

	Specification	Peaking
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Title: Technical Specification for Ankerlig 1 & 2 DC Essential Supply Replacement - Converters

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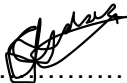

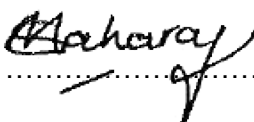
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CONTROLLED DISCLOSURE

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1. INTRODUCTION

The purpose of this modification is extend the design life of the DC essential supply systems of Ankerlig 1&2 Power Stations and to remedy any non-conformance to Eskom standards. The DC-DC converters have become obsolete. This modification would also allow for the latest technology to be procured which guarantees spares availability and local maintenance support.

2. SUPPORTING CLAUSES

2.1 SCOPE

The scope of this technical specification covers the converters only of the DC essential supply systems across all units and station.

2.1.1 Purpose

The purpose of this technical specification is to state the employer's technical requirements and provide the contractor with the necessary information to submit a comprehensive tender.

2.1.2 Applicability

This document shall apply to Peaking and is to be used as an input to the associated works information.

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] ISO 9001 Quality Management Systems.
- [2] 240-53114002 Engineering Change Management Procedure
- [3] 240-53114248 Thyristor and Switched Mode Charger, AC/DC to DC/AC Converters and Inverter/ Uninterrupted Power Supplies Standard
- [4] 240-53114186 Project Plant Specific Technical Document and Records Management Procedure.
- [5] 240-53114248 Thyristor and Switched Mode Charger, AC/DC to DC/AC Converters and Inverter/ Uninterrupted Power Supplies Standard
- [6] 240-71432150 Plant Labelling Standard
- [7] 240-170000055 Installation and Commissioning of Power Electronics Equipment
- [8] 240-86973501 Engineering Drawing Standard
- [9] NRS002 Graphical Symbols for Electrical Diagrams

2.2.2 Informative

- [10] Occupational Health and Safety Act and Regulations (Act 85 of 1993).
- [11] 36-681 Eskom Plant Safety Regulations
- [12] 240-170000055 Installation and Commissioning of Power Electronics Equipment.
- [13] 192/9701833-A Engineering Investigation Report for DC Essential Supply System at Ankerlig 1 Power Station

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- [14] 192/9701833-F Stakeholder Requirement Definition for Ankerlig 1 DC Essential Supply System Replacement
- [15] 192/9701833-G Concept Design Report Ankerlig 1 DC Essential Supply System Replacement
- [16] 192/9701833-K Detail Design Report Ankerlig 1 DC Essential Supply System Replacement
- [17] 193/404775-A Engineering Investigation Report for DC Essential Supply System at Ankerlig 2 Power Station
- [18] 193/404775-F Stakeholder Requirement Definition for Ankerlig 2 DC Essential Supply System Replacement
- [19] 193/404775-G Concept Design Report Ankerlig 2 DC Essential Supply System Replacement
- [20] 193/404775-K Detail Design Report Ankerlig 2 DC Essential Supply System Replacement

2.2.3 Disclosure Classification

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

3. DESCRIPTION OF THE WORKS

3.1 Executive overview

The works make provision for the design, manufacture, FAT and delivery of the dc-dc converters at Ankerlig 1&2 Power Stations.

Ankerlig 1&2 Power Station is located on Neil Hare road, Atlantis, Cape Town on the west coast of the Western Cape.

3.2 Employer's objectives and purpose of the works

The current system equipment has reached the end of design life, with the converters being obsolete. The purpose of the works is to extend the design life of the system by replacing converters and to ensure that new equipment is replaced with the latest technology. The employers seeks to receive fully functional converters as specified in the works, with a minimum design life of 15 years.

3.3 Interpretation and terminology

The following abbreviations are used:

Abbreviation	Meaning given to the abbreviation
AC	Alternating Current
AIA	Approved Inspection Authority
AFC	Approved for construction
CPA	Cost Price Adjustment
DC	DC Direct Current
OEM	Original Equipment Manufacturer

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KKS	Kraftwerk Kennzeichen System
LV	Low Voltage < 1000 V AC/DC
OHSA	Occupational Health and Safety Act
PS	Power Station
QC	Quality Control

4. MANAGEMENT AND START UP

4.1 Engineering quality assurance requirements

4.1.1 Quality Plan

The contractor shall submit a quality control plan for the execution of the works, maintaining the below minimum control points:

Activity Interventions		
H	Hold	Employer's representative to verify activity/intervention point is complete. Activity cannot be considered complete and the Contractor may not proceed with his schedule until the activity is signed off by Employer's representative.
W	Witness	Employer's representative to be informed of inspection/activity completion. If Employer's representative does not attend the final sign off inspection, the Contractor may continue with his schedule at his own risk.
S	Surveillance	The Contractor is responsible for ensuring the activity or material requirements are in accordance with the Contract specification. Documented evidence to be submitted to the Employer.

Document/Record Requirements		
R	Review	Employer's representative to review documentation for acceptability. The Contractor's program may not proceed until acceptance of the submitted documentation.
X	Submitted	Documentation or records to be submitted to the Employer
O	Not Required	No documentation required.

Activity	Intervention	Documentation
Approval of installation program	H	R
Material and Equipment certificates	S	R
Final Installation	H	X
Final Commissioning	H	X

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4.1.2 Meetings

Regular meetings of a general nature may be convened and chaired by the project manager as follows:

- Prior to site delivery – A meeting will be held on site to verify requirements

4.1.3 Documentation Control

- The contractor implements a comprehensive document control of all documents, their revision status and of the document status in relation to the 'as built' and 'as designed' or commonly known as “approved for construction” plant status. In this regard the contractor ensures that the documentation supplied by the project manager as tie-in information, accurately reflects the contract requirements.
- The contractor submits all documentation throughout the design phases of the project in electronic format to the project manager
- The contractor submits the final documentation on a formal transmittal form in triplicate to the project manager. All correspondence is sequentially numbered.
- The contractor adheres to employer’s technical documents and record management procedure (240-53114186) for all documents submitted.
- The documentation and drawings supplied is in South African English and SI units are used. The employer does not accept scanned electronic copies of documentation or drawings; however the original documentation with signature is scanned for electronic purposes.
- Documentation are of good quality, prepared by suitably qualified personnel and contain the general arrangement drawings, installation drawings and instructions, operating and maintenance instructions for all equipment.

4.1.4 Health and Safety Risk Management

N/A

4.1.4.1 SHE File

N/A

4.1.5 Work Packages

N/A.

4.1.6 Programming Constraints

- The contractor submits the program of delivery within two weeks after contract award,

4.1.7 Contractor’s Management, Supervision and Key People

- N/A

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4.2 Training workshops and technology transfer

Formal training is conducted as part of this contract before completion of the works. The contractor trains the employer’s personnel on the equipment specified below. The contractor will provide training to the employers personnel. The contractor is responsible for providing a training register in order to keep as proof of training provided. The signed off training register by all participants is also be supplied to the employer.

5. ENGINEERING AND THE CONTRACTORS DESIGN

5.1 EXISTING INSTALLATION

The converters are equipment that forms part of the DC Essential supply systems at all referenced power stations. Each of these systems provide power to the station and all units. The following is the system identification for equipment:

Ankerlig 1

<u>Description</u>	<u>Floc</u>
Station Converter A	0 0BUK01 GU011
Station Converter B	0 0BUK02 GU011
Converter A (2 converters in parallel)	* *BUK01
Converter B (2 converters in parallel)	* *BUK02

Ankerlig 2

<u>Description</u>	<u>Floc</u>
Station Converter A	0 1BUK01 GU011
Station Converter B	0 1BUK02 GU011
Converter A (2 converters in parallel)	* *BUK01
Converter B (2 converters in parallel)	* *BUK02

The employer shall provide detailed layout drawings of the works for submission to the contractor. The drawings shall clearly define the works boundaries as well as defining the preferred layout for the works and the equipment interfacing points.

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5.2 EMPLOYERS DESIGN

5.2.1 Equipment Specifications

The employers has designed the following for work specifications for the equipment:

- Converters

Sizing (H x W x D) mm: 177 x 483 x 230

The converters will occupy the top section in the existing cabinet and equivalent size converters will be used as to not disturb the C&I installation at the bottom of the cabinet. See Figure A for UNIT panel layout and Figure B for STATION panel layout.

