Eskom	TECHNICAL REQUIREMENT SPECIFICATION	NUCLEAR ENGINEERING

Title: **Technical Requirement Specification for the Replacement of the Seismic Monitoring System**

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1. Introduction

This technical requirement specification (TRS) describes the client requirements in respect of modification number 07072. It is intended to describe the functional and technical requirements for the design, supply of material, manufacturing, delivery, removal and disposal of existing, installation, testing and commissioning of the plant change.

2. Supporting Clauses

2.1 Scope

The primary objective of the project is the replacement of the existing seismic monitoring & instrumentation system (KIS) at Koeberg Nuclear Power Station (KNPS). The scope of modification 07072 is the replacement of the solid-state electronic system, triaxial accelerometers, obsolete angular sensors and obsolete response spectrum recorder instruments with associated alarm panel, and the installation of an additional sensor at the Cask Storage Building (CSB). It comprises of the following:

- A detailed design document according to 331-86 [39] populated in the latest detailed design template available from Design Engineering,
- Supply of material,
- Manufacturing,
- Delivery to KNPS,
- Removal of existing equipment,
- Installation of new equipment,
- Testing and commissioning of the modified system or equipment,
- Interfacing requirements i.e. design, configuration and installation of the KIS system ready for KIT interfacing. This includes but not limited to physical changes, cabling, hardware, programming, testing and commissioning associated with providing such interface,
- Interfacing with KSA (control room alarms) including physical changes, cabling, hardware, configuration, testing and commissioning associated with providing such interface,
- Interfacing with existing electrical boards,
- Disposal of existing equipment,
- Any engineering studies associated with providing the scope of works,
- All documents and document updates as required by this specification,
- Qualification Documentation (e.g. environmental qualification test reports and/or seismic qualification test reports, etc.),
- Provision of design basis documents. Where design basis documents are retained by the *Contractor* or others due to propriety information and/or intellectual property, the *Contractor* shall state how Eskom access to information will be provided,
- Providing support during National Nuclear Regulator (NNR) activities,

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- Providing training for operating, maintenance and engineering staff.

The scope of supply does not include the following (*Employer* supply):

- If work is performed in the controlled zone, Eskom shall be responsible to provide rigging equipment, scaffolding and tools as available from the NAB tool store,
- The *Employer* shall make available the plant in accordance with the outage schedule,
- The *Employer* shall make available the plant for inspection walk downs in a suitable outage preceding the implementation outage,
- The *Employer* shall allow access to the KNPS main documentation centre for access and retrieval of the archived design base documentation for the purposes of the scope as defined in this TRS,
- Software updates in KIT (Ovation) shall be performed by Eskom, however, the *Contractor* shall be responsible for providing the required design documents (KIT points database forms, etc.) for Eskom to perform the software update on the KIT system,
- All Ovation hardware to fulfil Ovation requirements of the modification scope shall be provided by Eskom.

2.1.1 **Purpose**

Provision of technical requirements associated with the replacement of the existing seismic monitoring & instrumentation system (KIS) at KNPS. The upgrade of the KIS system shall resolve the obsolescence risk of the current system which is imperative for the Long-Term Operation (LTO) of KNPS.

2.1.2 **Applicability**

This document shall apply throughout Nuclear Engineering.

2.1.3 **Effective date**

This document shall be effective from authorisation date.

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] ANSI 2.2: Earthquake Instrumentation Criteria for Nuclear Power Stations

[2] ASME NQA-1: Quality Assurance Requirements for Nuclear Facility Applications

[3] IEEE 344: Seismic Qualification of Equipment for Nuclear Power Generating Stations

[4] IEEE 730: Standard for Software Quality Assurance Processes

[5] IEEE 1012: Standard for System and Software Verification and Validation

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[6] ISO 9001: Quality Management Systems Requirements

[7] NUREG 0700: Human-System Interface Design Review Guidelines

[8] OHS Act: Occupational Health and Safety Act 85 of 1993

[9] RG-0014: Guidance on Implementation of Cyber or Computer Security for Nuclear Installations

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

[11] SANS 10091: National Colour Standard

[12] SANS 10111: Engineering Drawing Principles

[13] SANS 10142-1: The Wiring of Premises Part 1: Low-voltage Installations

[14] SANS 60950: Information Technology Equipment – Safety

[15] NRC RG 1.12: Regulatory Guide: Nuclear Power Plant Instrumentation for Earthquakes

[16] NRC RG 5.71: Regulatory Guide: Cyber Security Programs for Nuclear Facilities

[17] DSG-318-033: Specification for Seismic Qualification of Electrical and Mechanical Equipment

[18] 240-121010217: Design Extension Related Guidance for Modifications and Equipment – Seismic

2.2.2 **Informative**

[19] 0406-87Q (C): Classification KIS System Instrumentation

[20] 238-102: Quality and Safety Management Requirements for Nuclear Suppliers Level 2

[21] 240-110745414: Standard for the In-Service Inspection Programme at Koeberg Nuclear Power Station

[22] 240-127002040: Procurement Quality Engineering Requirements (KSA-089)

[23] 240-142639998: Safety Evaluation Process Guide (KGA-025)

[24] 240-143604773: Safety Evaluation Process

[25] 240-55410927: Cyber Security Standard for Operational Technology

[26] 240-79669677: Demilitarized Zone (DMZ) Designs for Operational Technology

[27] 240-83539994: Standard for Non-Destructive Testing (NDT) on Eskom Plant

[28] 240-86973501: Engineering Drawing Standard

[29] 240-89294359: Nuclear Safety, Seismic, Environmental, Quality, Importance and Management System Level Classification Standard

[30] 32-6: Document and Records Management Procedure

[31] 331-170: Requirements for Protective Coatings for Use at Koeberg Nuclear Power Station (KSA-106)

[32] 331-186: Environmental Qualification at Koeberg Operating Unit

[33] 331-313: Design Field Changes

[34] 331-398: Software Listing (KLA-022)

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[35] 331-399: Software Classification

[36] 331-433: Detailed Design Review report (KFU-026)

[37] 331-83: Standard for Plant Changes Affecting the Design of Koeberg Nuclear Power Station

[38] 331-85: Design Documentation Change Process

[39] 331-86: Design Changes to Plant, Plant Structures or Operating Parameters

[40] 331-87: Design Engineering Guide

[41] 331-91: Control of Equipment and Software Classifications

[42] 331-93: Guide for Classification of Plant Components, Structures and Parts (KGA-003)

[43] 331-94: Importance Category Classification Listing (KLA-001)

[44] 335-68: Fitness for Duty Process for Contractors who are required to Perform Work Inside the Owner Controlled Area of Koeberg Nuclear Power Station

[45] CN-2234: SAR Editorial Change Request for MOD 07072

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

[47] DVC DSE: Main Electrical Building, Control Room Air Conditioning System, Chapter II, System Function

[48] DVG DSE: System Manual Charging Pumps Room Emergency Ventilation System, Chapter III

[49] DVH DSE: System Manual CRDM Power Supply Room and ASG Pump Ventilation System, Chapter III

[50] 331-645: Elastomeric Aseismic Bearings – Current Position and the Way Forward

[51] DWS DSE: System Manual Essential Service Water Pumping Station Ventilation System, Chapter III

[52] ESKASAAU7: Quality Requirements for the Procurement of Assets, Goods and Services

[53] EVR DSE: System Manual Containment Continuous Ventilation System, Chapter III

[54] GGG-1299: Guide for Technical Writing

[55] K10000663N: National Nuclear Regulator Letter dated 30 July 2012. Title: Eskom Modification Process – Updated Regulatory Requirements

[56] KAA-501: Project Management Process for Koeberg Nuclear Power Station Modifications

[57] KAA-614: Control of Spares Assessments and New Stock Applications

[58] KAA-648: Administration and Responsibilities for Requalification Testing

[59] KAA-664: Issuing a Construction Status Certificate/Safety Clearance Certificate

[60] KAA-691: Response to Seismic Events

[61] KAA-751: The Control of Chemical Products at KNPS

[62] KAA-913: Integrated Equipment Reliability Process

[63] KAA-667: Processing a Permit to Work

[64] KBA 0015 M00 0007: Technical Specifications Earthing Circuits

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[65] KBA 0000 G00 1000: Koeberg Drawing Standard
[66] KBA 0015 K08 003: Technical Specification Grouping Cabinets and Local Control Cabinets
[67] KBA 0022 N NEPO LOPP 012: KIS Plant Engineering Life of Plant Plan
[68] KBA 1222 F00 001: Equipment Marking
[69] KBA-0022-SRSM-000-00: Safety Related Surveillance Manual
[70] KBA 0117 KIS 700: 1 KIS Seismic Instrumentation Wiring Diagrams
[71] KBA 0901 G00 256: Nuclear Island Room Identification
[72] KBA 1215 K00 007: Technical Specification for Cable Installation
[73] KBA 1216 H01 251: Standards Drawings for Sensor Installation
[74] KFA-002: Nuclear Project Management Workplan
[75] KFA-006: Testing Procedure for Plant Modifications
[76] KFA–035: Design Change Package Implementation Approval Form
[77] KIS DSE: KIS System Design Manual
[78] KLA-023: Outage Preparation Milestone Checklist
[79] KNM-001: Maintenance Welding Programme
[80] KSA-011: The Requirements for Controlled Documents
[81] KSA-020: Software Quality Assurance
[82] KSA-101: Software Requirement Specifications
[83] KSA-119: Management and Control of Supplemental Workers at Koeberg Nuclear Power Station
[84] KSA-132: Lifting and Rigging Program
[85] KSA-913: Integrated Equipment Reliability Standard
[86] MM 603: KIS Maintenance Manual
[87] NSIP03959: Eskom (2022) Duynefontein Site Safety Report Rev 1
[88] OTS Rev 7: Operating Technical Specification for Koeberg Nuclear Power Station
[89] KFU-038: ER Change Request
[90] SAR Part II-1.8.3: Koeberg Safety Analysis Report – Seismic Instrumentation

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2.3 Definitions

2.3.1 **Acceptance:** The *Employer's* use of this word on the *Contractors* documentation (including drawings, procedures, schedules, and so on) means that the *Employer* has observed no deviation from the requirements of this specification. The *Employer's* acceptance does not relieve the *Contractor* of its obligation to adhere to all the requirements of this specification and all applicable laws and regulations. The *Employer's* acceptance shall not relieve the *Contractor* of any responsibility for sufficiency, accuracy, or quality of workmanship.

