NEC3 Engineering & Construction Contract

Between **ESKOM HOLDINGS SOC Ltd**
(Reg No. 2002/015527/30)

and **[Insert at award stage]**
(Reg No. _____)

for **Vanderkloof Generator Protection, Synchroniser, Metering and Transmission Upgrade**

Contents:

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Enquiry No. **WCPK1106JC**

Part C1: Agreements & Contract Data

Contents:

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C1.2b Contract Data provided by the *Contractor*

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C1.1 Form of Offer & Acceptance

Offer

The Employer, identified in the Acceptance signature block, has solicited offers to enter into a contract for the procurement of:

Vanderkloof Generator Protection, Synchroniser, Metering and Transmission Upgrade

The tenderer, identified in the Offer signature block, has examined the documents listed in the Tender Data and addenda thereto and by submitting this Offer has accepted the Conditions of Tender.

By the representative of the tenderer, deemed to be duly authorised, signing this part of this Form of Offer and Acceptance the tenderer offers to perform all of the obligations and liabilities of the *Contractor* under the contract including compliance with all its terms and conditions according to their true intent and meaning for an amount to be determined in accordance with the *conditions of contract* identified in the Contract Data.

Options A	The offered total of the Prices exclusive of VAT is	**R [●]**
	Sub total	**R [●]**
	Value Added Tax @ 15% is	**R [●]**
	The offered total of the amount due inclusive of VAT is[1]	**R [●]**
	(in words) **[●]**	

This Offer may be accepted by the Employer by signing the Acceptance part of this Form of Offer and Acceptance and returning one copy of this document including the Schedule of Deviations (if any) to the tenderer before the end of the period of validity stated in the Tender Data, or other period as agreed, whereupon the tenderer becomes the party named as the *Contractor* in the *conditions of contract* identified in the Contract Data.

Signature(s) .....

Name(s) .....

Capacity .....

For the tenderer:

.....
(Insert name and address of organisation)

Name & signature of witness .....

Date .....

Tenderer's CIDB registration number (if applicable) .....

[1] This total is required by the *Employer* for budgeting purposes only. Actual amounts due will be assessed in terms of the *conditions of contract*.

Acceptance

By signing this part of this Form of Offer and Acceptance, the Employer identified below accepts the tenderer's Offer. In consideration thereof, the Employer shall pay the Contractor the amount due in accordance with the *conditions of contract* identified in the Contract Data. Acceptance of the tenderer's Offer shall form an agreement between the Employer and the tenderer upon the terms and conditions contained in this agreement and in the contract that is the subject of this agreement.

The terms of the contract, are contained in:

Part C1	Agreements and Contract Data, (which includes this Form of Offer and Acceptance)
Part C2	Pricing Data
Part C3	Scope of Work: Works Information
Part C4	Site Information

and drawings and documents (or parts thereof), which may be incorporated by reference into the above listed Parts.

Deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Returnable Schedules as well as any changes to the terms of the Offer agreed by the tenderer and the Employer during this process of offer and acceptance, are contained in the Schedule of Deviations attached to and forming part of this Form of Offer and Acceptance. No amendments to or deviations from said documents are valid unless contained in this Schedule.

The tenderer shall within two weeks of receiving a completed copy of this agreement, including the Schedule of Deviations (if any), contact the Employer's agent (whose details are given in the Contract Data) to arrange the delivery of any securities, bonds, guarantees, proof of insurance and any other documentation to be provided in terms of the *conditions of contract* identified in the Contract Data at, or just after, the date this agreement comes into effect. Failure to fulfil any of these obligations in accordance with those terms shall constitute a repudiation of this agreement.

Notwithstanding anything contained herein, this agreement comes into effect on the date when the tenderer receives one fully completed original copy signed between them of this document, including the Schedule of Deviations (if any).

Unless the tenderer (now *Contractor*) within five working days of the date of such receipt notifies the Employer in writing of any reason why he cannot accept the contents of this agreement, this agreement shall constitute a binding contract between the Parties.

Signature(s) .....

Name(s) .....

Capacity .....

for the Employer

.....
(Insert name and address of organisation)

Name & signature of witness .....

Date .....

Note: If a tenderer wishes to submit alternative tenders, use another copy of this Form of Offer and Acceptance.

Schedule of Deviations to be completed by the *Employer* prior to contract award

Note:

1. This part of the Offer & Acceptance would not be required if the contract has been developed by negotiation between the Parties and is not the result of a process of competitive tendering.
2. The extent of deviations from the tender documents issued by the Employer prior to the tender closing date is limited to those permitted in terms of the Conditions of Tender.
3. A tenderer's covering letter must not be included in the final contract document. Should any matter in such letter, which constitutes a deviation as aforesaid be the subject of agreement reached during the process of Offer and Acceptance, the outcome of such agreement shall be recorded here and the final draft of the contract documents shall be revised to incorporate the effect of it.

No.	Subject	Details
1	**[●]**	**[●]**
2	**[●]**	**[●]**
3	**[●]**	**[●]**
4	**[●]**	**[●]**
5	**[●]**	**[●]**
6	**[●]**	**[●]**
7	**[●]**	**[●]**

By the duly authorised representatives signing this Schedule of Deviations below, the Employer and the tenderer agree to and accept this Schedule of Deviations as the only deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Tender Schedules, as well as any confirmation, clarification or changes to the terms of the Offer agreed by the tenderer and the Employer during this process of Offer and Acceptance.

It is expressly agreed that no other matter whether in writing, oral communication or implied during the period between the issue of the tender documents and the receipt by the tenderer of a completed signed copy of this Form shall have any meaning or effect in the contract between the parties arising from this Agreement.

	For the tenderer:	**For the Employer**
Signature	.....	.....
Name	.....	.....
Capacity	.....	.....
On behalf of	..... *(Insert name and address of organisation)*	..... *(Insert name and address of organisation)*
Name & signature of witness	.....	.....
Date	.....	.....

C1.2 ECC3 Contract Data

Part one - Data provided by the *Employer*

[Instructions to the contract compiler: (delete these two notes in the final draft of a contract)

1. Please read the relevant clauses in the conditions of contract before you enter data. The number of the clause which requires the data is shown in the left-hand column for each statement however other clauses may also use the same data.

1. Some ECC3 options are always selected by Eskom Holdings SOC Ltd. The remaining ECC3 options are identified by shading in the left-hand column. In the event that the option is not required select and delete the whole row. Where the following symbol is used "**[●]" -** data is required to be inserted relevant to the specific option selected.]

Completion of the data in full, according to the Options chosen, is essential to create a complete contract.

Clause	Statement	Data
1	**General**	
	The *conditions of contract* are the core clauses and the clauses for main Option	
		A: Priced contract with activity schedule
	dispute resolution Option	**W1: Dispute resolution procedure**
	and secondary Options	
		X1: Price adjustment for inflation
		X2 Changes in the law
		X3: Multiple currencies
		X5: Sectional Completion
		X7: Delay damages
		X13: Performance Bond
		X15: Limitation of *Contractor's* liability for design to reasonable skill and care
		X16: Retention
		X17: Low performance damages
		X18: Limitation of liability
		Z: *Additional conditions of contract*
	of the NEC3 Engineering and Construction Contract, April 2013 (ECC3)	
10.1	The *Employer* is (Name):	**Eskom Holdings SOC Ltd (reg no: 2002/015527/30), a state-owned company incorporated in terms of the company laws of the Republic of South Africa**

	Address	**Registered office at Megawatt Park, Maxwell Drive, Sandton, Johannesburg**
10.1	The *Project Manager* is: (Name)	**Neil Davids**
	Address	**Eskom Road, Brackenfell Complex Block M Section A**
	Tel	**021 941 5988**
	e-mail	**DavidsNN@eskom.co.za**
10.1	The *Supervisor* is: (Name)	**Neil Davids**
	Address	**Eskom Road, Brackenfell Complex Block M Section A**
	Tel No.	**021 941 5988**
	e-mail	**DavidsNN@eskom.co.za**
11.2(13)	The *works* are	The *Works* entails the supply, design, software logic design and panel manufacturing, factory inspection, programming, factory acceptance testing, delivery to site, off-loading, decommissioning, installation, training, on-site commissioning as well as live commissioning and documentation of the following unit 1 and unit 2 equipment: • Generator and Generator Transformer Protection schemes • Generator Synchronisers and Bay Processor • Power Line differential protection scheme • Generator Metering and Measurement System • Excitation Metering and Measurement System • Unit Transformer Metering and Measurement System • Energy Management and Data

Acquisition System (EMDAS)

- Cabling (by Others – C&E Upgrade Cable *Contractor*)
- Spares (to be identified by the *Contractor* and the *Employer*)

The intent is that the new equipment will be the functional equivalent of the existing systems, but with the enhancements and improvements that are offered by the new technology and EMDAS.