Ankerlig 1 Converters				
		measure	Station and Unit	tolerance
Input	Voltage	V	220	+20/-15%
	Current	A	18	
	Input Ripple	%	<1	
Output	Voltage	V	26	24V – 30V
	Current	A	65(unit) 130(station)	
Cable Entry			Bottom	
Configuration			2 converters for station 4 converters per unit (2 in parallel configuration per installation)(note: When installed in parallel with another converter, the converter shall be capable to detect and share the total current to within 10% of each other)	

Ankerlig 2 Converters				
		measure		tolerance
Input	Voltage	V	220	+20/-15%
	Current	A	20 (station) 18.4 (unit)	
	Input Ripple	%	<1	
Output	Voltage	V	26	24V-30V
	Current	A	65(unit) 130(station)	
Cable Entry			Bottom of cabinet height 2200mm	
Configuration			2 converters for station 4 converters per unit (2 in parallel configuration per installation) (note: When installed in parallel with another	

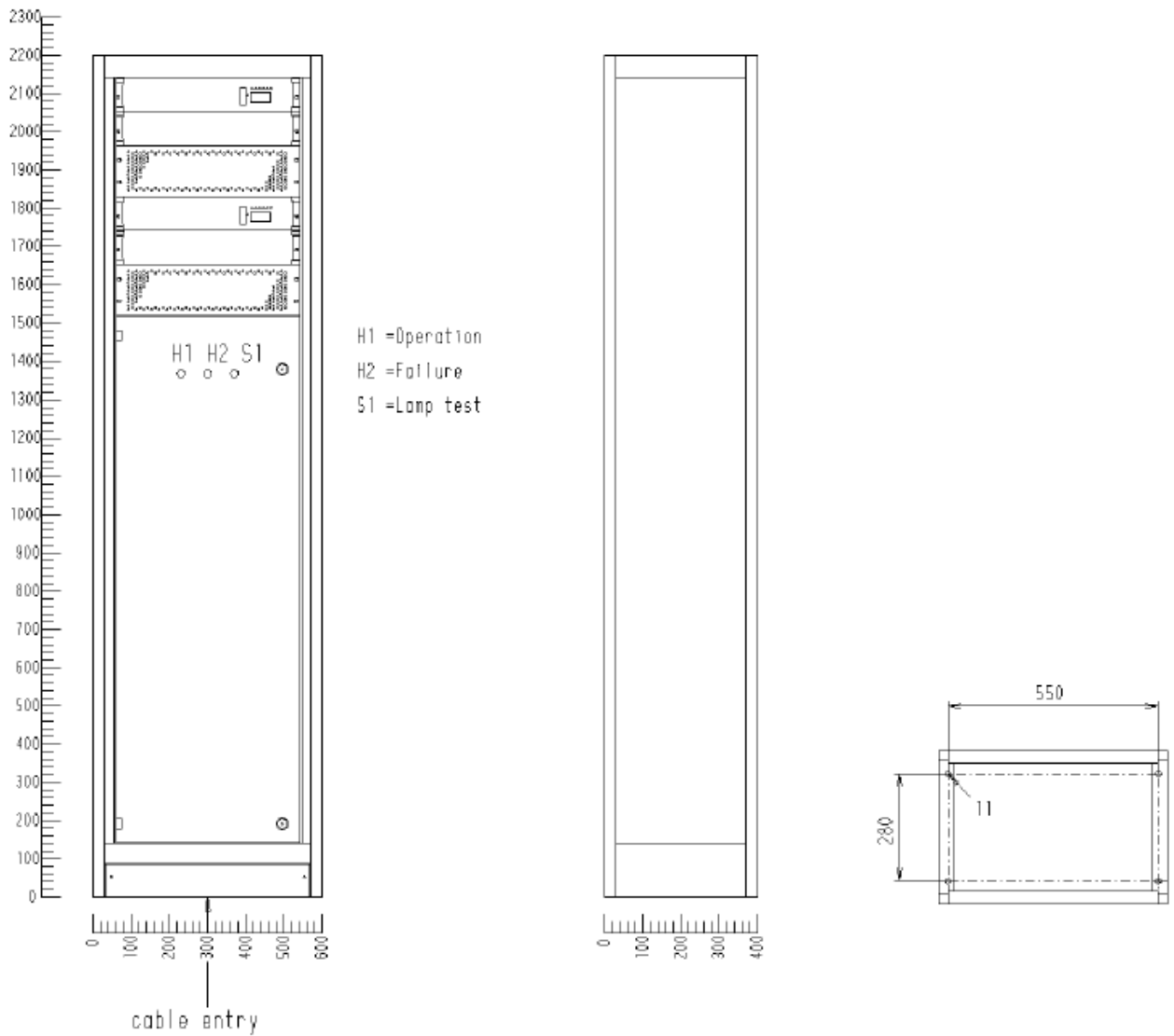
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		converter, the converter shall be capable to detect and share the total current to within 10% of each other)	
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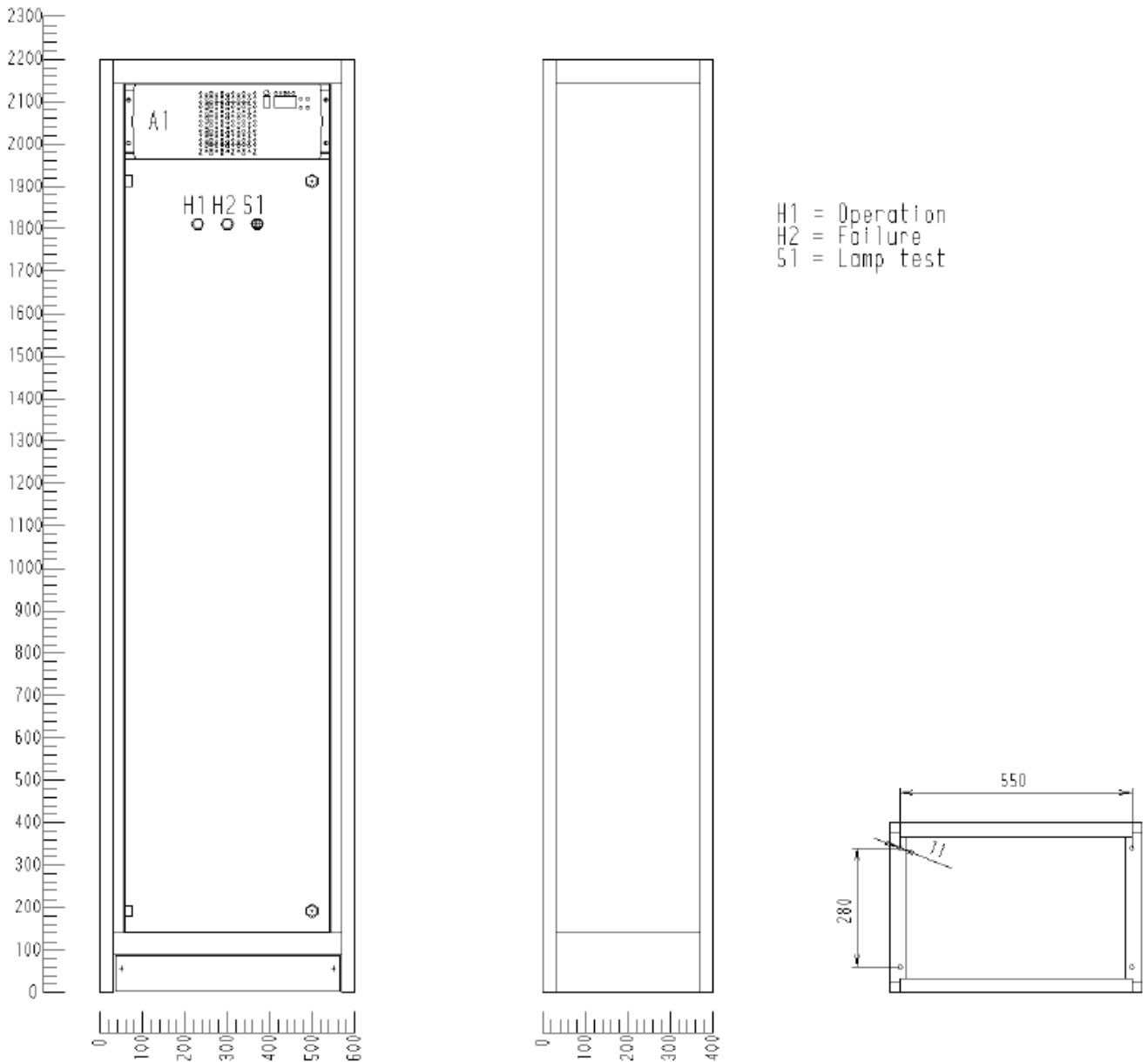
Figure A Unit Converter Panel layout



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Figure B Station Converter Panel Layout



5.2.2 Existing Installation Supply and Interfaces

The following electrical supply interfaces with the equipment existing equipment and will be reused for new equipment:

Ankerlig 1

DC Incomers				
Station			Unit	
DC-DC converter A	DC-DC converter B	DC-DC converter A	DC-DC converter B	

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Voltage	220V	220V	220V	220V
Current	18A	18A	18A	18A
Breaker Rating	31A	32A	32A	32A
Breaker KKS	(-Q02)	(-Q02)	(-Q02)	(-Q02)
Cable No:	00BUD1006	00BUE1006	**BUB1810	**BUC1806
Board Point of Installation	00BUD02.FA001B	00BUE03.DA001B	**BUB02.HA001B	**BUC02.FA001B
220 DC Distribution Board	00BUD	00BUE	**BUB	**BUC

Ankerlig 2

<u>DC Incomers</u>				
	Station		Unit	
	DC-DC converter A (01BUK01 GU011)	DC-DC converter B (01BUK02 GU011)	DC-DC converter A	DC-DC converter B
Voltage	220V	220V	220V	220V
Current	18A	18A	18A	18A
Breaker Rating	32A	32A	32A	32A
Breaker KKS	(-Q01)	(-Q01)	(-Q02)	(-Q02)
Cable No:	01BUD1012	01BUE1009	**BUB1810	**BUC1806
Board Point of Installation	01BUD02.FA001A	01BUE03.FA001A	**BUB02.HA001B	**BUC02.FA001B
220 DC Distribution Board	01BUD	01BUE	**BUB	**BUC