2.3.2 **Accepted with Comments:** Indicates that changes or clarifications are required to the document in order to satisfy the requirements of this specification or the quality expectations of the *Employer*. The Contractor is expected to incorporate the *Employer's* comments and resubmit the document to the *Employer* for acceptance prior to implementation unless specifically identified by the *Employer* as approved with comments, fabrication can proceed. The *Employer's* acceptance to proceed with fabrication does not relieve the *Contractor* of its obligation to adhere to all the requirements of this specification and all applicable laws and regulations. The *Employer's* acceptance to proceed with fabrication shall not relieve the *Contractor* of any responsibility for sufficiency, accuracy, or quality of workmanship.

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 **Cyber Security:** Cyber security is the collection of tools, policies, security concepts, security safeguards, guidelines, risk management approaches, actions, training, best practices, assurance and technologies that can be used to protect the cyber environment and organisation and user's assets. Organisation and user's assets include connected computing devices, personnel, infrastructure, applications, services, telecommunications systems, and the totality of transmitted and/or stored information in the cyber environment. Cyber security strives to ensure the attainment and maintenance of the security properties of the organisation and user's assets against relevant security risks in the cyber environment.

The general security objectives comprise the following:

- Availability,
- Integrity, which may include authenticity and non-repudiation,
- Confidentiality.

2.3.7 **Design Life:** Refers to 40 years since commissioning (1984-2024).

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2.3.8 **Design Life Extension:** Refers to an additional 20 years operation and 10 years decommissioning beyond the Design Life (up to 2054).

2.3.9 **Designer:** The Person/company responsible for the detailed design of the KIS that employs professionally registered personnel in terms of the Engineering Professions Act of South Africa (or equivalent in terms of the Washington Accord) appointed by the *Contractor* to perform the design activities required by this TRS.

2.3.10 ***Employer*:** Eskom Holdings SOC Ltd.

2.3.11 **Installer:** The person/company responsible for placing the KIS and associated equipment in place in accordance with all the design requirements.

2.3.12 **Not Accepted:** Indicates that the document as submitted does not satisfy the requirements of this specification or the quality expectations of the *Employer*. The *Employer* shall provide a reason (not necessarily specific comments) for not accepting the document. If the *Employer* requires the document, the document shall be revised and resubmitted for acceptance. The document cannot be used for fabrication until it has been dispositioned by the *Employer* as accepted or accepted with comments.

2.3.13 **Requirement**: A condition or capability needed by a user to solve a problem or achieve an objective.

2.3.14 **Scope of Supply**: The sum of the products, services, and results to be provided as a project.

2.3.15 **Shall, should, may**: “Shall” is used to denote a requirement, “should” a recommendation and “may” to denote permission.

2.3.16 **Trigramme**: KNPS 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

Abbreviation	Explanation
AR	Availability Related
DCS	Distributed Control System
DER	Design Extension Related
DMZ	Demilitarized Zone
DoS	Denial of Service
DSE	System Description Manual (Dossier du Système Élémentaire)
EOMR	End of Manufacturing Report
ER	Equipment Reliability
ERCR	Equipment Reliability Change Request
FAT	Factory Acceptance Testing
FFD	Fitness For Duty
GPS	Global Positioning System
HFE	Human Factor Engineering
HMI	Human Machine Interface
KIS	Seismic Monitoring & Instrumentation System
KIT	Computer and Data Processing System (Ovation)
KNPS	Koeberg Nuclear Power Station
LAN	Local Area Network
LOPP	Life of Plant Plan
MAC	Media Access Control
MM	Maintenance Manual
MPI	Magnetic Particle Inspection
NAB	Nuclear Auxiliary Building
NTP	Network Time Protocol
OBE	Operating Basis Earthquake
OE	Operating Experience
OEM	Original Equipment Manufacturer
OT	Operational Technology
OTS	Operating Technical Specification
PC	Personal Computer
PSR	Plant Safety Regulations
PTW	Permit to Work
RP	Responsible Person
SAT	Site Acceptance Testing
SI	International System
SR	Safety-Related
SSE	Safe Shutdown Earthquake
TCP	Transmission Control Protocol

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Abbreviation	Explanation
QA	Quality Assurance
QADP	Quality Assurance Data Package
QC	Quality Control
QCP	Quality Control Plan
TRS	Technical Requirement Specification

2.5 Roles and Responsibilities

Not Applicable.

2.6 Process for Monitoring

Not Applicable.

2.7 Related/Supporting Documents

Not Applicable.

3. Existing Design

3.1 Overview

The function of the KIS seismic monitoring system is to provide information to the operators during and after an earthquake so that a decision can be made as far as immediate and future operation of the plant is concerned.

In particular, the KIS system indicates the earthquake g level and all the information for later analysis of the behaviour of the structures and equipment.

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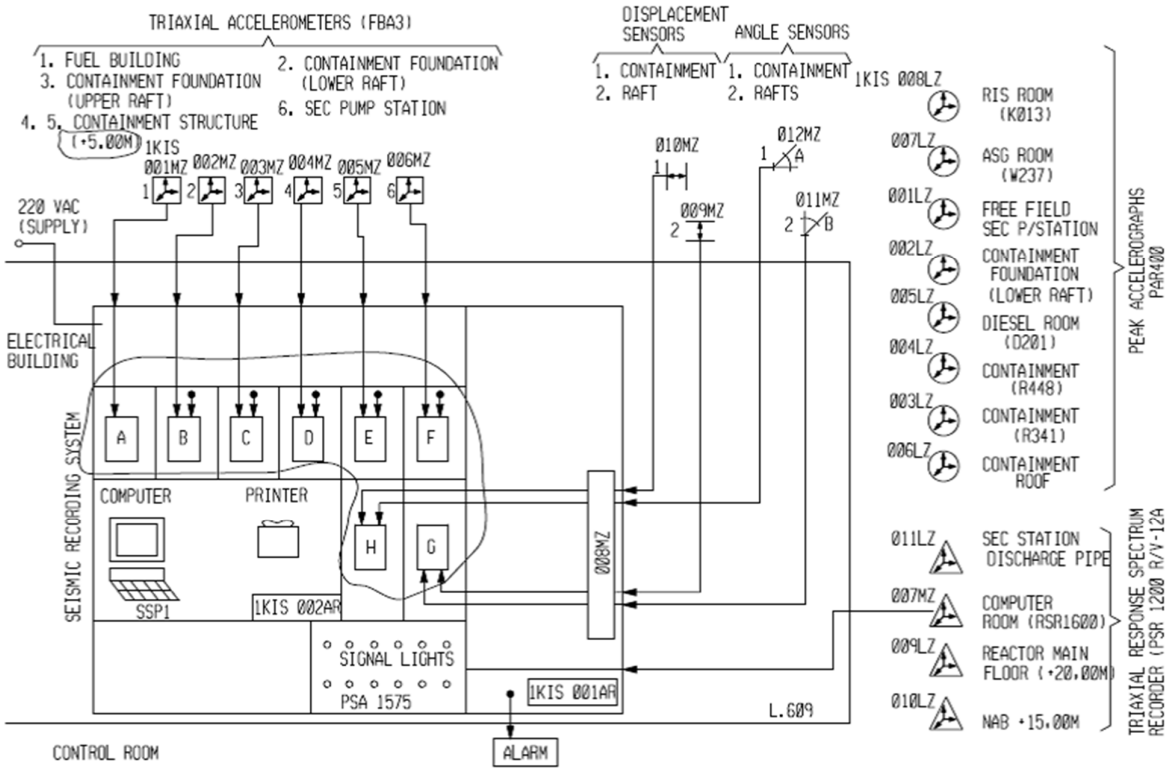

Figure 3-1 : Existing KIS System Layout

The KIS system monitors selected points on site structures and equipment to determine the magnitude of a seismic disturbance. In the event of a seismic disturbance, the system records the absolute accelerations that are experienced, for later analysis of the behaviour of the structures and equipment. The recorded information is used to decide on the immediate and future operation of the plant.

During normal plant operation the KIS system is in a quiescent state. When a pre-set acceleration value is detected, representative of an earthquake in progress, an alarm is sounded in the Unit 1 control room and the solid-state electronic system is automatically triggered. A passive (mechanical) system records peak acceleration.

Two distinctly different types of seismic monitoring sensors are used at KNPS:

- No power required:
  - PAR 400
  - PRA 103 (equivalent replacement to PAR 400)
  - PSR 1200 H/V
- Power required:
  - FBA-3
  - RSR 1600 (for annunciation purposes)
  - Linear displacement sensor

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- Angular position sensor

The sensors requiring power (with the exception of the RSR 1600) all feed a centralised cabinet 1 KIS 001 AR where their inputs are digitised and analysed. SSA-3 modules on the centralised cabinet supply the required power to the FBA-3 sensors while the Angular and Linear sensors have dedicated signal conditioning units.