11.2(14)	The following matters will be included in the Risk Register	**All early warning matters notified by the *Project Manager* or the *Contractor***
11.2(15)	The *boundaries of the site* are	**Control Room, Generator floor and Roodekuil switching substation**
11.2(16)	The Site Information is in	**Part 4: Site Information**
11.2(19)	The Works Information is in	**Part 3: Scope of Work and all documents and drawings to which it makes reference.**
12.2	The *law of the contract* is the law of	**the Republic of South Africa**
13.1	The *language of this contract* is	**English**
13.3	The *period for reply* is	**2 working days pre installation and 24 hours during installation**
2	**The *Contractor's* main responsibilities**	**Data required by this section of the core clauses is provided by the *Contractor* in Part 2 and terms in italics used in this section are identified elsewhere in this Contract Data.**
3	**Time**	
11.2(3)	The *completion date* for the whole of the *works* is	**31 August 2025.**
11.2(9)	The *key date*s and the *condition*s to be met are:	

	***Condition* to be met**	***key date***
1	**1st Unit 2**	**21 February 2024**
2	**2nd Unit 1**	**10 January 2025**
3	**Detailed Design submission**	**01 October 2023**
4	**Commissioning Completed Unit 2**	**22 June 2024**
5	**Commissioning Completed**	**12 May 2025**

		Unit 1	
30.1	The *access dates* are:	**Part of the Site**	**Date**
		1 Unit 2	**21 February 2024**
		2 Unit 1	**10 January 2025**
	Note: Eskom outages are subject to movements. For zero Compensation Events to the *Contractors.* Eskom to notify the *Contractor* at least one month prior to the new outage start date		
31.1	The *Contractor* is to submit a first programme for acceptance within	**2 (Two) weeks of the Contract Date.**	
31.2	The *starting date* is	**31 August 2023**	
32.2	The *Contractor* submits revised programmes at intervals no longer than	**1 (One) week.**	
35.1	The *Employer* is not willing to take over the *works* before the Completion Date **of each unit**.		
4	**Testing and Defects**		
42.2	The *defects date* is	**52 weeks after Completion of each unit.**	
43.2	The *defect correction period* is	**2 (Two) days**	
5	**Payment**		
50.1	The *assessment interval* is	**between the 25th day of each successive month.**	
51.1	The *currency of this contract* is the	**TBC.**	
51.2	The period within which payments are made is	**30 days after receipt of acceptable Tax Invoice and all relevant supporting documentation.**	
51.4	The *interest rate* is	**the publicly quoted prime rate of interest (calculated on a 365 day year) charged from time to time by the Standard Bank of South Africa Limited (as certified, in the event of any dispute, by any manager of such bank, whose appointment it shall not be necessary to prove) for amounts due in Rands and** **(ii) the LIBOR rate applicable at the time for amounts due in other currencies. LIBOR is the 6 month London Interbank Offered Rate quoted under the caption "Money Rates" in The Wall Street Journal for the applicable currency or if no rate is quoted for the currency in question then the rate for United States Dollars, and if no such rate appears in The Wall Street Journal then the rate as quoted by the Reuters Monitor Money Rates Service (or such service as may replace the Reuters Monitor Money**	

		Rates Service) on the due date for the payment in question, adjusted *mutatis mutandis* every 6 months thereafter and as certified, in the event of any dispute, by any manager employed in the foreign exchange department of The Standard Bank of South Africa Limited, whose appointment it shall not be necessary to prove.
6	**Compensation events**	**Applicable as per Section 6 of the NEC 3 ECC (April 2013)**
60.1(13)	The place where weather is to be recorded is: The *weather measurements* are supplied by	**The South African Weather Bureau** **The contractor to obtain the one in ten year return weather data from South African Weather Bureau**
7	**Title**	**Applicable as per Section 7 of the NEC 3 ECC (April 2013).**
8	**Risks and insurance**	
80.1	These are additional *Employer*'s risks	**Outage movement dates**
9	**Termination**	**Applicable as per Section 9 of the NEC 3 ECC (April 2013).**
10	**Data for main Option clause**	
A	**Priced contract with activity schedule**	**Refer to part 2: Pricing Data of this contract.**
11	**Data for Option W1**	
W1.1	The *Adjudicator* is	**the person selected from the ICE-SA Division (or its successor body) of the South African Institution of Civil Engineering Panel of Adjudicators by the Party intending to refer a dispute to him. (see www.ice-sa.org.za). If the Parties do not agree on an Adjudicator the Adjudicator will be appointed by the Arbitration Foundation of Southern Africa (AFSA).**
W1.2(3)	The *Adjudicator nominating body* is:	**the Chairman of ICE-SA a joint Division of the South African Institution of Civil Engineering and the London Institution of Civil Engineers. (See www.ice-sa.org.za) or its successor body.**
W1.4(2)	The *tribunal* is:	**arbitration.**
W1.4(5)	The *arbitration procedure* is The place where arbitration is to be held is The person or organisation who will choose an arbitrator	**the latest edition of Rules for the Conduct of Arbitrations published by The Association of Arbitrators (Southern Africa) or its successor body.** **Johannesburg, South Africa**

	- if the Parties cannot agree a choice or - if the arbitration procedure does not state who selects an arbitrator, is	**the Chairman for the time being or his nominee of the Association of Arbitrators (Southern Africa) or its successor body.**

12 Data for secondary Option clauses

X1	**Price adjustment for inflation**			
X1.1(a)	The *base date* for indices is	**SARB exchange rate published 7 calendar days before closing date**		
X1.1(c)	The proportions used to calculate the Price Adjustment Factor are:	**proportion**	**linked to index for**	**Index prepared by**
		0. [●]	**[●]**	**[●]**
		0. [●]	**[●]**	**[●]**
		0. [●]	**[●]**	**[●]**
		0. [●]	**[●]**	**[●]**
		0. [●]	**[●]**	**[●]**
		[●]	**non-adjustable**	
	Total			
X2	**Changes in the law**	**Applicable as per secondary option Clause X2.**		
X5	**Sectional Completion**			
X5.1	The *completion date* for each *section* of the *works* is:	***Section***	**Description**	***Completion date***
		1	**Unit 2**	**22 June 2024**
		2	**Unit 1**	**12 May 2025**
X5 & X7	**Sectional Completion and delay damages used together,**			
X7.1 X5.1	Delay damages for late Completion of the *section*s of the *works* are:	***section***	**Description**	**Amount per day**
		1	**Installation and Commissioning First Unit**	**10% of listed activities**
		2	**Installation and Commissioning Second Unit**	**10% of listed activities**
	The total delay damages payable by the *Contractor* does not exceed:	**10% of the contract value**		

X13	**Performance bond**	
X13.1	The amount of the performance bond is	**10% of the contract value.**
X15	**Limitation of the *Contractor*'s liability for his design to reasonable skill & care**	**Applicable as per secondary clause X15**
X16	**Retention**	
X16.1	The *retention free amount* is The *retention percentage* is	**R0.00 (Zero Rand).** **10% of the Prices, 5% will be released at Completion of each unit and the remaining 5% will be released after the Defects Certificate has been issued.**
X17	**Low performance damages**	
X17.1	The amounts for low performance damages are:	**10% of the contract value.**
X18	**Limitation of liability**	
X18.1	The *Contractor*'s liability to the *Employer* for indirect or consequential loss is limited to:	**R0.0 (zero Rand)**
X18.2	For any one event, the *Contractor*'s liability to the *Employer* for loss of or damage to the *Employer*'s property is limited to:	**the amount of the deductibles relevant to the event described in the insurance policy format selected in the data for clause 84.1 above, which is available on request from Eskom Group Insurance.**
X18.3	The *Contractor*'s liability for Defects due to his design which are not listed on the Defects Certificate is limited to	**The greater of** • **the total of the Prices at the Contract Date and** • **the amounts excluded and unrecoverable from the *Employer*'s assets policy for correcting the Defect (other than the resulting physical damage which is not excluded) plus the applicable deductible as at contract date.**
X18.4	The *Contractor*'s total liability to the *Employer* for all matters arising under or in connection with this contract, other than excluded matters, is limited to:	**the total of the Prices other than for the additional excluded matters.** **The *Contractor's* total liability for the additional excluded matters is not limited.** **The additional excluded matters are amounts for which the *Contractor* is liable under this contract for** • **Defects due to his design which arise before the Defects Certificate is issued,** • **Defects due to manufacture and fabrication outside the Site,** • **loss of or damage to property (other than the *works*, Plant and Materials),** • **death of or injury to a person and** • **infringement of an intellectual property right.**