All stations

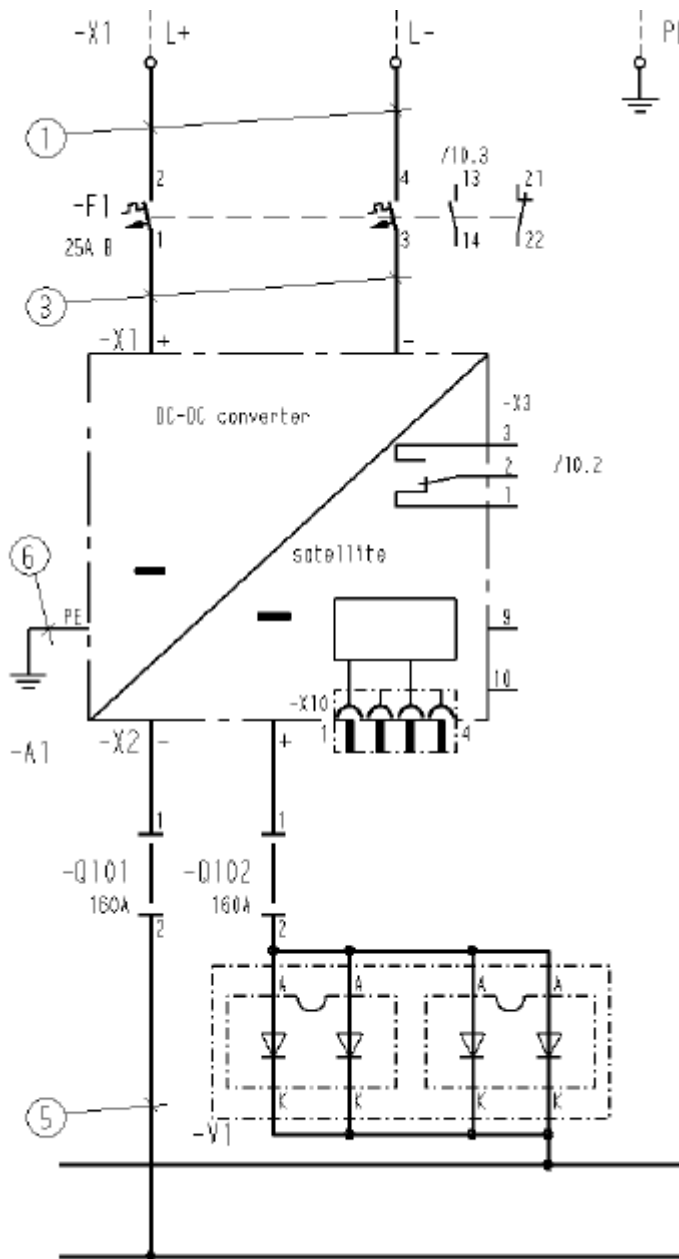
Converters will interface with loads via existing Fuses as per the following:

Each Station DC-DC converters via existing fuses Q101 and Q102 see Figure 1.

Each Unit DC-DC converter via existing fuses Q101, Q102, Q103 and Q104 see Figure 2.

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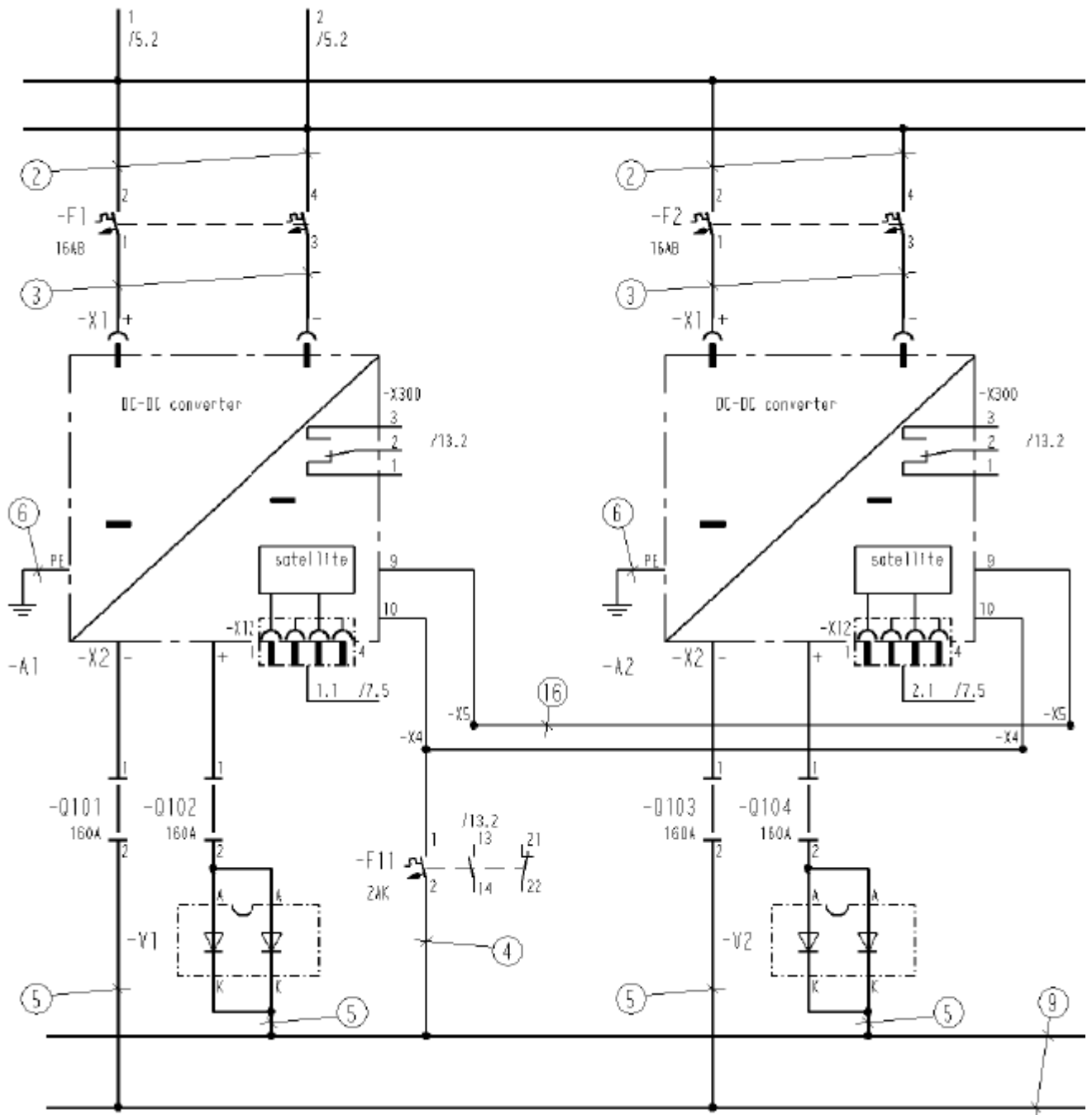
Figure 1



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Figure 2



5.3 PARTS OF THE WORKS WHICH THE CONTRACTOR IS TO DESIGN

The contractor shall manufacture, procure, supply and deliver all equipment necessary for completion of the works. This includes, but is not limited to:

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Ankerlig 1

- 2 x Station Converters as specified in Section 5.2

Unit Converters as specified in Section 5.2

- 4 x Unit 11 Converters
- 4 x Unit 12 Converters
- 4 x Unit 21 Converters
- 4 x Unit 22 Converters

Ankerlig 2

- 2 x Station Converters as specified in Section 5.2

Unit Converters as specified in Section 5.2

- 4 x Unit 31 Converters
- 4 x Unit 32 Converters
- 4 x Unit 41 Converters
- 4 x Unit 42 Converters
- 4 x Unit 43 Converters

The contractor shall ensure that equipment issued complies fully with the specifications as indicated in Appendix A of this document as per schedule A. Any deviations from schedule A should be documented in schedule B and listed in the deviation schedule Appendix C and sent for review/ approval to Eskom

5.4 PROCEDURE FOR SUBMISSION AND ACCEPTANCE OF CONTRACTOR'S DESIGN

The contractor shall submit all necessary documentation to the project manager for acceptance prior to any fabrication or procurement taking place. The documentation required for acceptance shall be:

- Data sheets of proposed converters
- Internal single line diagram diagrams - Converters
- Installation/Erection Procedure
- Quality Control Plan

5.5 OTHER REQUIREMENTS OF THE CONTRACTOR'S DESIGN

5.5.1 Design & Constructability Requirements

- Due to the spacial limitation on site the sizing of equipment must be strictly adhered to.
- All plant material provided must be new.