The system is not safety related in terms of ANSI N 18.2.

3.2 KIS System Power Supplies

The active part of the system is powered by 220 Vac from the Unit 1 Train A essential busbar (1LMA).

The LMA switchboard is fed from the 380 V ac essential switchboard LLE, which in turn is fed from LHA. The supply is passed through a step-down single-phase transformer (380 V/220 V), which is connected directly to the LMA busbar.

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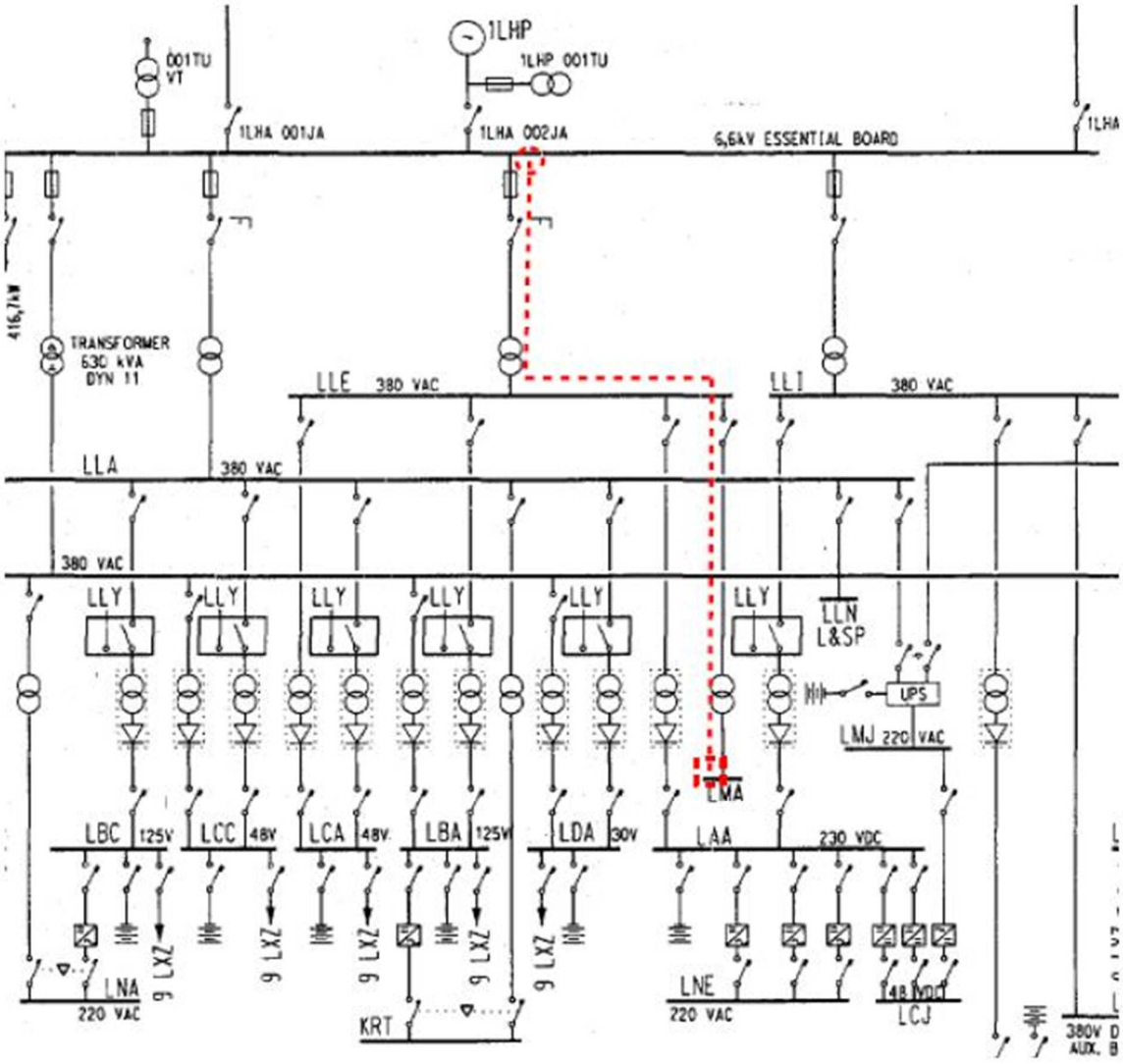

Figure 3-2 : Essential 220 V ac Supply (LMA)

3.3 Centralised Recording Cabinets (1 KIS 001 / 002 AR)

This system analyses the data acquired from the sensors (excludes the mechanical passive peak accelerometers and the response spectrum recorders) and displays all results on a single monitor.

It displays, transmits, or receives the following information:

- Displaying and transmitting of an alarm to the control room indicating a seismic event or system malfunction,
- Recording, analysis and displaying of the time history accelerometers (x6) against the design base spectrum of each measured point,

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- Recording and displaying of the linear and angle sensors. This recording must then be manually interpreted to length (mm) or degrees.

3.4 Summary of Different Sensors

3.4.1. **PAR 400:** The PAR 400 (1 KIS 001 LZ to 008 LZ) is a passive unit where permanent records are scribed by diamond styli on replaceable metal plates. The plates lie in the horizontal (North-South), transverse (East-West) and vertical axes. Information scribed on the plates is analysed after the event to determine the magnitude of the event.

Equivalency I004/18E was performed to address the obsolescence issue identified on the originally installed ENGDAHL PAR 400 peak acceleration recorder sensors. The equivalent sensor is the PRA-103, which applies a peak acceleration record by erasing pre-recorded lines on magnetic tape clips. The lines are erased by non-contact permanent stylus.

3.4.2. **PSR 1200 H/V:** The PSR 1200 H/V peak shock recorder (1 KIS 009, 010 and 011 LZ) is also a passive device requiring no power supply. Twelve reeds, per axis, of different lengths and weights, one for each frequency, are made from spring steel. A diamond tipped-stylus is attached to the free end of each reed to inscribe a permanent record of its deflection on one of twelve record plates. A calibration sheet for each recorder lists the resonant frequency and g-sensitivity of each reed. This sensor comprises of three axes, similar to the PAR 400.

3.4.3. **RSR 1600 H/V - A:** The RSR 1600 (1 KIS 007 MZ) works on the same principle as the PSR 1200 but has 16 separate channels, per axis, each tuned to a different frequency. Acceleration g forces are recorded on scratch plates. The plates are physically much smaller than those of the PSR 1200. An additional feature is that miniature contacts are fitted on each channel of the RSR 1600 such that if pre-set acceleration limits are exceeded, these contacts make and latch an indication lamp on a remote annunciator unit (PSA 1575). The annunciator is located in cabinet 1 KIS 001 AR.

3.4.4. **FBA-3:** The FBA-3 (1 KIS 001 MZ to 006 MZ) is a triaxial force balance accelerometer which measures g force in three separate planes. Horizontal, Vertical and Transverse. The device works on a variable capacitance plate principle where movement of the capacitance plates relates to g force. The device has a +/- 2,5 V output which is equivalent to +/- 1g. The resonant frequency of the circuit is 50 Hz. The output of the FBA-3 feeds an SSA-3 module in cabinet 1 KIS 001 AR. The SSA-3 module digitizes the incoming signals before passing them on to the computer for analysis.

3.4.5. **Linear Displacement and Angular Position Sensors:** These devices provide information on the possible displacement of the upper raft versus the lower raft. Two linear (1 KIS 009 MZ and 010 MZ) and two angular (1 KIS 011 MZ and 012 MZ) sensors deliver continuous measurements to corresponding signal conditioners (1 KIS 008 MZ). The signal conditioners convert the sensor signals into a compatible signal to be recorded on the SSA-3 recorders which are the same as the ones used for the FBA-3's.

Equivalency I022/08E was performed to address the obsolescence issue identified on the originally installed PENNY AND GILES linear displacement sensors (1 KIS 009 MZ and 010 MZ).

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3.5 Interventions or Modifications

3.5.1 Modifications

Table 3-1 : Modifications Completed

MOD No.	Title and description	YEAR
88129	Relocation of seismic sensor 1 KIS 007 MZ in room L709 to gain greater access to the room.	1989
91016	Replacement of the SMA-3 seismic detection system with the SSA-3 detection system due to obsolescence and operability.	1995
93066	Relocation of PAR 400 seismic sensors 1 KIS 003 and 004 LZ off the RCP pipe and motor stand to the floor.	1996
94023	Relocation of PAR 400 seismic sensors 1 KIS 007 and 008 LZ off the ASG/RIS pipes to the floor.	1996
98003	Relocation of FBA-3 seismic sensors 1 KIS 001 MZ (from MAB basement to fuel building pool), 004 MZ (from Unit 2 upper raft to Unit 1 R341) and 006 MZ (from +2,5m to basement of SEC pump house room 021).	2001
03007	Relocation of FBA-3 seismic sensor 1 KIS 006 MZ (to room 121 in SEC pump house) and PAR 400 sensor 1 KIS 001 LZ (from MAB basement to room 121).	2003

3.5.2 Equivalencies

Table 3-2 Equivalencies Completed

Equivalency / Safety Screening No.	Title and description	YEAR
I022/08E S2008-0289	**Linear Displacement Sensor** Equivalency evaluation between Penny and Giles Linear Displacement Sensor HLP 350 and proposed replacement Penny And Giles Linear Displacement Sensor SLS 320.	2008
I004/18E S2018-0127	**Peak Acceleration Recorder** Equivalency evaluation between ENGDAHL PAR 400 Peak Acceleration Recorder and proposed replacement TRANSPEAK PRA 103 Peak Acceleration Recorder.	2018

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4. Problems with Existing Design

Obsolescence is the main driving force behind the upgrade of the KIS system. Support from the OEM of the solid-state electronic system is also not guaranteed as the system has exceeded its end-of-life. The OEM for the passive system, Engdahl Enterprises, has discontinued service/running business. Life of Plant Plan (LOPP) earmarked a replacement of the system in 2010. The current system was installed in 1995.