X18.5	The *end of liability date* is	**(i) 1 (one) year after the *defects date* for latent Defects and** **(ii) the date on which the liability in question prescribes in accordance with the Prescription Act No. 68 of 1969 (as amended or in terms of any replacement legislation) for any other matter.** **A latent Defect is a Defect which would not have been discovered on reasonable inspection by the *Employer* or the *Supervisor* before the *defects date*, without requiring any inspection not ordinarily carried out by the *Employer* or the *Supervisor* during that period. If the *Employer* or the *Supervisor* do undertake any inspection over and above the reasonable inspection, this does not place a greater responsibility on the *Employer* or the *Supervisor* to have discovered the Defect.**
Z	**The *Additional conditions of contract* are**	**Z1 to Z15 always apply.**

Z1 Cession delegation and assignment

Z1.1 The *Contractor* does not cede, delegate or assign any of its rights or obligations to any person without the written consent of the *Employer.*

Z1.2 Notwithstanding the above, the *Employer* may on written notice to the *Contractor* cede and delegate its rights and obligations under this contract to any of its subsidiaries or any of its present divisions or operations which may be converted into separate legal entities as a result of the restructuring of the Electricity Supply Industry.

Z2 Joint ventures

Z2.1 If the *Contractor* constitutes a joint venture, consortium or other unincorporated grouping of two or more persons or organisations then these persons or organisations are deemed to be jointly and severally liable to the *Employer* for the performance of this contract.

Z2.2 Unless already notified to the *Employer*, the persons or organisations notify the *Project Manager* within two weeks of the Contract Date of the key person who has the authority to bind the *Contractor* on their behalf.

Z2.3 The *Contractor* does not alter the composition of the joint venture, consortium or other unincorporated grouping of two or more persons without the consent of the *Employer* having been given to the *Contractor* in writing.

Z3 Change of Broad Based Black Economic Empowerment (B-BBEE) status

Z3.1 Where a change in the *Contractor's* legal status, ownership or any other change to his business composition or business dealings results in a change to the *Contractor*'s B-BBEE status, the *Contractor* notifies the *Employer* within seven days of the change.

Z3.2 The *Contractor* is required to submit an updated verification certificate and necessary supporting documentation confirming the change in his B-BBEE status to the *Project Manager* within thirty days of the notification or as otherwise instructed by the *Project Manager*.

Z3.3 Where, as a result, the *Contractor's* B-BBEE status has decreased since the Contract Date the *Employer* may either re-negotiate this contract or alternatively, terminate the *Contractor*'s obligation to Provide the Works.

Z3.4 Failure by the *Contractor* to notify the *Employer* of a change in its B-BBEE status may constitute a reason for termination. If the *Employer* terminates in terms of this clause, the procedures on termination are P1, P2 and P3 as stated in clause 92, and the amount due is A1 and A3 as stated in clause 93.

Z4 Confidentiality

Z4.1 The *Contractor* does not disclose or make any information arising from or in connection with this contract available to Others. This undertaking does not, however, apply to information which at the time of disclosure or thereafter, without default on the part of the *Contractor*, enters the public domain or to information which was already in the possession of the *Contractor* at the time of disclosure (evidenced by written records in existence at that time). Should the *Contractor* disclose information to Others in terms of clause 25.1, the *Contractor* ensures that the provisions of this clause are complied with by the recipient.

Z4.2 If the *Contractor* is uncertain about whether any such information is confidential, it is to be regarded as such until notified otherwise by the *Project Manager*.

Z4.3 In the event that the *Contractor* is, at any time, required by law to disclose any such information which is required to be kept confidential, the *Contractor*, to the extent permitted by law prior to disclosure, notifies the *Employer* so that an appropriate protection order and/or any other action can be taken if possible, prior to any disclosure. In the event that such protective order is not, or cannot, be obtained, then the *Contractor* may disclose that portion of the information which it is required to be disclosed by law and uses reasonable efforts to obtain assurances that confidential treatment will be afforded to the information so disclosed.

Z4.4 The taking of images (whether photographs, video footage or otherwise) of the *works* or any portion thereof, in the course of Providing the Works and after Completion, requires the prior written consent of the *Project Manager*. All rights in and to all such images vests exclusively in the *Employer*.

Z4.5 The *Contractor* ensures that all his subcontractors abide by the undertakings in this clause.

Z5 Waiver and estoppel: Add to core clause 12.3:

Z5.1 Any extension, concession, waiver or relaxation of any action stated in this contract by the Parties*,* the *Project Manager*, the *Supervisor*, or the *Adjudicator* does not constitute a waiver of rights, and does not give rise to an estoppel unless the Parties agree otherwise and confirm such agreement in writing.

Z6 Health, safety and the environment: Add to core clause 27.4

Z6.1 The *Contractor* undertakes to take all reasonable precautions to maintain the health and safety of persons in and about the execution of the *works*. Without limitation the *Contractor*:

- accepts that the *Employer* may appoint him as the "Principal Contractor" (as defined and provided for under the Construction Regulations 2014 (promulgated under the Occupational Health & Safety Act 85 of 1993) ("the Construction Regulations") for the Site;
- warrants that the total of the Prices as at the Contract Date includes a sufficient amount for proper compliance with the Construction Regulations, all applicable health & safety laws and regulations and the health and safety rules, guidelines and procedures provided for in this contract and generally for the proper maintenance of health & safety in and about the execution of *works*; and
- undertakes, in and about the execution of the *works*, to comply with the Construction

Regulations and with all applicable health & safety laws and regulations and rules, guidelines and procedures otherwise provided for under this contract and ensures that his Subcontractors, employees and others under the *Contractor's* direction and control, likewise observe and comply with the foregoing.

Z6.2 The *Contractor*, in and about the execution of the *works*, complies with all applicable environmental laws and regulations and rules, guidelines and procedures otherwise provided for under this contract and ensures that his Subcontractors, employees and others under the *Contractor's* direction and control, likewise observe and comply with the foregoing.

Z7 Provision of a Tax Invoice and interest. Add to core clause 51

Z7.1 Within one week of receiving a payment certificate from the *Project Manager* in terms of core clause 51.1, the *Contractor* provides the *Employer* with a tax invoice in accordance with the *Employer*'s procedures stated in the Works Information, showing the amount due for payment equal to that stated in the payment certificate.

Z7.2 If the *Contractor* does not provide a tax invoice in the form and by the time required by this contract, the time by when the *Employer* is to make a payment is extended by a period equal in time to the delayed submission of the correct tax invoice. Interest due by the *Employer* in terms of core clause 51.2 is then calculated from the delayed date by when payment is to be made.

Z7.3 The *Contractor* (if registered in South Africa in terms of the companies Act) is required to comply with the requirements of the Value Added Tax Act, no 89 of 1991 (as amended) and to include the *Employer*'s VAT number 4740101508 on each invoice he submits for payment.

Z8 Notifying compensation events

Z8.1 Delete from the last sentence in core clause 61.3, "unless the *Project Manager* should have notified the event to the *Contractor* but did not".

Z9 *Employer's* limitation of liability

Z9.1 The *Employer's* liability to the *Contractor* for the *Contractor's* indirect or consequential loss is limited to R0.00 (zero Rand)

Z9.2 The *Contractor*'s entitlement under the indemnity in 83.1 is provided for in 60.1(14) and the *Employer*'s liability under the indemnity is limited.

Z10 Termination: Add to core clause 91.1, at the second main bullet point, fourth sub-bullet point, after the words "against it":

Z10.1 or had a business rescue order granted against it.