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5.5.2 Software and Firmware

5.5.2.1 General

- Software for equipment equipped with serial and network interfaces whereby fault recordings, sequence of events, settings and marshalling can be accessed by a PC and are downloadable in an acceptable format (e.g. csv, xls, and txt), shall be made available as it is deemed to be an integral part of the required converter system functionality. This software shall be compatible with the current Eskom approved Microsoft Windows (latest available) operating system. Software with DOS as the operating system will not be acceptable. Details of various operating systems supported shall be included in the tender documentation.
- Any future software versions shall be backward compatible.
- The cost of the software, including software manuals, disks and serial cable, shall be limited to a fair cost that shall be included in the tender documentation. A “fair cost” is deemed to be an amount sufficient to cover the material cost and overhead of such items and not the perceived intellectual value of the software. Eskom shall have the right to freely copy the software and reproduce the manuals for exclusive use within Eskom and the successful tenderer shall issue Eskom with a Corporate Software Licence. Preference will be given to on-board web based software which does not require additional software installation.
- The supplier shall provide software support for the full, guaranteed, lifetime of the hardware.
- The supplier shall, on request from Eskom, provide Eskom with the necessary software detail when this is required for the converter system interfacing with future or existing systems.
- The supplier shall adhere to the software control standard 240-76624509: Control of New Metering Product and Version Changes in Technical, Software, Firmware and Hardware.
- All settings and display features available on the front keypad / display of the converter system shall be available on the operating software for remote or local applications.
- The alarm / event log page shall be able to be downloaded as a text (*.txt) or excel (*.xls) file to the host PC.
- The software shall be able to save all alarm / charge mode settings as a file (settings sheet) which can be uploaded to the converter system. All the converter settings shall also be downloadable into the setting template format.
- The software shall display the status of any modules connected to the converter system
- During an AC mains failure condition or equipment system failure, the converter system shall record the discharge curve (battery bank voltage and current, as a minimum) of the battery until the converter system shut down due to low volts. The recording function shall be optimised to save memory space. This discharge information shall be downloaded when the converter system is back to normal for review purposes. This file shall also be able to be downloaded to the remote PC, for viewing with the front- end software. This data shall not be stored on or reduce the required memory allocated for normal event logging purposes.

5.5.2.2 Software verification and validation

- To meet the requirements of future contracts based on this specification, if a microprocessor based converter is being offered, the contractor shall supply evidence on request in the form of reports from a mutually acceptable third party that:
- An adequate formal specification for the software has been produced, based on a requirement document and comprehensive hazard analysis.

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- The software has been developed using tested tools, adequately trained staff and using an acceptable quality management system. In particular, all stages of design, development and testing process shall have been adequately planned and documented.
- The software has been formally verified to ensure that it matches its specification.

5.5.2.3 System firmware

- The equipment system firmware version shall be displayed on the rectifier and controller module display and on the operating software.
- Any converter system based firmware (EPROM or Flash ROM) supplied to Eskom, shall not be changed unless Eskom requests the modification or Eskom gives written approval to the supplier to do the proposed modification. Any modification shall be subject to testing and verification and formal approval, in writing by Eskom, shall be required prior to the supplier placing the altered firmware into operation. The requirements of 240-76624509: Control of New Metering Product and Version Changes in Technical, Software, Firmware and Hardware, shall be adhered to.
- The estimated data retention time of EPROM or FLASH ROMs used in the converter systems shall be the design life of the equipment.
- The equipment firmware shall be upgradeable via remote communication and security checks shall be in place to ensure that such remote upgrade has been successfully completed. In the event of the remote upgrade being unsuccessful, the converter shall resume normal operation on the older firmware version.

5.5.2.4 The equipment system software operational features

- All settings and display features available on the front keypad / display of the converter system shall be available on the operating software for remote or local applications.
- The alarm / event log page shall be able to be downloaded as a text (*.txt), excel (*.xls), Comma-separated values (*.csv) file to the host PC.
- The software shall be able to save all alarm / charge mode settings as a file (settings sheet) which can be uploaded to the converter system. All the converter settings shall also be downloadable into the setting template format.
- The software shall display the status of any modules connected to the converter system.
- The software shall display the status of the remote communications connection.
- During an equipment system failure, the converter system shall record the discharge curve (battery bank voltage and current, as a minimum) of the battery until the converter system shut down due to low volts. The recording function shall be optimised to save memory space. This discharge information shall be downloaded when the converter system is back to normal for review purposes. This file shall also be able to be downloaded to the remote PC, for viewing with the front-end software. This data shall not be stored on or reduce the required memory allocated for normal event logging purposes.

5.5.3 Configuration Management

The contractor shall label the equipment in accordance with the Eskom Plant Labelling Standard as indicated in Section 2.2.1 [6]. The employer shall provide the contractor with the desired label description and KKS code and the contractor shall print the label as given by the employer

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5.5.4 Civil Requirements

Ankerlig 1 and 2 Station

The allowable point load for the location of the converters is $G=4kN$. Since the new equipment will replace the old equipment in the exact same positions, the floor plan will not change. The new equipment shall not exceed the permissible loading as illustrated in the loading schedule as per drawing issued in section 9.1 of this document. The following are the weight specifications for the equipment:

- Converter – may not exceed 400Kg

Unit

The allowable Area Load loading in the Building location housing the Converters is $g=5kN/m^2$. Since the new equipment will replace the old equipment in the exact same positions, the floor plan will not change. The new equipment shall not exceed the permissible loading as illustrated in the loading schedule as per drawing issued in section 9.1 of this document. The following are the weight specifications for the equipment:

- Converters may not exceed 56Kg

5.5.5 Mechanical Requirements

5.5.5.1 General

- The converter shall comply with the fundamental safety requirements of Clause 5 of SANS 10142-1 and SANS 62040-1, Uninterruptible power systems (UPS) Part 1: General and safety requirements for UPS.
- The converter shall as a minimum be designed, constructed and tested in accordance with the requirements of Clause 6.6 of SANS 10142-1.
- All components and electric conductors fitted to the ASSEMBLY shall be certified as safe by means of a valid Regulatory Certificate of Compliance (RCC) in accordance with SANS 10142 - 1 Table 4.2 or an SABS Mark of approved performance.

5.5.5.2 Doors and covers

- N/A

5.5.6 Nameplate/Rating plate/Declared Electrical Performance

Each cubicle shall have a stainless steel or anodized aluminium plate on which the electrical performance of the product is declared. The following information as a minimum is engraved:

- As per IEC requirements
- Manufacturer
- Month/year of manufacture
- Type/model of unit
- Serial number

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5.5.7 Measurements, Controls, Indications and Alarms

5.5.7.1 Converter measurement

The following meter types shall be used:

- Panel meters;
- Liquid crystal display (LCD).

All meters shall be of class 1% accuracy.

The following measurements shall be displayed:

- Input voltage
- Output voltage
- Output current

5.5.7.2 Converter Indications

- The indications stipulated above will be the norm unless differently indicated in schedule A, The following indications shall be available on the facia of each converter as part of functional single line mimic:
 - Input healthy
 - Output healthy
- Where LEDs are used, green LEDs shall indicate active or operational circuits, and red LEDs shall be used to indicate non-operational circuits.
- All indications shall be clearly labelled.

5.5.7.3 Converter Alarms

- Each unit is provided with a relay dedicated to each alarm for remote indication of the listed alarms.
- Each relay is equipped with two normally open and two normally closed potential free contacts to provide for two independent sets of remote alarms.
- The following remote alarms shall be available:
 - OUTPUT FAILURE,
 - INPUT FAILURE,
 - a) Mains failure to the rectifier
 - b) Rectifier failure
 - c) Rectifier voltage out of limits
 - d) Ripple voltage out of limits

Any additional alarms shall be specified in schedule A

5.6 USE OF CONTRACTOR'S DESIGN

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When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

- All designs, drawings, specifications, instructions, manuals and other documents created, produced by or on behalf of the contractor for the purposes of providing the works (collectively, the “Contractor’s Copyright Documents”) and copyright therein and all intellectual property rights relating thereto, are, will be, and will remain the property of the contractor.
- The contractor hereby grants to the employer, with effect from the contract date or in the case of documents or other matter not yet in existence, with the effect from the creation thereof (and notwithstanding the completion or abandonment of the works or termination of this agreement) an irrevocable, royalty-free, non-exclusive and perpetual licence to use those of the contractor’s documents and other matter supplied to the employer under this contract, for any purpose whatsoever connected with the works, including for the purpose of maintenance, operation, construction, retrofit, refurbishment, upgrade, repair or demolition of the works or any parts thereof.
- The employer uses the contractor’s copyright documents and all intellectual property rights relating thereto for the sole purpose of all its needs at Ankerlig 1&2 Power Stations, which includes any employer processes and procedures pertaining to use, maintenance, operation, construction, retrofit, refurbishment, upgrade, repair or demolition of the works.
- The employer may copy and submit, without restriction, all documentation to others employed or contracted by the employer who has duly signed a confidentiality agreement with the employer.
- The contractor may not use any Copyright Documents (and the copyright therein and all intellectual property rights relating thereto), which are owned by the employer and/or others and provided to the contractor, for any other purpose than to provide the works. The contractor may not copy and therefore not retain copies of any such Copyright Documents. At completion of the whole of the works, or earlier termination, the contractor returns to the employer all such documentation provided to him by the employer and/or others.

5.7 DESIGN OF EQUIPMENT

N/A.

5.8 EQUIPMENT REQUIRED TO BE INCLUDED IN THE WORKS

N/A

5.9 AS-BUILT DRAWINGS, OPERATING MANUALS AND MAINTENANCE SCHEDULES

The following minimum documentation is to be supplied to the project manager for acceptance prior to commencement of installation.

