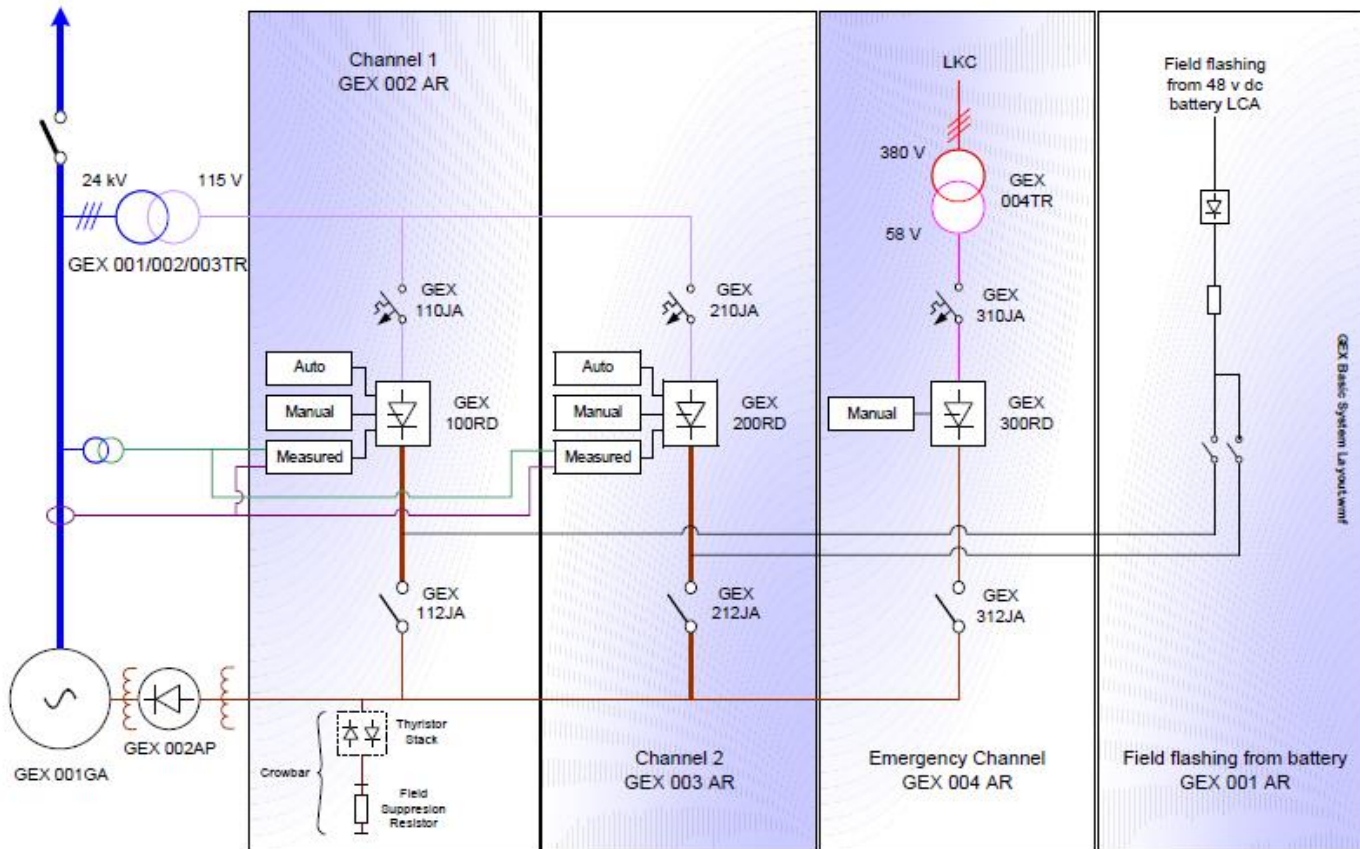
**AB-SCHEDULE:**

**See attached spreadsheet.**

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APPENDIX B

EXCITAION SYSTEM BASIC CIRCUIT :



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APPENDIX C

EXCITATION TRANSFORMER RAILS AND UNDER CARRIAGE:

The existing transformer rails and undercarriage.