Z11 Addition to secondary Option X7 Delay damages (if applicable in this contract)

Z11.1 If the amount due for the *Contractor*'s payment of delay damages reaches the limits stated in this Contract Data for Option X7 or Options X5 and X7 used together, the *Employer* may terminate the *Contractor*'s obligation to Provide the Works using the same procedures and payment on termination as those applied for reasons R1 to R15 or R18 stated in the Termination Table.

Z12 Ethics

For the purposes of this Z-clause, the following definitions apply:

Affected Party means, as the context requires, any party, irrespective of whether it is the *Contractor* or a third party, such party's employees, agents, or Subcontractors or Subcontractor's employees, or any one or more of all of these parties' relatives or friends,

Coercive Action means to harm or threaten to harm, directly or indirectly, an Affected Party or the property of an Affected Party, or to otherwise influence or attempt to influence an Affected Party to act unlawfully or illegally,

Collusive Action means where two or more parties co-operate to achieve an unlawful or illegal purpose, including to influence an Affected Party to act unlawfully or illegally,

Committing Party means, as the context requires, the *Contractor*, or any member thereof in the case of a joint venture, or its employees, agents, or Subcontractor or the Subcontractor's employees,

Corrupt Action means the offering, giving, taking, or soliciting, directly or indirectly, of a good or service to unlawfully or illegally influence the actions of an Affected Party,

Fraudulent Action means any unlawfully or illegally intentional act or omission that misleads, or attempts to mislead, an Affected Party, in order to obtain a financial or other benefit or to avoid an obligation or incurring an obligation,

Obstructive Action means a Committing Party unlawfully or illegally destroying, falsifying, altering or concealing information or making false statements to materially impede an investigation into allegations of Prohibited Action, and

Prohibited Action means any one or more of a Coercive Action, Collusive Action Corrupt Action, Fraudulent Action or Obstructive Action.

Z12.1 A Committing Party may not take any Prohibited Action during the course of the procurement of this contract or in execution thereof.

Z12.2 The *Employer* may terminate the *Contractor*'s obligation to Provide the Services if a Committing Party has taken such Prohibited Action and the *Contractor* did not take timely and appropriate action to prevent or remedy the situation, without limiting any other rights or remedies the *Employer* has. It is not required that the Committing Party had to have been found guilty, in court or in any other similar process, of such Prohibited Action before the *Employer* can terminate the *Contractor*'s obligation to Provide the Services for this reason.

Z12.3 If the *Employer* terminates the *Contractor*'s obligation to Provide the Services for this reason, the amounts due on termination are those intended in core clauses 92.1 and 92.2.

Z12.4 A Committing Party co-operates fully with any investigation pursuant to alleged Prohibited Action. Where the *Employer* does not have a contractual bond with the Committing Party, the *Contractor* ensures that the Committing Party co-operates fully with an investigation.

Z13 Insurance

Z 13.1 Replace core clause 84 with the following:

Insurance cover 84

84.1 When requested by a Party, the other Party provides certificates from his insurer or broker stating that the insurances required by this contract are in force.

84.2 The *Contractor* provides the insurances stated in the Insurance Table A.

84.3 The insurances provide cover for events which are at the *Contractor*'s risk from the *starting date* until the earlier of Completion and the date of the termination certificate.

INSURANCE TABLE A

Insurance against	Minimum amount of cover or minim limit of indemnity
Loss of or damage to the *works*, Plant and Materials	The replacement cost where not covered by the *Employer*'s insurance The *Employer*'s policy deductible, as Contract Date, where covered by the *Employer*'s insurance
Loss of or damage to Equipment	The replacement cost
Liability for loss of or damage to property (except the *works*, Plant and Materials and Equipment) and liability for bodily injury to or death of a person (not an employee of the *Contractor*) caused by activity in connection with this contract	Loss of or damage to property *Employer*'s property The replacement cost where not covered by the *Employer*'s insurance The *Employer*'s policy deductible, as Contract Date, where covered by the *Employer*'s insurance Other property The replacement cost Bodily injury to or death of a person The amount required by applicable l
Liability for death of or bodily injury to employees of the *Contractor* arising out of and in the course of their employment in connection with this contract	The amount required by the applicabl law

Z 13.2 **Replace core clause 87 with the following:**
The *Employer* provides the insurances stated in the Insurance Table B.

INSURANCE TABLE B

Insurance against or name of policy	**Minimum amount of cover or minimum l of indemnity**
Assets All Risk	Per the insurance policy document
Contract Works insurance	Per the insurance policy document
Environmental Liability	Per the insurance policy document
General and Public Liability	Per the insurance policy document
Transportation (Marine)	Per the insurance policy document
Motor Fleet and Mobile Plant	Per the insurance policy document

Terrorism	Per the insurance policy document
Cyber Liability	Per the insurance policy document
Nuclear Material Damage and Business Interruption	Per the insurance policy document
Nuclear Material Damage Terrorism	Per the insurance policy document

Z14 Nuclear Liability

Z14.1 The *Employer* is the operator of the Koeberg Nuclear Power Station (KNPS), a nuclear installation, as designated by the National Nuclear Regulator of the Republic of South Africa, and is the holder of a nuclear licence in respect of the KNPS.

Z14.2 The *Employer* is solely responsible for and indemnifies the *Contractor* or any other person against any and all liabilities which the *Contractor* or any person may incur arising out of or resulting from nuclear damage, as defined in Act 47 of 1999, save to the extent that any liabilities are incurred due to the unlawful intent of the *Contractor* or any other person or the presence of the *Contractor* or that person or any property of the *Contractor* or such person at or in the KNPS or on the KNPS site, without the permission of the *Employer* or of a person acting on behalf of the *Employer*.

Z14.3 Subject to clause Z14.4 below, the *Employer* waives all rights of recourse, arising from the aforesaid, save to the extent that any claims arise or liability is incurred due or attributable to the unlawful intent of the *Contractor* or any other person, or the presence of the *Contractor* or that person or any property of the *Contractor* or such person at or in the KNPS or on the KNPS site, without the permission of the *Employer* or of a person acting on behalf of the *Employer*.

Z14.4 The *Employer* does not waive its rights provided for in section 30 (7) of Act 47 of 1999, or any replacement section dealing with the same subject matter.

Z14.5 The protection afforded by the provisions hereof shall be in effect until the KNPS is decommissioned.

Z15 Asbestos

For the purposes of this Z-clause, the following definitions apply:

AAIA means approved asbestos inspection authority.

ACM means asbestos containing materials.

AL means action level, i.e., a level of 50% of the OEL, i.e. 0.1 regulated asbestos fibres per ml of air measured over a 4 hour period. The value at which proactive actions is required in order to control asbestos exposure to prevent exceeding the OEL.

Ambient Air means breathable air in area of work with specific reference to breathing zone, which is defined to be a virtual area within a radius of approximately 30cm from the nose inlet.

Compliance Monitoring means compliance sampling used to assess whether or not the personal exposure of workers to regulated asbestos fibres is in compliance with the Standard's requirements for safe processing, handling, storing, disposal and phase-out of asbestos and asbestos containing material, equipment and articles.

OEL means occupational exposure limit.

Parallel Measurements means measurements performed in parallel, yet separately, to existing measurements to verify validity of results.

Safe Levels means airborne asbestos exposure levels conforming to the Standard's requirements for safe processing, handling, storing, disposal and phase-out of asbestos and asbestos containing material, equipment and articles.

Standard means the *Employer*'s Asbestos Standard 32-303: Requirements for Safe Processing, Handling, Storing, Disposal and Phase-out of Asbestos and Asbestos Containing Material, Equipment and Articles.

SANAS means the South African National Accreditation System.

TWA means the average exposure, within a given workplace, to airborne asbestos fibres, normalised to the baseline of a 4 hour continuous period, also applicable to short term exposures, i.e. 10-minute TWA.

Z15.1 The *Employer* ensures that the Ambient Air in the area where the *Contractor* will Provide the Services conforms to the acceptable prescribed South African standard for asbestos, as per the regulations published in GNR 155 of 10 February 2002, under the Occupational Health and Safety Act, 1993 (Act 85 of 1993) ("Asbestos Regulations"). The OEL for asbestos is 0.2 regulated asbestos fibres per millilitre of air as a 4-hour TWA, averaged over any continuous period of four hours, and the short term exposure limit of 0.6 regulated asbestos fibres per millilitre of air as a 10-minute TWA, averaged over any 10 minutes, measured in accordance with HSG248 and monitored according to HSG173 and OESSM.