- Data sheets of proposed converters
- Internal single line diagram diagrams - Converters
- Quality Control Plan

CONTROLLED DISCLOSURE

5.9.1 Drawings

- All drawings are created electronically and 100% compatible with Micro station V8 software in a DGN file format.
- In conjunction with the electronic DGN copies the contractor also provides a merged set of *.pdf electronic copies upon first issue and each time drawing updates are required. All drawings are signed and the revisions noted as per employer's specifications.
- The electronic files are provided in A3 size and conform to the requirements of The Engineering Drawing Standard 240-86973501 as indicated in Section 2.2.1[8].
- Graphical symbols are used in accordance with the NRS002 Graphical Symbols for electrical diagrams standard.as indicated in Section 2.2.1 [9]
- All drawings are submitted to the project manager for his acceptance.
- The contractor produces the following types of drawings:
 - Cover sheet
 - Index sheet
 - List of symbols
 - List of components with values, tolerances, ratings, type numbers, purchasing specification numbers, manufacturer and circuit reference numbers
 - General layout drawing of the proposed panels
 - Single line diagram
 - Panel internal wiring drawings, including cross referencing and wire numbers
 - Cable block diagrams with termination points
- The contractor is liable for updating drawings till after the final commissioning of the last unit when the employer has signed off and approved the final "As Built" state of the drawings. After commissioning of each unit the contractor supplies two sets of drawing hardcopies within two separate files and in A3 format.

5.9.2 Technical Maintenance and operating Manuals

- All manuals are specific to each of the 2 power stations namely, Ankerlig 1&2 Power Stations. The file descriptions include the following on the front as well as the spine. The Contractor incorporates all necessary technical data, design, data literature and drawings into his operating and maintenance manuals.
- An electronic PDF copy and hardcopies of each equipment is to be supplied to the project manager.
- The technical, maintenance and operating manuals also contains the information and course material of the training manuals
- All design information forming part of the works Information is included in the manuals.
- All documentation including drawings and operating and maintenance instruction manuals is uniquely identified and cross-referenced with all related documents.
- The manuals are complete with:
 - Power station name and order number

CONTROLLED DISCLOSURE

- Content list
- List of reference drawings
- Details of all components
- Manuals are of good quality prepared by suitably experienced personnel. The contractor ensures that the manuals/files are complete with the following information represented as a minimum
 - Details and descriptions of all hardware and software
 - Detailed product descriptions and features
 - Datasheets of all components used
 - Operating, maintenance and testing requirements
 - Installation procedures of each equipment
 - Isolation procedures
 - Test certificates
 - Certificates of compliance to international standards
 - Routine test results reports
 - Commissioning test results reports
 - Training information
 - Technical tender submission information
- Any special instructions pertaining to storage of spare parts or to their shelf life are included in the manual.
- All drawings required for component location, dismantling, and re-assembly for maintenance is provided in the manual.
- All special tools required for maintaining and operating the plant and material are identified in a schedule and described in the manual.
- Manuals are produced such that a synopsis is first presented, followed by a first draft, then a pre-print proof and finally by the final manual.

6. PROCUREMENT

6.1 PLANT AND MATERIALS

6.1.1 Quality

- The contractor establishes and implements a system that, as a minimum, meets the requirements of the ISO 9000 series for quality management systems.
- The contractor defines the level of QA/QC or inspection imposed on his sub-contractors and suppliers.
- The contractor ensures that appropriate quality requirements are placed to comply with the services.
- The contractor notifies the employer of any proposed changes to the quality management system that will affect the contract quality requirements, prior to implementing such changes.

CONTROLLED DISCLOSURE

- The contractor rectifies, at his own cost and to the satisfaction of the employer all defects, or other faults, which may appear during the defect liability period.
- In case of specialized work based on the contractors own design and their standard manufacturing product in the works being defective or any components used found to be defective due to manufacturing defects and thus forcing, any improvement to be implemented to rectify such inherent defects, the cost of such an undertaking would be the responsibility of the contractor.

6.1.2 Guarantee Inspection

- All equipment supplied will carry a warrantee of minimum 36 months starting from the delivery date.
- The contractor will supply a written and electronic warrantee to the project manager by 15 days after completion of delivery.

6.1.3 Product Support

- All equipment supplied by the contractor need to have local support available within the Republic of South Africa.
- The contractor should provide product support of the provided solution for the entire life cycle of the equipment.

6.1.4 Defects correction

- The employer will provide the contractor access to correct any post commissioning defects that may arise.
- It will be the responsibility of the contractor to rectify any defects prior to the defects date being reached.

6.1.5 Reliability, security, dependability, maintainability and life expectancy

- The supplier / tenderer shall submit a full track record which shall include the following:
- Equipment hours of installed units per voltage or model / type.
- Customers indicating the number of units employed per model / type.
- Environmental conditions where such equipment is installed.
- All converters to be used shall have:
 - A proven service record of at least two years and one hundred equipment years.
 - All tendered equipment shall be designed for a minimum working lifetime of 10 years for electronic equipment and 20 years for the balance as indicated in schedule A.
 - Written guarantees to this effect shall be made available as part of the tender.
 - The supplier shall make a statement regarding re-calibration of the equipment to keep it in perfect working order or any other required intervention by the supplier, subsequent to the sale of equipment that will have a financial impact on Eskom.
 - Any internal battery requirements for converters/ controllers, i.e., battery lifetime, type of battery etc. shall be stated during tender and on a label attached to the front of the equipment.

CONTROLLED DISCLOSURE

6.1.6 Plant & Materials provided “free issue” by the Employer

No Plant and Materials will be free issued by the Employer.

6.1.7 Contractor’s procurement of Plant and Materials

- The employer requires warranties from the contractor’s suppliers to be in favour of the Employer.
- The contractor provides all their supplier’s information to the employer.

6.1.8 Spares and consumables

N/A.

6.2 TESTS AND INSPECTIONS BEFORE DELIVERY

The equipment and components making up the works shall be of standard construction and shall be supplied with factory acceptance test certificates from the manufacturer.

6.3 MARKING PLANT AND MATERIALS OUTSIDE THE WORKING AREAS

The contractor is requested to mark all identified items of plant and material with the contract and order numbers.

Plant and material is delivered to either the site or the contractor’s works.

The following requirements apply to the off-site marking of plant, materials and equipment:

- The contractor gives two (2) weeks’ notice to the project manager and it is shown in the programme.
- The notification to the project manager is accompanied by a comprehensive inventory of all plant, materials and equipment ready for marking.
- Plant, materials and equipment located at the contractor’s subcontractor/s or sub-suppliers are not considered ready for marking.
- Only plant, materials and equipment physically located at the contractor’s facility are considered ready for marking.

6.4 CONTRACTOR’S EQUIPMENT (INCLUDING TEMPORARY WORKS).

N/A.

6.5 CATALOGUING REQUIREMENTS BY THE CONTRACTOR

N/A.

7. CONSTRUCTION

This part of the technical specification addresses constraints, facilities, services and rules applicable to the contractor whilst he is doing work on the site during the construction and maintenance phase. It does not specify the work itself as that is included in Section 6 of the Works Information.

7.1 TEMPORARY WORKS, SITE SERVICES & CONSTRUCTION CONSTRAINTS

7.1.1 Contractor’s equipment

CONTROLLED DISCLOSURE

N/A

7.1.2 Equipment provided by the Employer

No equipment will be provided by the employer.

7.1.3 Site services and facilities

N/A.

7.1.4 Facilities provided by the Contractor

N/A.

7.1.5 Existing premises, inspection of adjoining properties and checking work of Others

N/A.

7.1.6 Survey control and setting out of the works

N/A.

7.1.7 Excavations and associated water control

N/A.

7.1.8 Underground services, other existing services, cable and pipe trenches and covers

N/A.

7.1.9 Sequences of construction or installation

N/A

7.1.10 Hook ups to existing works

N/A.

7.2 COMPLETION, TESTING, COMMISSIONING AND CORRECTION OF DEFECTS

7.2.1 Work to be done by the Completion Date

On or before the completion date the contractor shall have done everything required to provide the works except for the work listed below which may be done after the completion Date but in any case before the dates stated.

The project manager cannot certify completion until all the work except that listed below has been done and is also free of defects which would have, in his opinion, prevented the employer from using the works and others from doing their work.

Item of work	To be completed by
--------------	--------------------

CONTROLLED DISCLOSURE

	As built drawings of converters	Within 30 days after Completion
	Maintenance and Operating Manuals	Within 30 days after Completion

7.2.2 Use of the works before Completion has been certified

N/A.

7.2.3 Materials, facilities and samples for tests and inspections

N/A.

7.2.4 Commissioning

N/A

7.2.5 Start-up procedures required to put the works into operation

N/A.

7.2.6 Take over procedures

N/A

7.2.7 Access given by the Employer for correction of Defects

Clause 43.4 requires that the Project Manager arranges for the employer to allow the contractor access to and use of a part of the works which has been taken over if needed to correct a defect. After the works have been put into operation, the employer may require the contractor to undertake certain procedures before such access can be granted.

7.2.8 Performance tests after Completion

- N/A

7.2.9 Training and technology transfer

- N/A

7.2.10 Operational maintenance after Completion

- N/A.

8. PLANT AND MATERIALS STANDARDS AND WORKMANSHIP

8.1 INVESTIGATION, SURVEY AND SITE CLEARANCE

The contractor is responsible to survey the current equipment location, layout and positioning of the panels and need to clearly specify any additional requirements.

CONTROLLED DISCLOSURE

8.2 BUILDING WORKS

N/A.

8.3 CIVIL ENGINEERING AND STRUCTURAL WORKS

N/A.