5. Design Change Requirements

The design requirements are based on eliminating the current obsolescence from the existing KIS system, and therefore the functionality is primarily the same as the current system. A description of the existing installation, equipment and functionality is provided in Section 3.

5.1. Environmental Conditions

The KIS system shall remain operational during all plant operating states.

The centralised recording and analysing seismic equipment shall be installed in Room L609, Electrical building Unit 1.

The seismic sensors are installed in various locations within the plant. Refer to Figure 3-1 : Existing KIS System Layout.

The Angular Position and Linear Displacement sensors are installed within the seismic vault next to columns R1 and R28.

An additional seismic sensor shall be installed at the CSB to record the seismic activity where the fuel casks are stored.

5.1.1 **Centralised Recording and Analysing Seismic Equipment:**

5.1.1.1 Normal Operating Conditions **[47]**

Radiation:	Background
Pressure:	Atmospheric
Temperature:	20℃ to 24℃
Relative humidity:	45% to 55%

(**NB:** Total loss of ventilation function results in a slow temperature rise of 5℃/hr under worst conditions)

5.1.1.2 During <u>and</u> After Seismic Event **[90]**

The equipment is required to operate during and after a seismic event but not under nuclear accident conditions.

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5.1.2 Seismic Monitoring Sensors

5.1.2.1 Radiological Environment (for sensor with highest exposure)

5.1.2.1.1 Normal Operating Conditions [48][49][53]

Radiation: Yellow (>25 µSvh & <1000 µSvh)
Pressure: Atmospheric
Temperature: 15℃ to 55℃
Relative humidity: 15% to 95%

5.1.2.1.2 During and After Seismic Event [90]

The equipment is required to operate during and after a seismic event but not under nuclear accident conditions.

5.1.2.2 Marine Environment

5.1.2.2.1 Normal Operating Conditions [87]

Radiation: Background
Pressure: Atmospheric
Temperature: 2℃ to 40℃
Relative humidity: 74% to 92%

NB: *This is a highly corrosive environment.*

5.1.2.2.2 During and After Seismic Event [90]

The equipment is required to operate during and after a seismic event but not under nuclear accident conditions.

5.1.2.3 Angular Position and Linear Displacement Sensors (raft)

5.1.2.3.1 Normal Operating Conditions [50]

Radiation: Background
Pressure: Atmospheric
Temperature: 12℃ to 25℃
Relative humidity: 30% to 82%

5.1.2.3.2 During and After Seismic Event [90]

The equipment is required to operate during and after a seismic event but not under nuclear accident conditions.

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5.2 Classification

5.2.1 Component Classification

Trigramme	Item Description	Classification number	Safety Class	Seismic Class	Quality Level	Environmental Category	Importance Class
1KIS001AR	Seismic Instrumentation Cabinet	I0015/21C	NSF	1A	Q3	0	SR
1KIS001LZ	Peak Accelerometer	I0015/21C	NSF	1A	Q3	0	SR
1KIS001MZ	Triaxial Accelerometer	I0015/21C	NSF	1A	Q3	0	SR
1KIS002AR	Seismic Instrumentation Cabinet	I0015/21C	NSF	1A	Q3	0	SR
1KIS002LZ	Peak Accelerometer	I0015/21C	NSF	1A	Q3	0	SR
1KIS002MZ	Triaxial Accelerometer	I0015/21C	NSF	1A	Q3	0	SR
1KIS003LZ	Peak Accelerometer	I0015/21C	NSF	1A	Q3	1	SR
1KIS003MZ	Triaxial Accelerometer	I0015/21C	NSF	1A	Q3	0	SR
1KIS004LZ	Peak Accelerometer	I0015/21C	NSF	1A	Q3	1	SR
1KIS004MZ	Triaxial Accelerometer	I0015/21C	NSF	1A	Q3	1	SR
1KIS005LZ	Peak Accelerometer	I0015/21C	NSF	1A	Q3	0	SR
1KIS005MZ	Triaxial Accelerometer	I0015/21C	NSF	1A	Q3	1	SR
1KIS006LZ	Peak Accelerometer	I0015/21C	NSF	1A	Q3	0	SR
1KIS006MZ	Triaxial Accelerometer	I0015/21C	NSF	1A	Q3	0	SR
1KIS007LZ	Peak Accelerometer	I0015/21C	NSF	1A	Q3	0	SR
1KIS007MZ	Response Spectrum Recorder	I0015/21C	NSF	1A	Q3	0	SR
1KIS008LZ	Peak Accelerometer	I0015/21C	NSF	1A	Q3	0	SR
1KIS008MZ	Signal Conditioning Module	I0015/21C	NSF	1A	Q3	0	SR
1KIS009LZ	Response Spectrum Recorder	I0015/21C	NSF	1A	Q3	1	SR
1KIS009MZ	Linear Displacement Sensor	I0015/21C	NSF	1A	Q3	0	SR
1KIS010LZ	Response Spectrum Recorder	I0015/21C	NSF	1A	Q3	0	SR
1KIS010MZ	Linear Displacement Sensor	I0015/21C	NSF	1A	Q3	0	SR
1KIS011LZ	Response Spectrum Recorder	I0015/21C	NSF	1A	Q3	0	SR
1KIS011MZ	Angular Position Sensor	I0015/21C	NSF	1A	Q3	0	SR
1KIS012MZ	Angular Position Sensor	I0015/21C	NSF	1A	Q3	0	SR

5.2.2 Parts Classification

Trigramme	Item Description	Classification number	Safety Class	Seismic Class	Quality Level	Environmental Category
1KIS001AR	Electronic parts	I0016/21C	NSF	1	Q4	0
1KIS001LZ	Magnetic tape clips-KIS 001,002,005,006,007&008 LZ)	I0016/21C	NSF	1	Q4	0
1KIS002AR	Electronic parts	I0016/21C	NSF	1	Q4	0
1KIS003LZ	Magnetic tape clips-KIS 003 LZ and KIS 004 LZ	I0016/21C	NSF	1	Q4	1

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5.2.3 Software Classification

Software	Classification number	Safety Class	Quality Level	Importance Class
KIS 001/002 AR	S0012/021C	NSF	Q3	NSA

5.2.4 Design Engineering Service Classification

Services	Classification number	Quality Level	Importance Class	RD-0034 Level
Design service	D0017/21C	Q3	SR	L2

5.3 General Requirements

5.3.1. The *Contractor* shall provide a detailed design for the KIS system at KNPS, in accordance with KNPS procedure 331-86 [39]

5.3.2. The KIS system shall comply with nuclear industry regulations USNRC RG 1.12, IEEE 344 and ANSI/ANS 2.2.

5.3.3. The design shall describe the concept design, supply, installation, testing and commissioning aspects of the modified systems and shall be on the prescribed *Employer* template.

5.3.4. The KIS system shall comply with this TRS and all documents listed in section 2.2.1. The latest authorised revisions at the time of Contract award shall be used.

5.3.5. The KIS system shall be seismically qualified and shall envelope the seismic qualification of the plant (see DSG-318-033 [17] and 240-121010217 [18]).

5.3.6. The KIS system sensors shall be physically protected against external factors such as bumping, flooding etc.

5.3.7. 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 this specification. The *Contractor* shall not adopt case rulings, code interpretations, or exceptions to requirements listed in the referenced standards unless authorised by the *Employer*.

5.3.8. The requirements of this specification shall take precedence if they are more stringent than the requirements specified in the codes, standards, and regulations.

5.3.9. The modification shall not introduce additional risks to personnel or plant integrity. The requirements of the Occupational Health and Safety Act (85 of 1993) [8] and Eskom's lifesaving rules shall be complied with by the *Contractor's* staff at all times.

5.3.10. If any conflict arises between this TRS and other referenced documents, the *Contractor* shall not proceed and request clarification, in writing, from the *Employer.*

5.3.11. Initial design 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.

5.3.12. A complete set of post manufacturing "as built" drawings shall be provided as part of the QADP.

5.3.13. The *Contractor* shall verify, by performing a detailed plant walk down before using the information, that the existing documentation represent the actual plant design layout. Any

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deviation shall be reported to the *Employer*. Inconsistencies shall be corrected through a revision of the documentation by the *Contractor*.

5.3.14. P&IDs shall be comprehensively updated or new drawings with unique identifiers shall be issued to the *Employer* on the prescribed drawing template.

5.3.15. In the interests of maintaining a safe working environment, installed equipment should be chosen to minimise employee's exposure to noise. Installed equipment should produce noise levels less than 85 dB(A). Where it is impractical to do so, control measures should be designed to reduce such noise levels to below 85 dB (A).

5.3.16. In order to simplify spares holding and staff training requirements, any new equipment introduced to the power plant should as far as possible be standardised with existing equipment. Lists of existing plant equipment that may relate to this modification are available from Eskom on request.

5.3.17. The *Contractor's* Scope includes the work and services which, although it may not be expressly noted herein, can reasonably be inferred from the *Employer's* Specifications, the only exclusion being that which are specifically stated to be excluded or otherwise to be provided by the *Employer* or Others.