Z15.2 Upon written request by the *Contractor*, the *Employer* certifies that these conditions prevail. All measurements and reporting are effected by an independent, competent, and certified occupational hygiene inspection body, i.e. a SANAS accredited and Department of Employment and Labour approved AAIA. The *Contractor* may perform Parallel Measurements and related control measures at the *Contractor*'s expense. For the purposes of compliance the results generated from Parallel Measurements are evaluated only against South African statutory limits as detailed in clause Z15.1. Control measures conform to the requirements stipulated in the AAIA-approved asbestos work plan.

Z15.3 The *Employer* manages asbestos and ACM according to the Standard.

Z15.4 In the event that any asbestos is identified while Providing the Services, a risk assessment is conducted and if so required, with reference to possible exposure to an airborne concentration of above the AL for asbestos, immediate control measures are implemented and relevant air monitoring conducted in order to declare the area safe.

Z15.5 The *Contractor*'s personnel are entitled to stop working and leave the contaminated area forthwith until such time that the area of concern is declared safe by either Compliance Monitoring or an AAIA approved control measure intervention, for example, per the emergency asbestos work plan, if applicable.

Z15.6 The *Contractor* continues to Provide the Services, without additional control measures presented, on presentation of Safe Levels. The contractually agreed dates to Provide the Services, including the Completion Date, are adjusted accordingly. The contractually agreed dates are extended by the notification periods required by regulations 3 and 21 of the Asbestos Regulations, 2001.

Z15.7 Any removal and disposal of asbestos, asbestos containing materials and waste, is done by a registered asbestos contractor, instructed by the *Employer* at the *Employer*'s expense, and conducted in line with South African legislation.

Annexure A: One-in-ten-year-return *weather data* obtained from SA Weather Bureau for [weather station]

If any one of these *weather measurements* recorded within a calendar month, before the Completion Date for the whole of the *works* and at the place stated in this Contract Data is shown to be more adverse than the amount stated below then the *Contractor* may notify a compensation event.

	Weather measurement				
Month	Cumulative rainfall (mm)	Number of days with rain more than 10mm	Number of days with min air temp < 0 deg.C	Number of days with snow lying at 08:00 CAT	[Other measurements if applicable]
January	**[●]**	**[●]**	**[●]**	**[●]**	
February	**[●]**	**[●]**	**[●]**	**[●]**	
March	**[●]**	**[●]**	**[●]**	**[●]**	
April	**[●]**	**[●]**	**[●]**	**[●]**	
May	**[●]**	**[●]**	**[●]**	**[●]**	
June	**[●]**	**[●]**	**[●]**	**[●]**	
July	**[●]**	**[●]**	**[●]**	**[●]**	
August	**[●]**	**[●]**	**[●]**	**[●]**	
September	**[●]**	**[●]**	**[●]**	**[●]**	
October	**[●]**	**[●]**	**[●]**	**[●]**	
November	**[●]**	**[●]**	**[●]**	**[●]**	
December	**[●]**	**[●]**	**[●]**	**[●]**	

Only the difference between the more adverse recorded weather and the equivalent measurement given above is taken into account in assessing a compensation event.

C1.2 Contract Data

Part two - Data provided by the *Contractor*

[Instructions to the contract compiler: (delete this notes before issue to tenderers with an enquiry) Whenever a cell is shaded in the left hand column it denotes this data is optional. If not required select and delete the whole row, otherwise insert the required Data.]

Notes to a tendering contractor:

1. Please read both the NEC3 Engineering and Construction Contract (April 2013) and the relevant parts of its Guidance Notes (ECC3-GN)[2] in order to understand the implications of this Data which the tenderer is required to complete. An example of the completed Data is provided on pages 156 to 158 of the ECC3 (April 2013) Guidance Notes.
2. The number of the clause which requires the data is shown in the left hand column for each statement however other clauses may also use the same data
3. Where a form field like this [ ] appears, data is required to be inserted relevant to the option selected. Click on the form field ***once*** and type in the data. Otherwise complete by hand and in ink.

Completion of the data in full, according to Options chosen, is essential to create a complete contract.

Clause	Statement	Data
10.1	The *Contractor* is (Name): Address Tel No. Fax No.	
11.2(8)	The *direct fee percentage* is The *subcontracted fee percentage* is	**%** **%**
11.2(18)	The *working areas* are the Site and	
24.1	The *Contractor's* key persons are: 1 Name: Job: Responsibilities: Qualifications: Experience: 2 Name: Job Responsibilities:	

[2] Available from Engineering Contract Strategies Tel 011 803 3008, Fax 011 803 3009 or see www.ecs.co.za

	Qualifications: Experience:	**CV's (and further key persons data including CVs) are appended to Tender Schedule entitled .**
11.2(3)	The *completion date* for the whole of the *works* is	
11.2(14)	The following matters will be included in the Risk Register	
11.2(19)	The Works Information for the *Contractor*'s design is in:	
31.1	The programme identified in the Contract Data is	
A	**Priced contract with activity schedule**	
11.2(20) 11.2(30)	The *activity schedule* is in The tendered total of the Prices is	**(in figures)** **(in words), excluding VAT**
	Data for Schedules of Cost Components	*Note "SCC" means Schedule of Cost Components starting on page 60, and "SSCC" means Shorter Schedule of Cost Components starting on page 63 of ECC3 (April 2013).*
A	**Priced contract with activity schedule**	**Data for the Shorter Schedule of Cost Components**
61 in SSCC	The hourly rates for Defined Cost of design outside the Working Areas are **Note: Hourly rates are estimated 'cost to company of the employee' and not selling rates.** **Please insert another schedule if foreign resources may also be used**	**Category of employee** / **Hourly rate**
62 in SSCC	The percentage for design overheads is	**%**
63 in SSCC	The categories of design employees whose travelling expenses to and from the Working Areas are included in Defined Cost are:	
44 in SCC	The percentage for Working Areas overheads is:	: **%**
51 in SCC	The hourly rates for Defined Cost of manufacture or fabrication outside the Working Areas are **Note: Hourly rates are estimated 'cost to company of the employee' and not selling rates**	**Category of employee** / **Hourly rate**

	Please insert another schedule if foreign resources may also be used	
52 in SCC	The percentage for manufacture and fabrication overheads is	**%**

C1.3 Forms of Securities

Pro formas for Bonds & Guarantees

For use with the NEC3 Engineering & Construction Contract

[Note to contract compiler:
Once it has been decided which securities are required for this contract delete from this file the ones not required, revise the notes below accordingly and delete this note.]

The *conditions of contract* stated in the Contract Data Part 1 include the following Secondary Options:

Option X13: Performance Bond

Each of these secondary Options requires a bond or guarantee "in the form set out in the Works Information". Pro forma documents for these bonds and guarantees are provided here for convenience but are to be treated as part of the Works Information.

Option X16: Retention (not used with Option F)

The *Contractor* may provide a Retention Money Guarantee in the form stated here. When the *Employer* receives and accepts a Retention Money Guarantee exactly in the form stated he will instruct the *Project Manager* not to assess any amount be retained in terms of secondary Option X16.

The organisation providing the bond / guarantee does so by copying the pro forma document onto his letterhead without any change to the text or format and completing the required details. The completed document is then given to the *Employer* within the time stated in the contract.

Pro forma Performance Bond – Demand Guarantee (for use with Option X13)

(to be reproduced exactly as shown below on the letterhead of the Contractor's Parent Company)

Eskom Holdings SOC Ltd
Megawatt Park
Maxwell Drive
Sandton
Johannesburg Date:

Dear Sirs

Reference No. **[●]** *[Drafting Note: Bank reference number to be inserted]*

Performance Bond – Demand Guarantee: *[Drafting Note: Name of Contractor to be inserted]*

Project [ ] Contract Reference: …… *[Drafting Note: Contractor contract reference number to be inserted]*

1. In this Guarantee the following words and expressions shall have the following meanings:-

1.1 "Bank" - means [●], [●] Branch, (Registration No. [●]); [Drafting Note: Name of Bank to be inserted]

1.2 "Bank's Address" - means [●]; [Drafting Note: Bank's physical address to be inserted]

1.3 "Contract" – means the written agreement relating to the Project, entered into between Eskom and the Contractor, on or about the [●] day of [●] 200[●] (Contract Reference No. [.]as amended, varied, restated, novated or substituted from time to time; [Drafting Note: Signature Date and Contract reference number to be inserted]

1.4 "Contractor" – means [●] a company registered in accordance with the laws of [●] under Registration Number [●]. [Drafting Note: Name and details of Contractor to be inserted]

1.5 "Eskom" - means Eskom Holdings SOC Ltd, a company registered in accordance with the laws of the Republic of South Africa under Registration Number 2002/015527/30].