8.4 ELECTRICAL & MECHANICAL ENGINEERING WORKS

Reference number	Title / Description	Tick if Publicly available
240-53114248	Thyristor and Switched Mode Charger, AC/DC to DC/AC Converters and Inverter/ Uninterrupted Power Supplies Standard	*
SANS 10142-1:2020 Edition 3	The wiring of premises Part 1 Low Voltage installations	✓
240-170000055	Installation and Commissioning of Power Electronics Equipment Procedure	
240-56227443	Requirements for Control and Power Cables for Power stations Standard	*

8.5 PROCESS CONTROL AND IT WORKS

N/A

8.6 OTHER

Reference number	Title	Tick if publicly available
QM-58	Supplier Contract Quality Requirements Specification	*
ISO 9001:2008	Quality Management Systems	✓
OHASA (1993)	Occupational Health and Safety Act of South Africa, Act 85 of 1993	✓
ESKARAAG4	Eskom Operating Regulations for High Voltage Systems, ESKARAAG4	*
	National Environmental Management Act of 1988	✓
32-136	Contractor Health and Safety Requirements	*

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32-245	Eskom Waste Management Standard	*
36-681	Generation Plant Safety Regulations	*
240-62196227	Eskom Life-saving Rules Directive 23-421	*
240-71432150	Plant Labelling and Equipment Description Standard	*
240-54179170	Classification and designation of technical documentation	*
240-86973501	ESKOM General documentation standard	*
32-644 Rv1	ESKOM Documentation Management Standard	*
167A/49	Drawing and documentation standard for Contractors	*
167A/49	Documentation Process Procedure	*

9. LIST OF DRAWINGS

9.1 DRAWINGS ISSUED BY THE EMPLOYER

This is the list of drawings issued by the employer at or before the contract date and which apply to this contract.

Note: Some drawings may contain both works information and site information.

Ankerlig 1

Drawing number	Revision	Title
0.86/8966		Unit Single Line Diagram
0.86/8967		Station Single Line Diagram
0.86/9011		PCC Power Control General Arrangement
0.86/8998		Admin & Control Building
0.88/1		Ankerlig Power Station Layout Drawing Gas 1 Station Layout
0.88/3451		GAS Turbine building Load Plan
0.88/3449		Plan View Central Control and Office Building Load Input

Ankerlig 2

Drawing number	Revision	Title
0.88/2622		Unit Single Line Diagram
0.88/2623		Station Single Line Diagram
0.88/2441		PCC Power Control General Arrangement

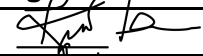


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0.88/3434		Admin & Control Building
0.88/1		Ankerlig Power Station Layout Drawing Gas 1 Station Layout
0.88/3451		GAS Turbine building Load Plan
0.88/3449		Plan View Central Control and Office Building Load Input

10. ACCEPTANCE

This document has been seen and accepted by:

Name & Surname	Designation	Signature
Ian Kuiler	Senior Technologist Engineering (Reviewer)	
Mfundo Sijeku	Engineer: C&I	
Zubair Johannes	Senior Technician: Civils	

11. REVISIONS

Date	Rev.	Compiler	Remarks
December 2021	0.1	AM Juries	First Compiled
January 2022	0.2	AM Juries	1 st Comments Reviewed
February 2022	0.3	AM Juries	2 nd Comments Reviewed – Combined all 3 stations under 1 technical specification
February 2022	0.4	AM Juries	3 rd Comments Reviewed – Health and Safety information updated
April 2022	1	AM Juries	4 th Comments Review – Tables edited and formatted

12. DEVELOPMENT TEAM

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

N/A.

13. ACKNOWLEDGEMENTS

N/A.

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14. APPENDIX A: CONVERTER REQUIREMENTS

Schedule A: The Engineer's particular requirements

Schedule B: Guarantees and technical particulars of equipment offered All Standards quoted will be the Latest revision

NOTES: REGARDING THE COMPLETION OF SCHEDULE A & B:

The requirements of this section specified under "Schedule A & B" form part of the Works Information. Schedule B shall be completed by the Contractor and submitted with his tender. Filling in Instructions

- Where the Contractor does not fully comply with the Engineering requirement, any deviations shall be clearly indicated in Schedule B and listed in the Deviation Schedule, with the cost of the deviation.
- Where there is a need to substantiate or further describe an item in Schedule B, especially in instances of non-compliance with Schedule A, particulars are furnished on a separate sheet clearly marked with the notation of the Schedule A item referred to.
- If a blank space is left in Schedule B next to certain requirements specified in Schedule A, this constitutes a confirmation that the tender does not comply with that specific requirement.
- Where xxxxx is indicated for an item in Schedule A, the Contractor is required to fill in the appropriate information in Schedule B, for the equipment offered.
- Where t.b.c. (to be confirmed) is indicated for an item in Schedule A, the Engineer will fill in the appropriate information in Schedule A, when confirmed.

A Evidence Reference

Each evidence reference shall be filled in with a reference to the delivery documentation where the word "REQUIRED" is stated. The evidence reference section will refer to the documentation that backs-up the statement made in Schedule B. If no evidence is received or it is not referenced to correctly, it shall be taken as non-compliance with regard to Schedule A

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
1.0	General Requirements					
1.1	Site conditions					
1.2	Elevation (Atlantis) and (Mosselbaai)	m.a.s.l	226.62 and 110.17			
1.3	Relative humidity	%	10-90 non condensing			
1.4	Lighting		SANS 1652 and SANS 61439 -1 Table G1			
1.5	Outdoor air temperature					
1.5.1	Maximum	°C	60			
1.5.2	Daily average	°C	30			
1.5.3	Minimum	°C	-15			
1.6	Equipment room air temperature					
1.6.1	Maximum	°C	50			
1.6.2	Daily average	°C	35			
1.6.3	Minimum	°C	-5			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
2.0	Electrical input supply					
2.1	Input supply configuration	SANS 10142	TN-S			
2.2	Input voltage fluctuations as percentage of nominal voltage	%	220V +20%/-15%			
2.3	Input voltage total distortion		Table 1 IEC 61000-2-2			
3.0	Operational requirements					

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
3.1	Modular converters					
3.1.1.	Load sharing requirement of parallel modules/units	%	≤10			
3.1.2	Individual converters for modular converter applications shall synchronize automatically	Yes/No	Yes			
3.1.3	Individual converters for modular application shall be hot pluggable	Yes/No	Yes			
3.1.4	Number of parallel modules/units	Number	Xxxxx			
3.2	Input requirements	Input voltage and tolerance	220V DC +20%/-15%			
3.3	Output requirements					
3.3.1	Standard output operating voltage tolerance Minimum output voltage Maximum output voltage	Vmin Vmax	24V 30V			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
3.4	Cooling requirements					
3.4.1	Natural	Yes/No	Yes			
3.5	Abnormal output voltage					
3.5.1	Abnormal DC output voltage protection as specified	Yes/No	Yes			
3.6	No-load operation					
3.6.1	No-load operation maximum voltage	%	+10			
3.7	Overload capability					
3.7.1	Overload capability	Duty class	II			
3.8	Short-circuit and current limit capability					
3.8.1	Short circuit capability as stipulated in IEC 62040-3	Yes/No	Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
3.9	Internal protection					
3.9.1	Internal protection	Yes/No	Yes			
3.10	Hardwire/hardware independent protection					
3.10.1	Hardwire/hardware independent protection: Overvoltage protection on load Over temperature monitoring	Yes/No Yes/No	Yes Yes			
3.11	Active load sharing					
3.11.1	Active load sharing	%	≤10			
3.12	Efficiency					
3.12.1	a) @ 25% load	%	>87.5			
3.12.2	b) @ 50% load	%	>90			
3.12.3	c) @75% load	%	>92.5			
3.12.4	d) @ 100% load	%	>95			
3.13	Electromagnetic environment and immunity requirements					
3.13.1	Conducted and radiated emissions					

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
3.13.1.1	Conducted and radiated emissions as specified in IEC 62040-2 for category C3	Yes/No	Yes			
3.13.1.2	Low frequency emissions THDI as per IEC 6100-3-2	%	≤10			
3.14	Immunity					
3.14.1	Immunity as specified in IEC 62040-2 for category C3	Yes/No	Yes			
3.15	Audible noise					
3.15.1	Audible noise	dB	<65			
3.16	Lightning protection					
3.16.1	Input	kV	6			
3.16.2	DC port	kV	4			
3.16.3	Output	kV	4			
3.17	Electrical Requirements					
3.17.1	General					
3.17.1.1	Combined fused switches	IEC 60947-3	IEC 60947-3			
3.17.1.2	Moulded case circuit breakers	IEC 60947-2	IEC 60947-2			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
3.17.1.3	Contactors	IEC 60947-4	IEC 60947-4			
3.17.1.4	Transfer switches	IEC 60947-6	IEC 60947-6			
3.17.1.5	Terminal blocks	IEC 60947-7 and Eskom standard 240-70413291	IEC 60947-7 and Eskom standard 240-70413291			
3.17.1.6	Control circuit devices and switching elements	IEC 60947-5	IEC 60947-5			
3.18	Input isolation and overload protection	CFS/MCCB/MC B		xxxx		
3.18.1	Input isolation and overload protection provided	Yes/No	Yes			
3.18.2	Aux contacts provided	Yes/No	Yes			
3.19	Output isolation and overload protection	CFS/MCCB/MC B		xxxx		
3.19.1	Output isolation and overload protection provided	Yes/No	Yes			
3.19.3	Aux contacts provided	Yes/No	Yes			
3.20	Input – output isolation	Yes/No				