5.3.18. The new KIS system shall use the latest technology that has a proven track record and is in line with the latest international trends. In addition, the new system should provide system enhancements and utilise operating practices that promote:

- General ease-of-use,
- History of system interventions and alarm fault logging,
- Security levels to prevent unauthorised setting changes,
- Testing and calibration functions,
- Indication of the inhibited or faulted channels,
- Continuous system health monitoring,
- Self-fault diagnostic capability.

5.3.19. All equipment installed shall have a 40-year life supported by the supplier/manufacturer.

5.3.20. The *Contractor* shall specify the maintenance and calibration requirements.

5.3.21. The *Contractor* shall provide a list of recommended spares, as well as a list of critical spares to maintain the system. Each list shall include relevant OEM part numbers for procurement purposes.

5.3.22. The *Contractor* shall include in the scope of supply such spares necessary to maintain the system in the short term of 2 years after installation.

5.3.23. Existing components (i.e. cabling, sensors, etc.) that are current and compatible with the new system and not at risk of becoming obsolete within the foreseeable future shall be re-used.

5.3.24. All equipment marking and identification shall be in accordance with the relevant KNPS standards [68].

5.3.25. Any equipment that does not have specific packaging, shipping, receiving, storage and handling requirements covered by a specification shall comply with ASME NQA 1 Subpart 2.2.

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5.3.26. Equipment shall be under the supervision and insurance of the *Contractor* during all stages of packaging and shipping of the equipment.

5.3.27. No shipment of equipment shall take place without an associated factory release authorised by Eskom or its appointed representative.

5.3.28. The *Contractor* shall ensure that the manufacturer's recommendations regarding shipping and packaging are adhered to. The *Contractor* shall advise Eskom of any special provisions regarding storage.

5.3.29. The KIS system is designed in full compliance with standard ISO 9001 [6].

5.3.30. The design shall include:

5.3.30.1 Calculations and justifications showing that the design meets the modification objectives.

5.3.30.2 Specifications for installed items.

5.3.30.3 Updating of all affected existing KNPS documentation to reflect the new installations, including, but is not limited to:

a. DSE documents,

b. Electrical and Instrumentation documents, including, but not limited to, drawings, diagrams and isometrics,

c. Specifications,

d. Maintenance documents,

e. Safety analysis reports,

f. Operating technical specifications,

g. Procedures,

h. Licensed documents,

i. Programmes.

5.3.31. The design shall in all respects comply with the requirements of SANS 10142-1: The wiring of premises Part 1: Low-voltage installations [13].

5.3.32. Where the *Employer* has provided design requirements and a contradiction occurs, the most stringent requirement applies.

5.3.33. All documentation, as specified herein, forms part of the services and is supplied to the Project Manager by the *Contractor*. The *Employer* reserves the right to issue the *Contractor's* design or drawings to other contractors for purposes of construction, erection, maintenance, spares, verifications, modifications in future or any other purposes required by the *Employer*. The *Employer* has total rights to use the design as the *Employer* requires. The *Contractor* notes that all drawings and other documentation supplied to the *Employer* become the property of the *Employer* upon completion of the services.

5.4 Functionality

The new KIS system shall provide at least all the functionality of the existing installation as described in Section 3.

The following components of the KIS system are to be considered in the scope of the upgrade.

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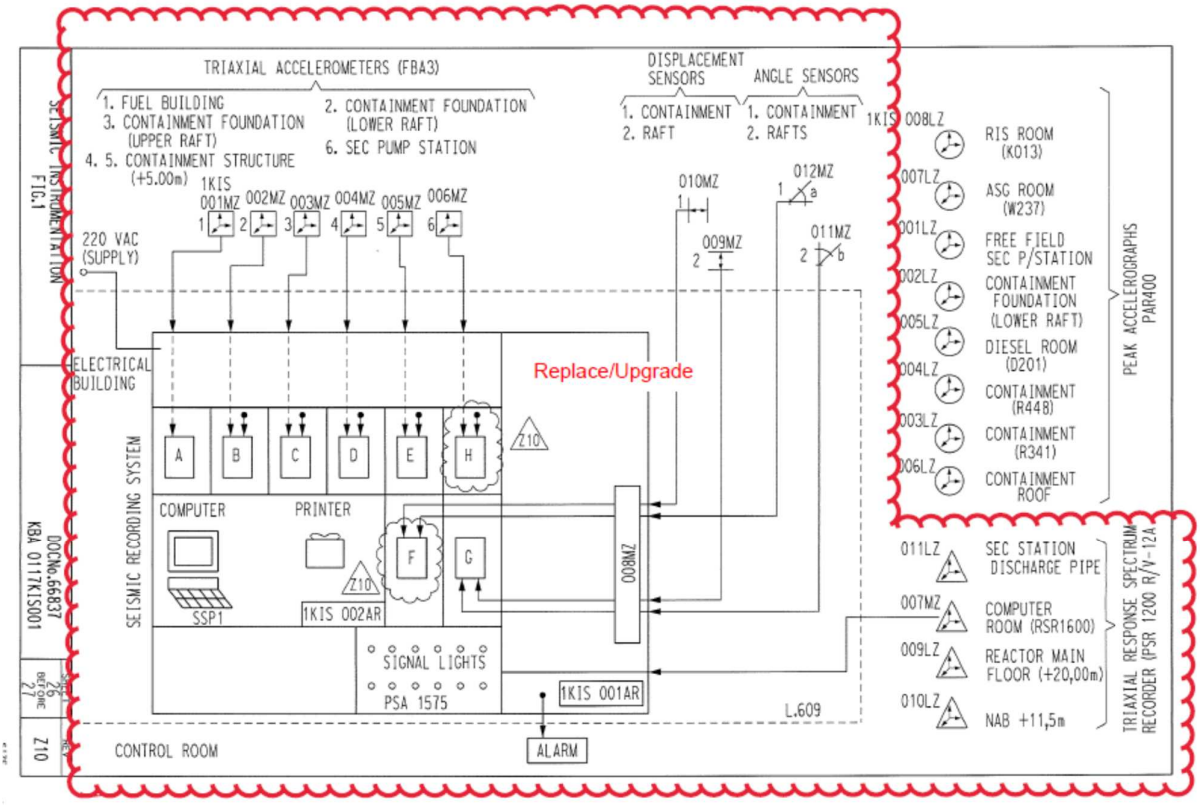

Figure 5-1 : KIS System Upgrade Scope

5.4.1 **Centralised Recording Cabinets**

Refer to Section 3.3 for information on existing design.

5.4.1.1. The cabinets housing all the equipment shall fit within the following spaces respectively: 700 x 1100 x 2280 (mm) (WxDxH) and 700 x 1100 x 1920 (mm) (WxDxH). The existing cabinets are 585 x830 x 2280 (mm) (WxDxH) and 585 x 815 x 1400 (mm) (WxDxH).

5.4.1.2. Castor wheel interface points shall be designed on the base of the new cabinet frame to allow for the attachment of temporary castor wheels for easy manoeuvring of new equipment during installation. The supply of the castor wheels shall be in the scope of the *Contractor*.

5.4.1.3. The cabinets shall be able to be tilted horizontally while being transported on the site for installation.

5.4.1.4. These cabinets shall be equipped with the latest technology components. An industrial PC with a printer shall be provided by the *Contractor* with the following:

5.4.1.4.1. The necessary software providing the capability of computing and displaying the response spectra for each monitored location, for each axis together with the trigger-and OBE/SSE alarm levels.

- Calculation and presentation of the cumulative absolute velocity (CAV) from each triaxial accelerometer.

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- All recordings and displaying of measurements shall be done using the appropriate SI unit (g, degrees, or mm). If the measurements in g, degrees, or mm cannot be displayed, detail shall be provided on how these measurements will be presented.
- A licensed client copy of the analysis software package shall also be provided for installation on a remote Engineering workstation.
- This software package shall also have the functionality of simulating a seismic event which will be utilised for training purposes.

5.4.1.4.2. A dual redundant communication ports to interface KIS with the station DCS system (Ovation) using MODBUS TCP protocol over Ethernet.

5.4.1.4.3. Capable of adjustable pre and post recording times of a seismic event, at a minimum, 60 seconds of low-amplitude motion prior to seismic trigger actuation and a minimum of 60 seconds beyond the last exceedance of the seismic trigger threshold.

5.4.1.4.4. Capability to link to the station GPS clock system to provide time synchronisation using NTP over Ethernet.

5.4.1.4.5. The recorders shall have a battery backup supply of 24 hours minimum. The UPS rating to the analysis station shall be at least 30 minutes.

5.4.1.4.6. The recorder shall have an expansion/spare capacity for 4 additional sensors.

5.4.1.4.7. Capability to download recorded data for remote analysis.

5.4.2 **Linear Displacement Sensors**

Refer to Section 3.4.5 for information on existing design.

5.4.2.1. These sensors shall be replaced with similar specified and qualified components.

5.4.2.2. The signal conditioning unit is obsolete and shall be replaced.

5.4.3 **Angular Position Sensors**

Refer to Section 3.4.5 for information on existing design.

5.4.3.1. These sensors together with its signal conditioning units are obsolete and shall be replaced with similar specified and qualified components.

5.4.4 **Time History Triaxial Accelerometers**

Refer to Section 3.4.4 for information on existing design.

5.4.4.1. These sensors shall be replaced with sensors that satisfy nuclear industry regulations USNRC RG 1.12, IEEE 344 and ANSI/ANS 2.2.