1.6 "Expiry Date" - means the date on which the Defects Certificate is issued in terms of the Contract.

1.7 "Guaranteed Sum" - means the sum of R [●] ([●] Rand);

1.8 "Project" - means [insert if applicable.].

2. At the instance of the Contractor, we the undersigned _____ and _____, in our respective capacities as _____ and _____ of the Bank, and duly authorized thereto, confirm that we hold the Guaranteed Sum at the disposal of Eskom, as security for the proper performance by the Contractor of all of its obligations in terms of and arising from the Contract and hereby undertake to pay to Eskom, on written demand from Eskom received prior to the Expiry Date, any sum or sums not exceeding in total the Guaranteed Sum.

3. A demand for payment under this guarantee shall be made in writing at the Bank's address and shall:

3.1 be signed on behalf of Eskom by a Group Executive, Divisional Executive, Senior General Manager, General Manager or its delegate;

3.2 state the amount claimed ("the Demand Amount');

3.3 state that the Demand Amount is payable to Eskom in the circumstances contemplated in the Contract.

4. Notwithstanding the reference herein to the Contract the liability of the Bank in terms hereof is as principal and not as surety and the Bank's obligation/s to make payment:

4.1 is and shall be absolute provided demand is made in terms of this bond in all circumstances; and

4.2 is not, and shall not be construed to be, accessory or collateral on any basis whatsoever.

5. The Bank's obligations in terms of this Guarantee:

5.1 shall be restricted to the payment of money only and shall be limited to the maximum of the Guaranteed Sum; and

5.2 shall not be discharged and compliance with any demand for payment received by the Bank in terms hereof shall not be delayed, by the fact that a dispute may exist between Eskom and the Contractor.

6. Eskom shall be entitled to arrange its affairs with the Contractor in any manner which it sees fit, without advising us and without affecting our liability under this Guarantee. This includes, without limitation, any extensions, indulgences, release or compromise granted to the Contractor or any variation under or to the Contract.

7. Should Eskom cede its rights against the Contractor to a third party where such cession is permitted under the Contract, then Eskom shall be entitled to cede to such third party the rights of Eskom under this Guarantee on written notification to the Bank of such cession.

8. This Guarantee:

8.1 shall expire on the Expiry Date until which time it is irrevocable;

8.2 is, save as provided for in 7 above, personal to Eskom and is neither negotiable nor transferable;

8.3 shall be returned to the Bank upon the earlier of payment of the full Guaranteed Sum or expiry hereof;

8.4 shall be regarded as a liquid document for the purpose of obtaining a court order; and

8.5 shall be governed by and construed in accordance with the law of the Republic of South Africa and shall be subject to the jurisdiction of the Courts of the Republic of South Africa.

8.6 Any claim which arises or demand for payment received after expiry date will be invalid and unenforceable.

9. The Bank chooses domicilium citandi et executandi for all purposes in connection with this Guarantee at the Bank's Address.

Signed at _____ Date _____

For and behalf of the Bank

Bank Signatory: _____ Bank Signatory: _____

Witness: _____ Witness: _____
Bank's seal or stamp

Pro forma Retention Money Guarantee (may be used when Option X16 applies)

(to be reproduced exactly as shown below on the letterhead of the Bank providing the Guarantee)

Eskom Holdings SOC Limited
Megawatt Park
Maxwell Drive
Sandton
Johannesburg Date:

Dear Sirs

Reference No. **[●]** *[Drafting Note: Bank reference number to be inserted]*

Retention Money Guarantee: *[Drafting Note: Name of Contractor to be inserted]*

Project [ ] : Contract Reference: *[Drafting Note: Contractor contract reference number to be inserted]*

1. In this Guarantee the following words and expressions shall have the following meanings:-

1.1 "Bank" - means [●], [●] Branch, (Registration No. [●]); [Drafting Note: Name of Bank to be inserted]

1.2 "Bank's Address" - means [●]; [Drafting Note: Bank's physical address to be inserted]

1.3 "Contract" – means the written agreement relating to the Project, entered into between Eskom and the Contractor, on or about the [●] day of [●] 200[●] (Contract Reference No. ……. as amended, varied, restated, novated or substituted from time to time; [Drafting Note: Signature Date and Contract reference number to be inserted]

1.4 "Contractor" – means [●] a company registered in accordance with the laws of [●] under Registration Number [●]. [Drafting Note: Name and details of Contractor to be inserted]

1.5 "Eskom" - means Eskom Holdings SOC Limited, a company registered in accordance with the laws of the Republic of South Africa under Registration Number 2002/015527/30

1.6 "Expiry Date" - means the date on which the Defects Certificate is issued in terms of the Contract.

1.7 "Guaranteed Sum" - means the sum of R [●] ([●] Rand); [Drafting Note: Insert amount of Retention Money Guarantee.].

1.8 "Project" - means the……..

2. At the instance of the Contractor, we the undersigned _____ and _____, in our respective capacities as _____ and _____ of the Bank, and duly authorized thereto, confirm that we hold the Guaranteed Sum at the disposal of Eskom, as security for the proper performance by the Contractor of all of its obligations in terms of and arising from the Contract and hereby undertake to pay to Eskom, on written demand from Eskom received prior to the Expiry Date, any sum or sums not exceeding in total the Guaranteed Sum.

3. A demand for payment under this guarantee shall be made in writing at the Bank's address and shall:

3.1 be signed on behalf of Eskom by a director of Eskom or his authorised delegate.

3.2 state the amount claimed ("the Demand Amount');

3.3 state that the Contractor has failed to carry out his obligation(s) to rectify certain defect(s) for which he is responsible under the Contract (and the nature of such defect(s)) alternatively that the Demand Amount is payable to Eskom in the circumstances contemplated in the Contract.

4. Notwithstanding the reference herein to the Contract the liability of the Bank in terms hereof is as principal and not as surety and the Bank's obligation/s to make payment:

4.1 is and shall be absolute provided demand is made in terms of this bond in all circumstances; and

4.2 is not, and shall not be construed to be, accessory or collateral on any basis whatsoever.

5. The Bank's obligations in terms of this Guarantee:

5.1 shall be restricted to the payment of money only and shall be limited to the maximum of the Guaranteed Sum; and

5.2 shall not be discharged and compliance with any demand for payment received by the Bank in terms hereof shall not be delayed by the fact that a dispute may exist between Eskom and the Contractor.

6. Eskom shall be entitled to arrange its affairs with the Contractor in any manner which it sees fit, without advising us and without affecting our liability under this Guarantee. This includes, without limitation, any extensions, indulgences, release or compromise granted to the Contractor or any variation under or to the Contract.

7. Should Eskom cede its rights against the Contractor to a third party where such cession is permitted under the Contract, then Eskom shall be entitled to cede to such third party the rights of Eskom under this Guarantee on written notification to the Bank of such cession.

8. This Guarantee:

8.1 shall expire on the Expiry Date until which time it is irrevocable;

8.2 is, save as provided for in **7** above, personal to Eskom and is neither negotiable nor transferable;

8.3 shall be returned to the Bank upon the earlier of payment of the full Guaranteed Sum or expiry hereof;

8.4 shall be regarded as a liquid document for the purpose of obtaining a court order; and

8.5 shall be governed by and construed in accordance with the law of the Republic of South Africa and shall be subject to the jurisdiction of the Courts of the Republic of South Africa.

8.6 Any claim which arises or demand for payment received after expiry date will be invalid and unenforceable.

9. The Bank chooses domicilium citandi et executandi for all purposes in connection with this Guarantee at the Bank's Address.