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
3.20.1	Input – output isolation galvanically	Yes/No	Yes			
3.21	Earthing					
3.21.1	Exposed non-current carrying parts earthed onto earth bar	Yes/No	Yes			
3.21.2	External earthing point	Yes/No	Yes			
3.21.3	Neutral (grounded circuit conductor) bonded to safety- earthing	Yes/No	Yes			
3.21.4	Earthing compliant with IEEE142:1991	Yes/No	Yes			
3.22	Measurements, controls, indications and alarms					
3.22.1	Converter measurement					
3.22.1.1	Meter types	Panel meters/ LCD	LCD			
3.22.1.2	Meter accuracy	%	1			
3.22.1.3	Input voltage measurement	Yes/No	Yes			
3.22.1.4	Output voltage measurement	Yes/No	Yes			
3.22.1.5	Output current measurement	Yes/No	Yes			
3.23	Converter controls					
3.23.1	Alarm reset	Yes/No	Yes			
3.23.2	On-off switch	Yes/No	Yes			
3.23.3	Lamp test if not LCD	Yes/No	Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
3.24	Converter indications					
3.24.1	Input healthy	Yes/No				
3.24.2	Output healthy	Yes/No				
3.25	Local Alarms	Remote Alarm				
3.25.1	Output failure	Output Failure	Yes			
3.25.2	Mains failure	Input Failure	Yes			
3.25.3	Additional alarms	Specify				
3.26	Communication and control design requirements					
3.26.1	General					
3.26.2	Remote communication link	Yes/No	Yes			
3.26.3	Communications protocol DNP 3.0 level 2 or 3 protocols and IEC 61850	Yes/No	Yes			
3.26.4	Micro-processor controlled	Yes/No	Yes			
3.26.5	Internal rectifier module micro-processor controlled as back-up	Yes/No	Yes			
3.26.6	Diagnostic and telemetry capability	Yes/No	Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
3.27	Real time clock and time synchronization					
3.27.1	Real time clock and time synchronization for 30 years	Yes/No	Yes			
3.27.2	Real time clock drift	Seconds/Month	<60			
3.27.3	Resettable clock with resetting other parameters	Yes/No	Yes			
3.27.4	Maintain time of clock for 7 days during loss of supply	Yes/No	Yes			
3.27.5	Synchronization of IEDs	Yes/No	Yes			
3.27.6	Synchronization indicated in event log	Yes/No	Yes			
3.28	Communication ports					
3.28.1	Communication ports	2 x Rs-232 1x Rs485 1 x Ethernet or Fibre optic	Yes Yes Yes			
3.29	Monitoring and control					
3.29.1	Interface to local PC	Yes/No	Yes			
3.29.2	Remote interface with charger/rectifier	Yes/No	Yes			
3.29.3	Pre-programmed current/voltage/time durations	Yes/No	Yes			
3.29.4	Optimal management during normal supply unavailability	Yes/No	Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
3.29.5	Software and firmware upgradeable	Yes/No	Yes			
3.29.6	Settings, indications and alarm display via front panel	Yes/No	Yes			
3.29.7	Password controlled	Yes/No	Yes			
3.29.8	Real time control	Yes/No	Yes			
3.29.9	Default values for stand-alone operation	Yes/No	Yes			
3.29.10	Individual rectifier module parameter monitoring and comparison.	Yes/No	Yes			
3.29.11	Unique remote controller identification	Yes/No	Yes			
3.30	Software and firmware					
3.30.1	General					
3.30.1.1	Software to access equipment	Yes/No	Yes			
3.30.1.2	Software updates compatible with supplied systems	Yes/No	Yes			
3.30.1.3	Software license and documentation copyright	Yes/No	Yes			
3.30.1.4	Software support	Yes/No	Yes			
3.30.1.5	Software detail to be supplied	Yes/No	Yes			
3.30.1.6	Adhere to software control standard	Yes/No	Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
3.30.1.7	Settings and display features available from front panel display	Yes/No	Yes			
3.30.1.8	Alarm/event lock downloadable	Yes/No	Yes			
3.30.1.9	Software capable to upload and download alarm/ event log or settings	Yes/No	Yes			
3.30.1.10	Software display the status of any modules connected	Yes/No	Yes			
3.30.1.11	Software to display the status of remote communication connections	Yes/No	Yes			
3.30.1.12	Software verification and validation	Yes/No	Yes			
3.30.2	System firmware					
3.30.2.1	Equipment system firmware displayed on the equipment	Yes/No	Yes			
3.30.2.2	Firmware alterations to be controlled	Yes/No	Yes			
3.30.2.3	Data retention for the expected life of the equipment	Yes/No	Yes			
3.30.2.4	Firmware upgradeable	Yes/No	Yes			
4.0	Mechanical Requirements					
4.1	General					
4.1.1	Compliance to clause 5 of SANS 10142-1 and SANS 62040-1	Yes/No	Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
4.1.2	Designed, constructed and tested in accordance to clause 6.6 of SANS 10142-1	Yes/No	Yes			
4.2	Main, Distribution, Equalizing and Collection Busbars					
4.2.1	Joints and tees in busbar compliance Bolts high tensile	T-22 8.8 to ISO 898-1	T-22 8.8 (ISO 898-1)			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
4.2.2	Joints: Minimum number of bolts Busbar overlap Washers	Multiple of thickness or relative to width Conical or spring	≥2 ≥6 or equal Conical			
4.2.3	All busbar supports with minimum rating of the respective fault current rating	Yes/No	Yes			
4.2.4	Span of distribution busbar shall not interfere with cable entry zone.	Yes/No	Yes			
4.3.0	Busbar identification marking: DC Busbars 220 and 26V DC Busbars	Yes/No Red – positive and Black -Negative	Yes Red – positive and Black- Negative			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
4.3.1	Collection busbars need to be constructed where SCPD's and mcb's need to be connected in cascaded circuits	Yes/No	Yes			
4.3.2	Sufficient supports for equalizing busbars to withstand fault current	Yes/No	Yes			
4.4	Protective earth conductor and screened earth busbar					
4.4.1	A separate protective earth connected	Yes/No	Yes			
4.4.2	Non-current carrying conductive parts connected to PE	Yes/No	Yes			
4.4.3	Earth conductor size connected to doors	mm ²	6			
4.4.4	PE rating	SANS 10142-1	SANS 10142-1			
4.4.5	Protective circuit parts rated for the highest fault condition	Yes/No	Yes			
4.4.6	Screened earth busbar		xxxx			
4.4.7	PE conductor colour	Green with yellow stripes	Green with yellow stripes			
4.5	Power and control cabling					
4.5.1	Power circuit wiring and connections rated according to the de-rated operating current of the associated protective gear	Yes/No	Yes			
4.5.2	Control wiring connected to source of fault energy rating	1.5 times fuse rating and	1.5 times fuse rating			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
		withstanding I ² t fuse rating	and withstanding I ² t fuse rating			
4.5.3	Individual function unit connection to the control busbar		Xxxx			
4.5.4	Connections to equipment mounted on swing doors		Xxxx			
4.5.5	Type of conductor cable	Stranded, single or solid	Stranded			
4.5.6	Multistrand cable conductor diameter	mm ²	1.5			
4.5.7	Multistrand cable conductor diameter for current and voltage transformers	mm ²	2.5			
4.5.8	Joints and splices in any circuit, more than one conductor in one lug.	Not allowed	Not allowed			
4.5.9	Terminals assembly and labels shall be accessible		Xxxx			
4.5.10	Terminals which are on the live side of fuses and isolating switches shall be completely shrouded	Yes/No	Yes			
4.5.11	Coils in-line with normally open contacts connected to positive	Yes/No	Yes			
4.5.12	Compression joints standard	BS EN 61238	BS EN 61238			
4.5.13	Grommets installed on all holes through which cables are passing	Yes/No	Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
4.5.14	Conductors >100A and passing through metal	Conductor (both poles of DC conductors) or metal barrier split	Xxxx			
4.5.15	Power circuit cable sizing standard for the specified volt-drop	SANS 1973-1	SANS 1973-1			
4.5.16	Stripping of insulation standard		Xxxx			
4.5.17	Crimping standard		Xxxx			
4.5.18	Correct torque standard		Xxxx			
4.6	Conductor identification					
4.6.1	Conductor identification	Yes/No	Yes			
4.6.2	Control conductor identification DC circuits	Black Grey	Black Grey			
4.6.3	Control bus wiring identification DC	Red – positive Black – negative	Red - positive Black - negative			
4.6.4	Control conductor wiring		Xxxx			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
4.7	Enclosure and Assembly					
4.7.1	EMC testing required with door open when MCB and MCCB are fitted behind the door	Yes/No	Yes			
4.7.2	Individual segregation for input, DC port, output, signal and control cabling	Yes/No	Yes			
4.7.3	Converter modules and controller sub rack assemblies	Swing/fix frame assembly	Swing/fix frame assembly options			
4.8	Sub- rack assemblies and input/output power distribution modules					
4.8.1	Sub-rack inclusions: <ul style="list-style-type: none"> • Controller sub-assembly in-front • Terminal plate sub-assembly rear • Segregated wire loom 	Yes/No Yes/No Yes/No	Yes Yes Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
4.8.2	Input/output power modules : Front distribution modules Terminal plate sub assembly rear Segregated wire loom	Yes/No Yes/No Yes/No	Yes Yes Yes			
4.8.3	Sub-rack expandable to maximum modules power rating	Yes/No	Yes			
4.8.4	Sub-rack pre wired for expansion	Yes/No	Yes			
4.8.5	Blanking plates installed on unused module positions	Yes/No	Yes			
4.8.6	Ingress protection	IP	IP2X			
4.8.7	Individual MCB module locking facility	Yes/No	Yes			
4.8.8	Terminal plate and top drawer plate thickness	mm	1.6			
4.8.9	Slotted mounting hole dimensions as per IEC 60297-1 <ul style="list-style-type: none"> • Width • Height • Horizontal distance between hole centres 	IEC 60297-1 mm mm mm	IEC 60197-1 10.3 6.80 465.1			
4.8.10	Overall aesthetically pleasing appearance	Yes/No	Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
4.8.11	Earthing stud fitted on terminal plate	Yes/No	Yes			
4.9	Ingress protection					
4.9.1	IP rating Panel doors closed Panel doors open	IP IP	31 2X			
4.9.2	Additional IP rating requirements	IP	As options IP45 IP55 IP65			
4.10	Cable entry					
4.10.1	Cable entry	Top/bottom	Bottom			
4.11	Fire retardant and sealing of floor slot	Yes/No	Yes required as part of installation			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
4.12	Corrosion protection					
4.12.1	Corrosion protection standard	SCSSCAAP9	SCSSCAAP 9			
4.12.2	DC input supply assembly colour	A11	A11			
4.13	Terminations					
4.13.1	Termination standard	240-70413291	240-70413291			
4.13.2	Terminations for all input output and alarming	Yes/No	Yes			
4.13.3	Maximum number of cable cores per termination point	#	2			
4.13.4	Input terminal rating at input minimum voltage	Yes/No	Yes, alternatives can be specified as an option			
4.14	Internal wiring					
4.14.1	Wire ways and trunking shall be smooth and free of sharp edges	Yes/No	Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
4.14.2	Trunking temperature rating	°C	90			
4.14.3	All wiring in trunking or wire looms clipped or laced	Yes/No	Yes			
4.15	Conformal coatings					
4.15.1	Conformal coatings required	Yes/No	Yes			
4.16	Accessibility					
4.16.1	Accessibility for cable termination	Yes/No	Yes			
4.16.2	Normal maintenance accessibility following installation	Yes/No	Yes			
4.16.3	Accessibility	Front/rear	Front and rear			
4.17	Minimum clearances					
4.17.1	Pole-to-pole and pole-to-earth clearance standard	SANS 10142-1	SANS 10142-1			
4.17.2	Terminals for input, DC port and output	Segregated/ barriers	Segregated /barriers			
4.17.3	Minimum creepage distance rating as per SANS 60439-1 clause 7.1.2	Pollution Degree 3, material group 111a with the specified insulation voltage	Pollution Degree 3, material group 111a with the specified insulation voltage			
4.17.4	Clearance and creepage distances	SANS 60439-1	SANS 60439-1			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
		Table 14 and 16	Table 14 and 16			
4.18	Nameplate/rating plate/declared electrical performance					
4.18.1	Nameplate material	Stainless steel/ anodized aluminum	Stainless steel/ anodized aluminum			
4.18.2	Nameplate information	Clause 3.4.18	Clause 3.4.18			
5.0	Settings and Commissioning					
5.1	Settings					
5.1.1	Settings standard	240-56176168	240-56176168			
5.1.2	Settings document for each piece of equipment required based on specific application	Yes/No	Yes To be compiled by OEM based on application.			
5.1.3	Microprocessor shall be programmed with these settings as default	Yes/No	Yes			
5.1.4	Revision indicated on document	Yes/No	Yes			
5.1.5	SCPD indicated on settings document	Yes/No	Yes			
5.2	Commissioning					
5.2.1	Commissioning standard	240-56177186	240-56177186			
5.2.2	As commissioning routine, operational and functional tests shall be performed	Yes/No	Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
5.3	Upgrading/modifications					
5.3.1	Upgrade/modification report required	Yes/No	Yes			
5.3.2	Hardware upgrade identification	Yes/No	Yes			
5.4	Equipment performance					
5.4.1	Warranty					
5.4.1.1	Warranty period	36 months from date of commissioning	36 months from date of commissioning			
5.4.2	Reliability, security, dependability, maintainability and life expectancy					
5.4.2.1	Equipment hours of installed units per voltage or model/type	Yes/No	Yes			
5.4.2.2	Customers indicating the number of units employed per model/type	Yes/No	Yes			
5.4.2.3	Environmental conditions where such equipment is installed	Yes/No	Yes			
5.4.2.4	Equipment proven record	>2 years and one hundred equipment years	>2 years and one hundred equipment years			
5.4.2.5	Life expectancy Electronic equipment Other hardware	≥15 years ≥20 years				
5.4.2.6	Written guarantee to meet life expectancy	Yes/No	Yes			