5.4.5 **Peaking Accelerometers (PAR 400 and PRA 103)**

Refer to Section 3.4.1 for information on existing design.

5.4.5.1. These sensors are not within the scope of this project.

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5.4.6 Triaxial Response Spectrum Recorder (PSR 1200 and RSR 1600)

Refer to Section 3.4.2 and 3.4.3 for information on existing design of PSR 1200 and RSR 1600, respectively.

5.4.6.1. The existing sensors together with associated PSA 1575 warning light panel in 1 KIS 001 AR are obsolete and shall be replaced.

5.4.6.1.1. The sensors 1 KIS 007 MZ, 009 LZ, and 010 LZ shall be replaced as follows:

a. These sensors shall each be replaced with a standalone time history triaxial accelerometer with local recorder, powered by a stable and reliable power supply,

b. These sensors shall remain operationally independent of the centralised solid state seismic monitoring system of 1 KIS 001 AR,

c. These sensors' statuses, including but not limited to, the exceedance of preset thresholds and health status shall be annunciated in the centralised cabinet 1 KIS 001 AR,

d. A touch screen computer with application software loaded shall be installed at or in close proximity of each sensor to view and download recorded data in-situ,

e. Each sensor/recorder/touch screen shall have at least a 1-hour battery backup supply,

f. The capability to download recorded data for remote analysis shall be included,

g. These sensors do not have to meet the requirements of Section 5.4.4.

5.4.6.2. The sensor 1 KIS 011 LZ, located at an elevation in a seismic category 1 structure where the response is different to that of the containment structure, shall be replaced as follows:

a. This sensor shall be replaced with a time history triaxial accelerometer and be recorded in the centralised cabinet 1 KIS 001 AR,

b. This sensor shall meet the requirements of Section 5.4.4.

5.4.6.3. An additional time history triaxial accelerometer shall be installed in the CSB to record the seismic activity where the fuel casks are stored.

a. This sensor shall be a time history triaxial accelerometer and be recorded in the centralised cabinet 1 KIS 001 AR,

b. This sensor shall meet the requirements of Section 5.4.4.

5.4.7 Interfaces

5.4.7.1. The *Contractor* shall ensure that all design interfaces are fully compatible with the existing plant and systems in use. Deviations shall be reported and presented to the *Employer* for acceptance.

5.4.7.2. The existing interfaces of the KIS system with other plant systems shall be retained. In particular, the interface with the Unit 1 control room alarm [70], KIT system and KNPS database (InSQL) shall be maintained.

5.4.7.3. The seismic event alarm signal, 1 KIS 001 IA, shall be recorded on the KIT system as a KIT digital input (EC).

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5.4.7.4. Existing interface with electrical boards is to be maintained as far as possible. The electrical load on the affected electrical board and circuit shall be re-evaluated. Volt drop requirements between point of supply and loads shall be adhered to.

5.4.7.5. The design shall evaluate the possibility of reusing existing cabling.

5.4.7.6. Input and output signals shall be compatible with the requirements of the KIT system.

5.4.7.7. The data generated by the instrumentation shall be accessible and be stored as historical data.

5.4.7.8. The control system and instrumentation shall not cause electrical interference and/or signal distortion.

5.4.7.9. The new system shall be capable of continuously monitoring the system state-of-health (functionality of the whole measuring chain including sensors, cables, recorders and the centralised cabinet) and issue an alarm any time an error occurs.

5.5 Testing

5.5.1. The *Contractor* shall be responsible for the performance of all tests in accordance with applicable Codes and Standards plus all additional requirements specified herein. The *Contractor* shall be responsible for furnishing all facilities necessary for the performance of such tests.

5.5.2. The *Contractor* shall be responsible for the performance of factory acceptance test (FAT) and site acceptance test (SAT).

5.5.3. The *Contractor* shall produce full FAT and SAT procedures.

5.5.4. Prior to the performance of any test, the *Contractor* shall submit copies of the FAT and SAT 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.

5.5.5. Testing milestones shall include FAT and SAT.

5.5.6. The *Contractor* shall invite the *Employer* to witness any testing being performed. Sufficient notice shall be provided to the *Employer* to accommodate this.

5.5.7. All Non-Destructive Testing (NDT) done shall comply with the following *Employer* standard:

a) 240-83539994: Standard for Non-Destructive Testing (NDT) on Eskom Plant [27].

5.5.8. 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.

5.5.9. Material test certification and reports as specified in this specification shall be included as part of the End of Manufacturing Report (EOMR).

5.5.10. The following tests shall be required as a minimum for all material supply:

a) Chemical analysis,

b) Tensile testing. This is not required at temperature unless the applicable material or design code requires it,

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c) Ultrasonic testing as required by material code,

d) Liquid penetrant testing or magnetic particle inspection (MPI) testing.

5.6 Installation

5.6.1 The design shall consider all installation-related constraints.

5.6.2 The Permit to Work (PTW) to perform/supervise work is completed by a responsible person (RP), supplied by the *Contractor* in accordance with the *Employer*'s plant safety regulation (PSR) procedures.

5.6.3 PTWs are raised and processed in accordance with the *Employer* procedure KAA-667 [63].

5.6.4 The *Contractor* shall ensure that mitigations are in place that will minimise the installation time to comply with OTS requirements [88] regarding inoperability of instrumentation channels.

5.6.5 The *Contractor* is responsible for the successful installation of the new KIS system. This includes but is not limited to:

5.6.5.1 The preparation of installation and verification procedures,

5.6.5.2 The identification and disconnection of cables connected to the old equipment to be dismantled,

5.6.5.3 The identification, dismantling and removal of the obsolete equipment to the scrap yard. (Eskom shall be responsible to transport the equipment off site),

5.6.5.4 Supply of the installation and assembly on site,

5.6.5.5 Supply of new cabling and connections between the new pieces of equipment and plant interfaces,

5.6.5.6 The installation and connection of new cables connected to the cabinets of the *Contractor's* supply,

5.6.5.7 Wire-to-wire verification of new and existing cables,

5.6.5.8 The *Contractor* shall provide all the required material.

5.7 Commissioning

5.7.1. It is the *Contractor's* responsibility to perform the commissioning in accordance with the approved commissioning procedures in the design document and conform to this specification.

5.7.2. The *Contractor* shall produce a comprehensive testing and re-qualification procedure of the proposed KIS system. The purpose of the testing will be to verify correct operation as per the design.

5.7.3. The *Contractor* shall provide all the test equipment for testing, the sub-assemblies and the functional groups for site testing, commissioning and performance testing.

5.7.4. The *Contractor* shall submit a full commissioning plan in accordance with KFA-006 [75] and KAA-648 [58] and shall be submitted to the *Employer* for acceptance.

5.7.5. The *Contractor*, with the assistance of the *Employer's* commissioning team, is responsible for commissioning.

5.7.6. 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:

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5.7.6.1 Approval of commissioning programs and procedures,

5.7.6.2 The coordination of the *Contractor's* commissioning interfaces,

5.7.6.3 The scheduling and progressing of commissioning activities,

5.7.6.4 The availability of manpower, plant, material and equipment resources,

5.7.6.5 Safety assurance and statutory requirements,

5.7.6.6 The completion of contractual obligations,

5.7.6.7 Any other relevant commissioning issues,

5.7.6.8 Review and integration of the *Employer's* existing commissioning programs and procedures,

5.7.6.9 Development of appropriate check lists,

5.7.6.10 Plan, implement and control the applicable commissioning activities,

5.7.6.11 Conduct inspections necessary for the issue of a completion certificate,

5.7.6.12 Ensure that Defects are timely rectified.

5.7.7. The commissioning of the new KIS system includes but is not limited to the following:

5.7.7.1. Applying power to the various pieces of equipment that make up the supply,

5.7.7.2. Start-up of the sub-assemblies of the supplied equipment,

5.7.7.3. Individual checking and testing of these sub-assemblies,

5.7.7.4. Setting up, calibration and adjustment of equipment,

5.7.7.5. Functional tests on the new KIS system,

5.7.7.6. Performance tests on site,

5.7.7.7. The alarm to the control room is checked for correct output and compared to the plant computer (KIT),

5.7.7.8. Verification of equipment and validation of test procedures,

5.7.7.9. Provision of test reports.

5.8 Maintenance

5.8.1. Maintenance requirements for the KIS system shall be minimised and shall consider access constraints due to location of components and possess the following characteristics:

a. Accessibility,

b. Modular system construction, expandability and standardised system configuration and hardware,

c. Supports on-line maintenance,

d. Diagnostic tools and the easy identification of faults,

e. Within the design requirement limits, environmental conditions should not increase maintenance requirements,

f. The maintenance regime shall be achievable within KNPS's planned maintenance and outage programs.

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5.8.2. The *Contractor* shall supply all special tools and equipment required to perform the prescribed maintenance on the proposed KIS system, taking into account that certain testing equipment, e.g. tilting tables will be used within the controlled zone and outside of the controlled zone respectively.

5.9 Cyber Security

5.9.1. The system shall be tested for cyber security invasion, anti-virus protection, and prevention of unauthorised access to the computer system and terminals.

5.9.2. A list shall be compiled of all MAC addresses.

5.9.3. All servers shall be configured in such a way that all brute force attacks and all multiple single password attempts shall be logged.

5.9.4. “Backdoor”. The developer shall agree to disclose all backdoors created for software testing purposes, or any other purpose, with an understanding to remove all backdoors before commissioning. Eskom shall deem the non-disclosure or non-removal of these backdoors as hostile and shall take appropriate action.