Signed at _____ Date _____ Bank's seal or stamp

For and behalf of the Bank

Bank Signatory: _____ Bank Signatory: _____

Witness: _____ Witness: _____

(to be reproduced exactly as shown below on the letterhead of the Bank providing the Guarantee)

Eskom Holdings Limited
Megawatt Park
Maxwell Drive
Sandton
Johannesburg Date:

Dear Sirs

Reference No. **[●]** *[Drafting Note: Bank reference number to be inserted]*

Pro-Forma ASGI-SA Guarantee: *[Drafting Note: Name of Contractor to be inserted]*

Project [ ] Contract Reference: **[●]** *[Drafting Note: Contractor contract reference number to be inserted]*

PART 2: PRICING DATA
ECC3 Option A

Document reference	Title	
C2.1	Pricing assumptions: Option A	
C2.2	The *activity schedule*	

C2.1 Pricing assumptions: Option A

1. How work is priced and assessed for payment

Clause 11 in NEC3 Engineering and Construction Contract, (ECC3) Option A states:

Identified and defined terms 11 11.2

(20) The Activity Schedule is the *activity schedule* unless later changed in accordance with this contract.

(27) The Price for Work Done to Date is the total of the Prices for

- each group of completed activities and
- each completed activity which is not in a group.

A completed activity is one which is without Defects which would either delay or be covered by immediately following work.

(30) The Prices are the lump sum prices for each of the activities on the Activity Schedule unless later changed in accordance with this contract.

This confirms that Option A is a lump sum form of contract where the work is broken down into activities, each of which is priced by the tendering contractor as a lump sum. Only completed activities are assessed for payment at each assessment date; no part payment is made if the activity is not completed by the assessment date.

2. Function of the Activity Schedule

Clause 54.1 in Option A states: “Information in the Activity Schedule is not Works Information or Site Information”. This confirms that specifications and descriptions of the work or any constraints on how it is to be done are not included in the Activity Schedule but in the Works Information. This is further confirmed by Clause 20.1 which states, “The *Contractor* Provides the Works in accordance with the Works Information”. Hence the *Contractor* does **not** Provide the Works in accordance with the Activity Schedule. The Activity Schedule is only a pricing document.

3. Link to the programme

Clause 31.4 states that “The *Contractor* provides information which shows how each activity on the Activity Schedule relates to the operations on each programme which he submits for acceptance”. Ideally the tendering contractor will develop a high level programme first then resource each activity and thus arrive at the lump sum price for that activity both of which can be entered into the *activity schedule*.

4. Preparing the *activity schedule*

Generally it is the tendering contractor who prepares the *activity schedule* by breaking down the work described within the Works Information into suitable activities which can be well defined, shown on a programme and priced as a lump sum.

The *Employer*, in his Instructions to Tenderers or in a Tender Schedule, may have listed some items that he requires the *Contractor* to include in his *activity schedule* and be priced accordingly.

It is assumed that in preparing his *activity schedule* the *Contractor:*

- Has taken account of the guidance given in the ECC3 Guidance Notes pages 19 and 20;
- Understands the function of the Activity Schedule and how work is priced and paid for;
- Is aware of the need to link the Activity Schedule to activities shown on his programme;
- Has listed and priced activities in the *activity schedule* which are inclusive of everything necessary and incidental to Providing the Works in accordance with the Works Information, as it was at the time of tender, as well as correct any Defects not caused by an *Employer's* risk;
- Has priced work he decides not to show as a separate activity within the Prices of other listed activities in order to fulfil the obligation to complete the *works* for the tendered total of the Prices.
- Understands there is no adjustment to the lump sum Activity Schedule price if the amount, or quantity, of work within that activity later turns out to be different to that which the *Contractor* estimated at time of tender. The only basis for a change to the Prices is as a result of a compensation event.

Activity Schedule

Item No	Activity Description	Planned Milestone Completion Date	Total FRP Cost in ZAR
1	Detailed Design Engineering		
2	Kick-off Meeting with Client		
3	Submission of First Programme for Acceptance U2		
4	Compile & Submit PMP		
5	Compile& Submit Safety File		
6	Procure Equipment Unit 2		
7	Delivery Panels and equipment to Vanderkloof Unit 2		
8	Maintain Site Establishment Unit 2		
9	Decommissioning and removal of old equipment		
10	Training on the new system		
11	Unit 2 - Installation		
12	Unit 2 - Commissioning		
13	Submission of First Programme for Acceptance U1		
14	Compile & Submit PMP U1		
15	Compile& Submit Safety File U1		
16	Procure Equipment Unit 1		
17	Delivery Panels and equipment to Vanderkloof Unit 1		
18	Maintain Site Establishment Unit 1		
19	Unit 1 - Installation		
20	Unit 1 Commissioning		
	Transmission panel		
21	Detailed Design Engineering Transmission panel		
22	Kick-off Meeting with Client		
23	Submission of First Programme for Acceptance		
24	Compile & Submit PMP		
25	Compile& Submit Safety File		
26	Procure Equipment Unit 2		
27	Delivery Panels and equipment to Vanderkloof Unit 2		
28	Maintain Site Establishment Unit 2		
29	Unit 2 - Installation		
30	Unit 2 - Commissioning		
31	Delivery Panels and equipment to Vanderkloof Unit 1		
32	Maintain Site Establishment Unit 1		
33	Unit 1 - Installation		
34	Unit 1 - Commissioning		
	Total		

C2.2 the *activity schedule*

Use this page as a cover page to the *Contractor*'s *activity schedule* or provide the schedule here

Item No.	Programme Reference	Activity description	Price

PART 3: SCOPE OF WORK

Document reference	Title	No of pages
	This cover page	1
C3.1	*Employer's* Works Information	131
C3.2	*Contractor's* Works Information	1
	Total number of pages	131

C3.1: *EMPLOYER'S* WORKS INFORMATION

Contents

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Description of the *Works*

Executive overview

The *Works* entails the supply, design, software logic design and panel manufacturing, factory inspection, programming, factory acceptance testing, delivery to site, off-loading, decommissioning, installation, training, on-site commissioning as well as live commissioning and documentation of the following unit 1 and unit 2 equipment:

- Generator and Generator Transformer Protection schemes
- Generator Synchronisers and Bay Processor
- Power Line differential protection scheme
- Generator Metering and Measurement System
- Excitation Metering and Measurement System
- Unit Transformer Metering and Measurement System
- Energy Management and Data Acquisition System (EMDAS)
- Cabling (by Others – C&E Upgrade Cable *Contractor*)
- Spares (to be identified by the *Contractor* and the *Employer*)

The intent is that the new equipment will be the functional equivalent of the existing systems, but with the enhancements and improvements that are offered by the new technology and EMDAS.

Employer's objectives and purpose of the *Works*

The intend of the *Employer* is to replace generator protection, synchronising scheme, manufacture and installation of Transmission protection panels, new EMADAS installation, replacement of metering and measurement system along with the other plant secondary systems (Control System, Excitation System and Transmission Line Protection). The existing installed primary plant remains unchanged including electrical ratings. The operating philosophy of the unit remains unchanged.

The design criteria are:

a) The new system is designed in accordance with *Employer* and Grid-code applicable standards.

b) The protection system is designed to protect the Generator, Generator Transformer and associated primary plant equipment in accordance with the protection philosophy of the existing design base.

c) The Transmission line differential protection schemes at Vanderkloof are manufactured and installed in accordance with the design provided. Existing Transmission line differential protection schemes at Vanderkloof are decommissioned and removed from site.

d) The metering system is designed to monitor and evaluate production and consumption of active and reactive energy, in accordance with the metering and measurement philosophy of the existing design base.

e) The EMDAS system design which includes the appropriate communication protocols required to integrate with the Eskom LAN interfaces.

f) The system is designed for a minimum life span as specified in schedules A&B .

g) Reduction in maintenance requirements.

h) Alignment of electrical rating of the primary plant (synchronous machine, transformer, power export system)

i) Maximise redundancy of critical components and optimise spares holding

j) Alignment of interfacing to the other secondary plant systems (Unit sequence controller, SCADA system, Excitation System, LV switchgear and Transmission line protection scheme).

k) Use of allocated existing space for Protection, Synchroniser and Metering schemes.