Dimensions:

Track Width = 460 mm

Wheel Track = 60 mm

Wheel Diameter = 40 mm

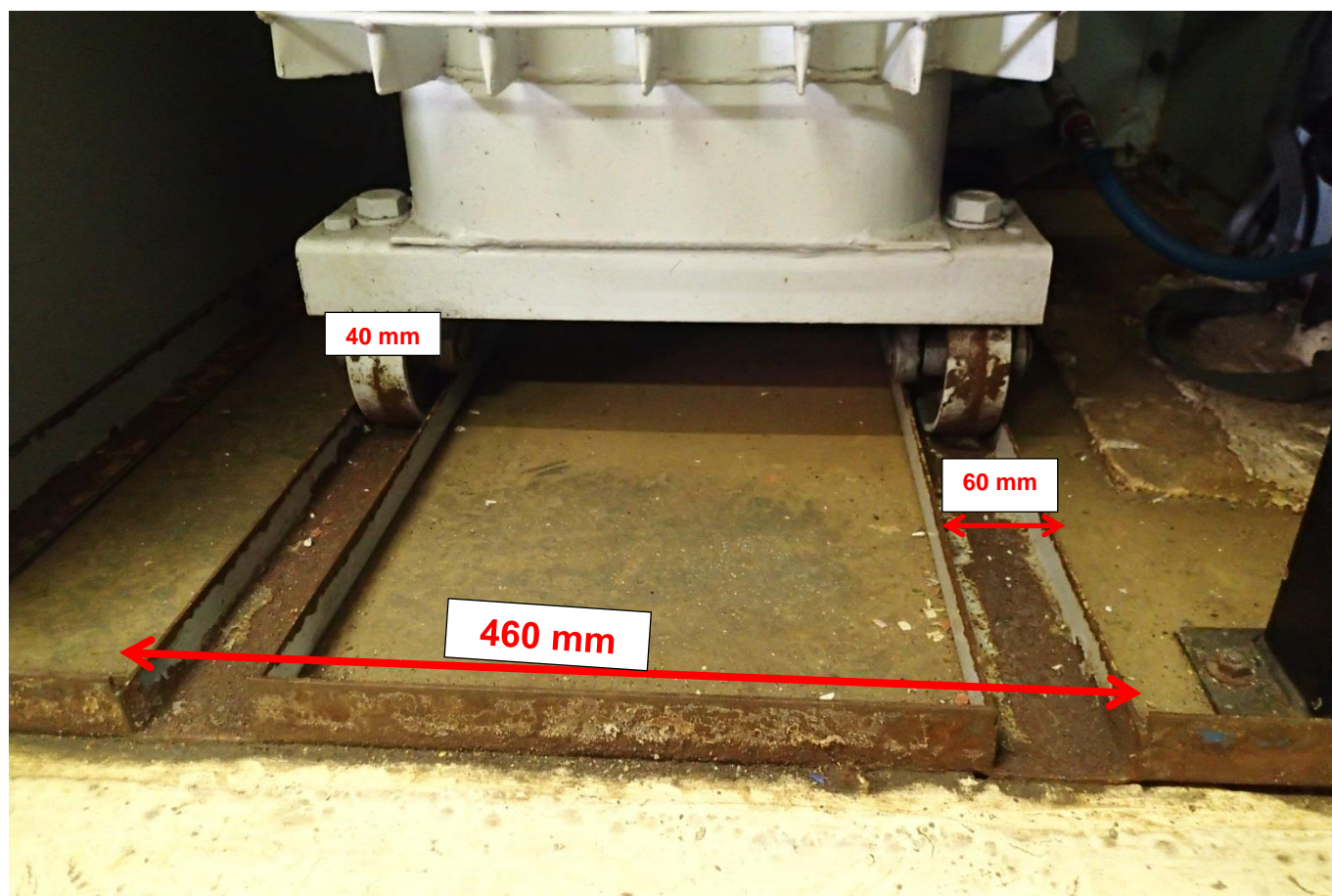


Figure 2: Rail Track of the existing Transformers

CONTROLLED DISCLOSURE

**APPENDIX D**

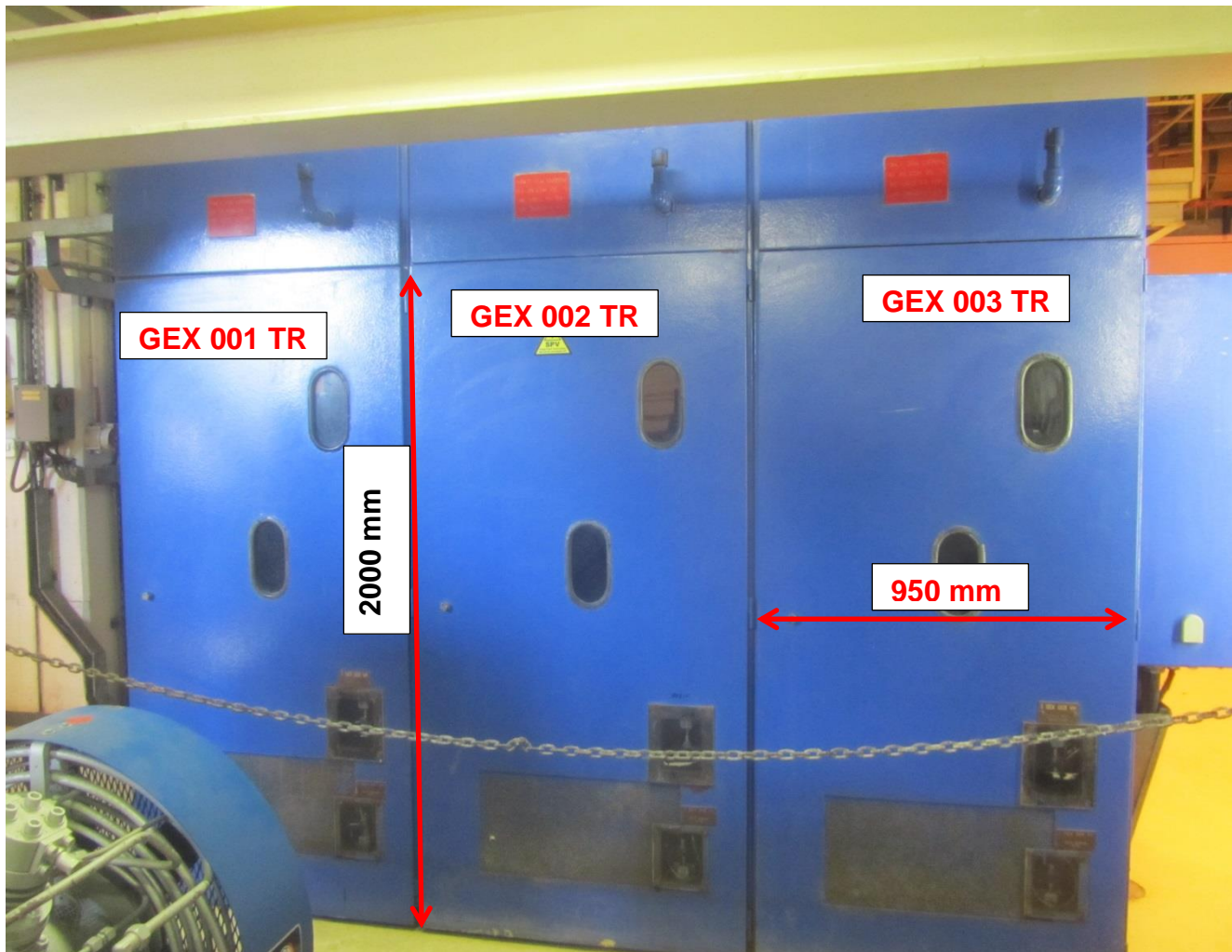
**TRANSFORMER ENCLOSURE CABINETS:**

Each transformer cubicle has the following dimensions.

Width = 950 mm

Depth = 1050 mm

Height = 2000mm



**Figure 3: Excitation Transformer Enclosure Cubicles**

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**CONCURENCE SHEET:**

**APPENDIX E**

<b>Line Group</b>	<b>Name</b>	<b>Signature</b>	<b>Date</b>
EMS	Paul Emmanuel		
ESE	Bulelwa Tina		
PTM	Thehrick Meyer		
NPM	Byron Martin		

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