5.9.5. All data tables and data objects shall be accessible through the normal Database Management System (DBMS) functionality, i.e. no private or proprietary tables and / or objects shall be used.

5.9.6. Each user shall have a unique account on the system, (i.e. username and password).

5.9.7. User account passwords shall be in line with Eskom standards on passwords for OT systems in accordance with 240-55410927 [25].

5.9.8. System administrator shall have the ability to be able to create, disable, and remove user accounts as need be, however changes to this degree shall also be logged in an unaltered file for auditing purposes.

5.9.9. Inactive user accounts shall automatically be disabled after a reasonable specified time.

5.9.10. User accounts shall automatically be locked if there are multiple failed login attempts, which shall be logged for retrieval.

5.9.11. Users shall not have any access to functionality other than that required to perform their duties.

5.9.12. The interface shall perform under all expected operating conditions, irrespective of server load, network load or any other condition normally expected of a system of this nature.

5.9.13. The system shall automatically recover from any loss in communication between any of its components and external interfaces.

5.9.14. All actions of users shall be logged with full detail of their action. The logs must also indicate values before and after actions, and these logs shall be used for auditing purposes.

5.9.15. All non-used ports on network devices shall be blocked electrically and physically.

5.9.16. All network equipment shall keep a log of events and changes to their configurations.

5.9.17. All devices shall operate on static IP addresses.

5.9.18. A list shall be compiled of all IP addresses.

5.9.19. Unused IP address shall be blocked on the system and shall have to be manually unblocked.

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5.9.20. There shall be a single connection to the Eskom business LAN. The connection shall not be a direct connection, but run through a DMZ connection as described in 240-79669677 Demilitarised Zone (DMZ) Design for Operation Technology [26], section 3.1.1 which shall be used for the network design.

5.9.21. There shall be a hardware, firmware, and software configuration management program proposed which shall form part of the NOU processes for updating digital systems.

5.9.22. A program shall be developed on how software will be updated.

5.9.23. A program shall be developed on how the system will be backed up. If the backup is to be stored at a non-secure location then the backup shall be encrypted.

5.9.24. Disaster recovery and contingency plans must be developed and tested where possible.

5.9.25. No data should be stored on portable devices. If such data does need to be stored on the system then all the data shall be encrypted.

5.9.26. The system shall have malware protection software and there shall be a program for updating this software, Windows updates and Antivirus software shall be covered.

5.9.27. The system shall detect and manage a DoS attack automatically.

5.9.28. The system shall have intrusion detection and prevention software.

5.9.29. All cabinets and equipment boxes shall have physical access control. Physical locks on the system cabinets shall be different from other systems on the site.

5.9.30. All unused ports on computers and servers shall be disabled in software and physically disabled for use.

5.9.31. The system shall be designed to handle the loss of environmental control for durations as defined in the detailed design.

5.9.32. The protocols used on the network shall be encrypted.

5.9.33. The systems shall perform integrity checks and data flow controls on all data in the network.

5.10 Service Life

5.10.1. The KIS system shall have a design life sufficient for the remainder of the design life of the plant, including the life extension time frame, i.e. the system shall have a service life of at least 40 years.

5.10.2. Maintenance requirements, to achieve the 40 year service life, shall be identified. (Refer to Section 5.8 for Maintenance Requirements).

5.10.3. The KIS system shall use equipment that will as far as possible negate the likelihood of obsolescence during the 40-year service life.

5.10.4. A list of spares that are deemed important to ensure the 40-year life span of the KIS system shall be included in the design.

5.10.5. Operating and lifetime cost shall be minimised.

5.11 Engineering and Implementation Strategy

The Engineering and Implementation Strategy clearly shows how the *Contractor* plans to deliver the services. This plan is submitted as part of the tender and shall be resubmitted according to the accepted programme after Contract award to the *Employer* for his acceptance.

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As a minimum, the Engineering and Implementation Strategy shall elaborate on the following:

5.11.1. A design and implementation narrative demonstrating how the *Contractor* plans to carry out the services and meet the *Employer's* requirements,

5.11.2. A detailed list with accompanying descriptions of the services, including, but not limited to:

5.11.2.1. Setting out the boundaries of the technical effort,

5.11.2.2. Possible challenges or risks with regard to the services,

5.11.2.3. Design interfaces.

5.11.3. A list of exclusions and deviations from the scope. This list explains the proposed exclusion/deviation, the rationale for the exclusion/deviation, any technical data supporting the exclusion/deviation and historical experience supporting the exclusion/deviation,

5.11.4. A risk register which addresses the key risks and constraints of the scope. The register includes a clear description of the risk, the root cause, a risk ranking and a mitigation plan, including a rating on the effectiveness of the mitigation plan,

5.11.5. A programme, listing all the various components of the services, with associated durations and respective accountable persons,

5.11.6. Engineering design team list and organogram,

5.11.7. A description of the tools and systems that will be used to carry out the engineering design work,

5.11.8. How training will be carried out.

5.12 Equipment Qualification Requirements

The *Contractor* shall supply a quality assurance data package (QADP) for the replacement of the KIS system.

The QADP shall include, but not limited to, the following documentation:

5.12.1. Certificate of conformance,

5.12.2. Certificate of manufacture,

5.12.3. Completed and signed-off FATs and SATs,

5.12.4. Copy of Eskom order,

5.12.5. Copy of the specifications,

5.12.6. Manufacturing QCP,

5.12.7. Material certificates,

5.12.8. Welder qualification and certificates,

5.12.9. Weld qualifications,

5.12.10. NDE/NDT reports,

5.12.11. Eskom waivers (if applicable),

5.12.12. Non-conformance reports,

5.12.13. Final supplier QA release,

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5.12.14. Seismic qualification report,

5.12.15. Installation QCP,

5.12.16. End of Manufacturing Report.

6. Quality Assurance and Inspection Requirements

6.1 Quality Assurance Program

6.1.1. The engineering classification assigned to the works is contained in Section 5.2. The *Contractor* shall implement and maintain a Quality Management System (QMS) that complies with the Eskom's Quality Specification DSG-318-087 [46].

6.1.2. The *Contractor's* QMS shall be certified to ISO 9001:2015 and is subject to review and acceptance by the *Employer*.

6.1.3. 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.

6.1.4. 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.

6.1.5. The *Contractor's* QCP for the installation of the new KIS system shall be based on proven OE.

6.1.6. Installation of the new KIS system shall be done by the *Contractor* or Sub-Contractor with verifiable experience.

6.1.7. The *Employer*, the *Employer* Quality Control (QC) representative and the *Contractor* shall review these QCP's/ITP's jointly and the actual scope of quality control and inspection required for the *Contract* agreed upon.

6.1.8. The *Contractor* shall submit an updated copy of the QCP's and ITP's.

6.1.9. 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 [56] and 331-86 [39], shall be a registered professional engineer or equivalent, as approved by the *Employer* in accordance with ECSA guidelines.

6.1.10. 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.

6.1.11. *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. Qualifications and experience of key staff shall be provided by the *Contractor* during any tendering processes.

6.1.12. The Contractor shall provide proof of previous projects in the nuclear industry, or as a minimum in highly regulated industries.

6.1.13. 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 proposed remedial actions.

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. Non-conformances shall be submitted to the *Employer* for review and approval by the *Employer's* Engineering Representative.

6.3.5. The *Employer* reserves the right to reject a component following the assessment of any non-conformance.

6.3.6. The non-conformance register and all closed non-conformances, inclusive of all engineering work, justifications, corrective actions history and *Contractor* and *Employer* approvals, shall be part of the End of Manufacturing Report.

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

7. Site Work Requirements

7.1 General

7.1.1. The *Contractor* notes that the Site is a Critical Infrastructure and complies with the associated requirements of the Critical Infrastructure Protection Act, Act Number 8 of 2019.

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7.1.2. All staff requiring access to the site for design and installation purposes shall be subject to security requirements as well as to the Fitness for Duty (FFD) process [44].

7.1.3. All Eskom procedures and standards referenced in section 2.2.2 and applicable to plant and personnel on the KNPS site shall be complied with.

7.1.4. The *Contractor* provides all labour, installation tackle, gear and tools, vehicles, rigging tackle, temporary works, consumables, equipment required to provide the works.

7.2 Spares and Special Tools

7.2.1. The *Contractor* shall supply all special tools and equipment required to perform the prescribed verification, testing and calibration of the proposed KIS system.

7.2.2. The *Contractor* is responsible for any works that can reasonably be inferred from this Works Information.

7.3 Rigging Requirements

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

7.3.2. 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 [84].

7.3.3. The *Contractor* shall submit comprehensive Lift Plans in accordance with KSA-132 [84] 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.

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

7.4 Welding Requirements

7.4.1. The *Contractor* responsible for welding should be ISO 3834-2 certified.

8. Documentation

8.1 General

8.1.1. The KNPS Modification Process [56] shall be adhered to. All drawings and documents shall be supplied to the *Employer* in pdf and in their native formats as applicable.

8.1.2. Drawings submitted to the *Employer* by the *Contractor* shall fulfil the *Employer* standard drawing practice as per 240-86973501 [28].

8.1.3. All equipment manuals shall be added to the documentation system in accordance with 331-85 [38].

8.1.4. All mark-ups of existing KNPS documents / drawings shall use the latest revision available in the KNPS documentation centre at the time of submission to the *Employer*.

8.1.5. All text documentation shall be submitted in Microsoft Word format as set out in approved templates.

8.1.6. All tabular data shall be submitted in Microsoft Excel format.

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a. One copy in CD/DVD or flash disc format.

b. Two hard copies in A4 format.

c. Drawing hard copies are printed to its designed size, i.e. an A0 drawing is printed to A0.