Tem	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
5.4.2.7	Supplier product health statement	Yes/No	Yes			
5.4.2.8	Internal battery specification		xxxx			
6.0	Type testing					
6.1	Converter tests	Type Tests Required as per IEC 60146-1-1				
6.1.1	Insulation test	Yes/No	Yes			
6.1.2	Light load functional test.	Yes/No	Yes			
6.1.3	Functional test	Yes/No	Yes			
6.1.4	Rated current test	Yes/No	Yes			
6.1.5	Power loss determination for assemblies and equipment	Yes/No	Yes			
6.1.6	Temperature rise test	Yes/No	Yes			
6.1.7	Power factor measurement	Yes/No	Yes			
6.1.8	Checking of auxiliary devices	Yes/No	Yes			
6.1.9	Checking the properties of the control equipment	Yes/No	Yes			
6.1.10	Checking the protective devices	Yes/No	Yes			
6.1.11	Immunity test	Yes/No	Yes			
6.1.12	Overcurrent capability test	Yes/No	Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
6.1.13	Radio frequency generated interference and conducted noise	Yes/No	Yes			
6.1.14	Audible noise	Yes/No	Yes			
6.1.15	Additional tests	Yes/No	Yes			
6.2	Type Tests Required as per SANS 1652	Yes/No	Yes			
6.2.1	Dielectric strength test	Yes/No	Yes			
6.2.2	Insulation resistance test	Yes/No	Yes			
6.2.3	Temperature rise test	Yes/No	Yes			
6.2.4	Power efficiency test	Yes/No	Yes			
6.2.5	Test for protection against lightning surges	Yes/No	Yes			
6.2.6	Short-circuit test on output terminals	Yes/No	Yes			
6.2.7	Audible noise level test	Yes/No	Yes			
6.2.8	Salt fog test	Yes/No	Yes			
6.2.9	Glow-wire test on non-metallic enclosures	Yes/No	Yes			
6.2.10	Lightning surge test	Yes/No	Yes			
6.2.11	Parallel operation test	Yes/No	Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
7.0	Marking, labeling and packaging					
7.1	Labelling					
7.1.1	Labeling	0.54/3695 sheet 1 & 2 or 240- 62629353	0.54/3695 sheet 1 & 2 or 240-62629353			
7.1.2	Package labelling	Yes/No	Yes			
7.2	Packaging					
7.2.1	Packaging	High specification impact resistant corrugated cardboard with waterproof outer plastic covering	High specification impact resistant corrugated cardboard with waterproof outer plastic covering			
7.2.2	Additional packaging requirements	Crating	Crating as an option			
8.0	Spares					
8.1	General					
8.1.1	Spares list	Yes/No	Yes			
8.1.2	Maintenance spares list	Yes/No	Yes			
8.1.3	Spares pricing	Yes/No	Yes			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
8.1.4	Spares life expectancy within packaging	Years	15			
8.1.5	Spares available for warranty period	Yes/No	Yes			
8.1.6	Delivery	hr ex-works	24			
8.1.7	Spares availability	Years	10			
9.0	Documentation					
9.1	General					
9.1.1	Sets of hard copies	#	3			
9.1.2	Drawings format Drawings size	.dgn A3	.dgn A3			
9.2	Drawings					
9.2.1	General arrangement drawings	Yes/No	Yes			
9.2.2	Single line diagrams	Yes/No	Yes			
9.2.3	Schematic drawings	Yes/No	Yes			
9.2.3	Installation, operating and maintenance instruction manuals					
9.2.3.1	All instruction detailed manuals shall be comprehensively	Number of copies including .pdf software copy				

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
9.2.3.2	The manuals shall cover all equipment forming part of the assembly including: <ul style="list-style-type: none"> • Content list • List of reference drawings • Detail of all components 	Yes/No Yes /No Yes /No Yes/No	Yes Yes Yes Yes			
9.2.3.3	Manual in loose leaf binder to ISO standard in A4 size	Yes/No	Yes			
9.2.3.4	Manual content	General arrangement drawings, installation drawings and instructions, operating and maintenance instructions for all components, detailed parts list, spare parts ordering instructions etc	General arrangement drawings, installation drawings and instructions, operating and maintenance instructions for all components, detailed parts list, spare parts ordering instructions etc			

Item	Description	Description	Schedule A	Schedule B	Evidence reference	Comments
9.2.3.5	Additional content	Special instructions pertaining to spares storage, drawings for component locations, dismantling and re-assembly.	Special instructions pertaining to spares storage, drawings for component locations, dismantling and re- assembly.			
9.2.3.6	Special tool requirements		xxxx			
9.2.4	Engineering design system					
9.2.4.1	EDS source document of design	Yes/No	Yes			
10.0	Language					
10.1	Language on display, drawings, documentation and software	US or UK English				