8.1.7. The *Employer* shall provide the *Contractor* with a sequence of drawing numbers that shall be used on any new drawings.

8.1.8. All symbols shall be used as specified in reference KBA 0000 G001 000 [65].

8.2 Detailed Final Design

8.2.1 The *Contractor* shall provide the *Employer* with a detailed design document according to the requirements of 331-86 [39] that includes all information relating to the design, supply, installation, testing and commissioning of the modified system as required in this specification.

8.2.2 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.

8.2.3 The *Contractor's* Detailed Design shall contain all the requirements as stated in the *Employer*'s Detailed Design review report 331-433 (KFU-026) [36]. The *Contractor* shall complete and submit to the *Employer* the KFU-026 form.

8.2.4 The detailed design shall be presented to the *Employer's* Design Engineering (DE) Group at KNPS. 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.

8.2.5 For the modification, as described in this TRS, an Equipment Reliability (ER) Change Request KFU-038 [89] shall be populated by the *Contractor* in accordance with the *Employer* Integrated Equipment Reliability Process KAA-913 [62]. The *Employer* shall use the populated KFU-038 form to initiate an Equipment Reliability Change Request (ERCR) in accordance with KAA-913.

8.2.6 The final design and design documents shall be issued for review to the *Employer*. Only after all review comments have been successfully resolved and the document updated shall the document be accepted and signed by the *Employer*.

8.2.7 The *Contractor* shall be informed by the *Employer* when the final design is accepted by the *Employer* and the NNR.

8.2.8 Manufacturing shall only proceed after acceptance of the relevant design documents.

8.3 Calculations, Reports, Models, Drawings, etc.

8.3.1. 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.

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8.3.2. A complete set of post manufacturing “as built” drawings shall be provided as part of the Quality Assurance Data Package (QADP).

8.3.2.1. The *Contractor* ensures that creation, issuing and control of drawings are in accordance with the *Employer’s* Engineering Drawing Standard (240-86973501) [28].

8.3.2.2. All symbols shall be used as specified in the KNPS document KBA 0000 G00 1000 (Koeberg Standard Graphic Symbols) [65].

8.3.2.3. Drawings are to be CAD-generated, compatible with Bentley Microstation and are submitted to the *Employer* in (.dgn) format. Drawings issued to the *Employer* in native format shall not be “Right Protected” or encrypted.

8.3.2.4. The electronic copies shall be approved and signed by professionally registered Engineer in terms of the Engineering Professions Act no.46 of 2000, including the Engineer’s Professional Engineering Number, signature and date when the drawing was signed.

8.3.2.5. The *Contractor’s* drawings are complete in every respect and are checked by the *Contractor* prior to submission to the *Project Manager* for acceptance.

8.3.2.6. Each drawing set have an overview drawing which shows the overall layout of the system relevant to the drawing, with references to drawings where the details of the components depicted in the overview drawing can be found.

8.3.2.7. A design drawing package is issued with one drawing number and multiple sheets, instead of multiple drawing numbers. The breakdown of the drawing packaging is sent to the *Project Manager* for acceptance.

8.3.2.8. Drawings containing references to interfacing systems and to other applicable/relevant drawings includes the *Employer’s* drawing number as well.

8.3.2.9. The reference drawing list shall include the *Employer’s* (Eskom) drawing number. The *Employer’s* drawing number is referenced in all communications and documentation.

8.3.2.10. Drawings contain parts lists of all the components depicted in the drawing set. These parts lists include at minimum the following information:

a. Number label of the part in accordance with the numbering convention indicated on the drawing,

b. Description of the part,

c. Description of the profile of the part (if it is not a standard profile, the dimensions are provided),

d. Length of the part,

e. Quantity of the part,

f. Material specification and reference to the relevant material standard/code for the part.

8.3.2.11. All connection details are indicated on drawings.

8.3.2.12. All dimensions of structural mechanical equipment and associated structures are provided. No dimensions are obtained from a drawing by scaling.

8.3.2.13. Tolerances for the design are clearly indicated on the drawings.

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8.3.2.14. Electronic drawings have a water mark indicating the approval phase of a drawing and hardcopies are stamped to indicate the phase, i.e. preliminary, issued for review, issued for construction, etc.

8.3.2.15. The final detailed engineering drawings that are issued for construction are on revision 0. Drawings submitted prior to that, have revisions of 0.1, 0.2 or a, b, c, etc.

8.3.2.16. All cells in the drawing title block needs to be populated and completed before the drawing is signed off.

8.4 Operating and Maintenance Manual Requirements

8.4.1. 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.

8.4.2. The *Contractor* shall provide Eskom with a detailed maintenance basis with maintenance baselines, procedures, and manuals applicable to the long-term operation of the KIS system.

8.4.3. The maintenance manual shall include spares lists and maintenance programs.

8.5 Documentation to be handed over to Eskom

8.5.1. Documentation to be submitted to the *Employer* prior to system handover includes but is not limited to:

8.5.1.1. KIS system Operational Documentation requirements:

a. Operational and monitoring procedure,

b. Emergency operating procedure,

c. Interpretation of alarms and fault-finding procedure,

d. Re-commissioning procedures that shall include crucial test values for acceptable equipment operation.

8.5.1.2. KIS system Maintenance and Engineering Documentation requirements to be included in the KNPS DSE and a Maintenance Manual:

a. Overall system design, layout drawings and installation information,

b. Codes and standards relevant to the various equipment,

c. Module circuit diagrams,

d. Software manuals,

e. Power supply requirements,

f. Seismic test reports,

g. Environmental requirements,

h. Performance characteristics and specifications,

i. Routine inspection specification,

j. Service interval specification,

k. Bill of material, material number and supplier,

l. Overhaul procedures and specifications,

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m. Test procedures and specifications,

n. Serial numbers of items installed,

o. Recommended spares list,

p. Drawings applicable to plant,

q. Certificate of compliance in terms of SANS 10142-1 [13] for 1 KIS in terms of OHS Act [8].

8.5.1.3. The *Contractor* is to identify all required and affected KNPS documentation and request such documentation from the *Employer*. The *Employer* does not guarantee that all requested documentation is available or can be provided.

8.5.1.4. Engineering and Implementation Execution Strategy.

9. Training

9.1. Discipline specific training shall be provided for the Eskom personnel responsible for the operation and maintenance of the equipment that shall include at least two persons from the following groups: Maintenance, System Engineering, Civil Engineering, Operating Training, and Design Engineering.

9.2. Training shall include:

9.2.1. Design principles,

9.2.2. Equipment selection criteria when designing the system,

9.2.3. System overview,

9.2.4. System functionality,

9.2.5. Operating parameters,

9.2.6. Monitoring parameters,

9.2.7. Fault finding,

9.2.8. Operation, testing and requalification of the system,

9.2.9. Alarm interpretation,

9.2.10. Maintenance procedures,

9.2.11. Analysis methods of recordings,

9.2.12. System reset,

9.2.13. Optimal versus non-optimal setting up of the system.

9.3. Eskom shall provide a list of names of the trainees on request from the *Contractor*.

9.4. Furthermore, Eskom shall provide a classroom or other suitable medium for the purposes of the training.

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10. Plant Computer Interface (KIT) Requirements

10.1. The *Contractor* shall design, configure and install the KIS system ready for KIT interfacing. This includes but not limited to physical changes, cabling, hardware, programming, testing and commissioning associated with providing such interface.

10.2. The existing interfaces of the KIS system with KIT shall be retained [70]. Monitoring enhancements i.e. additional digital/analogue points shall be submitted for review and approval by the *Employer's* Engineering Representative.

10.3. The KIS system shall use the MODBUS TCP protocol over Ethernet to interface to the KIT (Ovation) system.

10.4. The *Contractor* shall provide the mapping (addressing) for the MODBUS variables to be transmitted to KIT.

11. Human Factor

11.1 Human Factor Engineering

Human Factor Engineering (HFE) changes shall be evaluated. Refer to 331-87 [40] for relevant guides on reviewing Human Engineering aspects of the design.

11.2 Design for Safety

11.2.1. Nuclear Safety

11.2.1.1. A safety screening and/or evaluation shall be performed in accordance with KNPS procedures 240-143604773 [24] and 240-142639998 [23] to show that nuclear safety is not degraded by the design and installation of the KIS system. Where the *Contractor* does not have authorised safety evaluators, the *Employer* shall provide such authorised safety evaluators to assist the *Contractor* with performing the safety screening and/or evaluation.

11.2.2. Conventional Safety

11.2.2.1. The modification shall not introduce additional risks to personnel or plant integrity.

11.2.2.2. Applicable civil codes/building regulations must be identified and complied with.

12. Acceptance

This document has been seen and accepted by:

Name	Designation
M Hoole	Senior Technologist (System Engineering)
M Coetzer	Engineer (System Engineering)
P Xotyeni	Middle Manager (Procurement Quality Engineering)

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13. Revisions

Date	Rev.	Compiler	Remarks
February 2024	4	D Kruger	Full revision to clearly define the scope of work and to avoid ambiguities or proposals in the text.
June 2022	3	K Govender / R Aschmann	Updated 6.1.1 & 6.1.2 as per PQE request.
April 2022	2	K Govender / R Aschmann	Minor changes following review of RG 1.12 and response to RFI NO KBG2114.
April 2021	1	K Govender / R Aschmann	Scope increase from 07072-PCR Rev 0.
May 2010	0	N Boonzaier	First Issue.

14. Development Team

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

- M Hoole

15. Acknowledgements

Not Applicable.

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