Interpretation and terminology

The following definitions are used within this *Works* Information:

As built	the *Project Manager* or *Supervisor* certifies that this drawing is checked against the actual wiring of the corresponding circuit in the Plant and Material as correct after final hot commissioning is completed.
As commissioned	the *Project Manager* or *Supervisor* certifies that this drawing is checked against the actual wiring and functional operation of the corresponding circuit in the Plant and Material as correct after installation and cold commissioning is completed.
As manufactured	The *Contractor* certifies that this drawing is checked against the actual wiring of the corresponding circuits in Plant and Material as correct after factory acceptance testing.
Audit	The process of inspecting the procedures, facilities and other relevant items to confirm compliance with requirements laid down in SANS474 (NRS057).
Check Metering	A redundant metering system (a completely separate installation) that has a separate and dedicated CT core but may have only one dedicated VT winding
Data	The information that is contained in electronic format.
Energy Management Data Acquisition System (EMDAS)	Front-end data acquisition equipment where signal translation takes place via pulse counting or directly interfacing with the metering system via communication port/s, which includes the necessary computer interfaces/switches to the Eskom LAN network.
DEP Transmission Engineering	Responsible for the Line Protection Scheme design and implementation
EDWL	Vanderkloof Engineering Work integration
Equipment	The equipment is referred to all relevant devices that are required to fulfil the scheme design to function correctly and ensure a complete operational product of

	supply under this contract
ESD	An electrical shutdown initiated by the generator protection to disconnect the unit immediately by opening the HV breaker under electrical fault conditions.
Generator transformer	The 11kV/220 kV step up transformer that connects the generator to the transmission system.
Guarantee inspection and testing	Guarantee inspection and testing takes place at the time when the guarantee period elapses and the OEM then needs to conduct inspections and tests on the *works* which include but not be limited to visual inspection and physical tests to prove to the *Employer* that the *Works* are still in good standing and no abnormalities have emerged since commissioning and that it is fit for continued operation. All findings and recommendation are documented in a report to the *Employer*. Any deviation is listed and a follow-up/remedial plan is submitted.
LDE Generator Protection	Lead Engineer Responsible for Protection, Synchronizing, EMDAS, Metering and measurement Design Requirements
Generator	The term ‘machine’ is used throughout this document and is understood to refer to the main synchronous generator.
Maintenance function	Maintenance is the function of restoring failed/worn components to a state where it is capable of meeting its design intent and performance expectations, by repair or rework achieved through the application of material and human resources in an efficient and cost-effective manner.
Machine	The term ‘machine’ is used throughout this document and is understood to refer to the main synchronous machine
Main Metering	A dedicated metering system with a single precision energy meter that can measure export and import active and reactive energy quantities in four quadrants each quadrant having a separate and independent cumulative register
Major plant	Machinery e.g., pumps, turbine, transformer, stator, rotor, etc.
Measurement	Detection of real-time electrical quantities to determine the instantaneous behavior of an electrical system. Typical parameters of interest are Voltage, Current, Active Power and Reactive Power, measured in units of Volts (V), Amperes (A), Megawatts (MW) and Megavars (Mvar) respectively. Measurement also means quantities that are detected by measurement devices connected to instrument transformers in the field, as opposed to quantities that are calculated theoretically.
Meter	Device for measuring and totaling the variable consumption of a product. Note in general a meter consists of a sensor and an integrating device that displays the total consumption in metrological units (integrated values).
NSD	A normal shutdown performed as per control sequence.
QSD	A quicker than normal shutdown initiated by a mechanical/process related trip. The power is quickly reduced to a safe level before disconnecting the unit from the grid.
PTM	Responsible for Protection and Synchronizing Designs (Gx)
Pulse	A wave that departs from an initial level for a limited duration of time and ultimately returns to the original level.
Schedule A/B	List of requirements as indicated by the *Employer* (Schedule A), *Contractor* to

	confirm in writing (Schedule B) compliance to the requirements.
Specification	The document/s forming part of the contract in which are described the methods of executing the various items of work to be done, and the nature and quality of the materials to be supplied and includes technical schedules and drawings attached thereto as well as all samples and patterns.
Station or Power Station	Vanderkloof Power Station
Switching Station	Roodekuil Sub-Station (220kV)
Support period	This is the period in which the OEM is required to actively support the products which forms part of the *Works* until it reaches end of life status as agreed in the contract.
The plant area	The plant areas are the four generating unit areas.
Unit	Refers to a single generator and all associated equipment up to the 220kV breaker.
Work packages	A work package consists of a detailed method statement of how the work, identified at a specific step, is executed. A pre-job risk assessment as well as recording sheets is included in order to capture all data recorded during the activity where applicable.

- **Table 1: Definitions**

The following abbreviations are used:

Abbreviation	**Meaning given to the abbreviation**
AC	Alternating Current
A&A	Auxiliaries & Ancillaries
C&I	Control & Instrumentation
CT	Current transformer
DC	Direct Current
DMZ	De-Militarised Zone
DVD	Digital Video Disc
DSP	Digital Signal Processor
EMDAS	Energy Management Data Acquisition System
EHV	Extra High Voltage
EOD	Electrical Operating Desk
EOW	Electrical Operating Workstation
FTP	File Transfer Protocol
FSD	Full Scale Deflection
GPS	Global Positioning System
GPSS	Generation Power Sales System

Abbreviation	Meaning given to the abbreviation
Gx	Generation
IEC	International Electrotechnical Commission
IED	Intelligent electronic device
IEEE	Institute of Electrical and Electronic Engineers
LAN	Local Area Network
LV	Low Voltage
LSD	Least Significant Digit
MDMS	Metering Data Management System
NTP	Network Time Protocol
NVME	Non-volatile Memory Express
ODBC	Open Database Connectivity
KKS	Kraftwerk-Kennzeichen-System
OEM	Original Equipment Manufacturer
P	Active Power
PQ	Active and Reactive Power
Q	Reactive Power
RDB	Relational Data Base
RDK	Roodekuil Sub Station
ROC	Required Operational Capability
SATA	Serial Advanced Technology Attachment
SCADA	Supervisory Control and Data Acquisition
SFTP	Secure File Transfer Protocol
SNTP	Simple Network Time Protocol
SRD	Stakeholder Requirement Definition
SSL	Secure Socket Layer
SSD	Solid State Drive
USB	Universal Serial Bus
UPI	Unit Per Impulse
TNS	Test-Normal Switch
TOPP	Technical Operating Protection Procedure
TPIS	Teleprotection Isolate Switch
Tx	Transmission
VDK	Vanderkloof Power Station

Abbreviation	Meaning given to the abbreviation
VT	Voltage transformer

- **Table 2: Abbreviations**

Management and start up.

Management Meetings

Regular meetings of a general nature may be convened and chaired by the *Project Manager* as follows:

a) Prior to Site Implementation – At least Once a month

b) During Implementation - Daily progress Meetings at the Site

c) Meetings of a specialist nature may be convened as specified elsewhere in this Works Information or if not so specified by persons and at times and locations to suit the Parties, the nature and the progress of the *Works*. Records of these meetings has to be submitted to the *Project Manager* by the person convening the meeting within five days of the meeting.

d) All meetings are recorded using minutes or a register prepared and circulated by the person who convened the meeting. Such minutes or register does not be used for the purpose of confirming actions or instructions under the contract as these are done separately by the person identified in the conditions of contract to carry out such actions or instructions.

Documentation Control

a) 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.

b) The *Contractor* Submits all documentation throughout the design phases of the project in electronic format to the *Project Manager*.

c) The *Contractor* submits the final documentation on a formal transmittal form in triplicate to the *Project Manager*. All correspondence is sequentially numbered.

d) The *Contractor* adheres to *Employer*s Documents and Record Management Procedure (240-53114186) for all documents submitted.

e) 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.

f) 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 components.

Health and safety risk management

a) The *Contractor* comply with the South African Occupational Health and Safety Act No. 85 of 1993 and regulations, Eskom Safety, Health, Environment and Quality (SHEQ) Policy 32-727, National Building Regulations as well as SANS 10400 for all w*orks*. Furthermore, the *Contractor* comply with any additional current statutory requirements of any relevant Government Departments regarding health and safety and environmental health.

b) The *Project Manager* instruct the *Contractor* to stop work, without penalty to the *Employer*, when the *Contractor's* personnel do not adhere to acceptable health & safety standards or contravene the health and safety sections and regulations. The *Project Manager* is immediately or before the end of a particular shift, informed of any injury or damage to property or equipment. The *Contractor* provides all the required safety and personal protective equipment to his staff for the duration of the contract.

c) Vanderkloof SHE Specification, procedures, policies, guidelines and standards applicable to the works, used as Eskom's minimum requirements for Health and Safety, are provided to the *Contractor*.

d) The *Contractor* comply with the requirements for COVID-19 as per Government Directive from Department of Employment and Labour (DEL); Consolidate COVID-19 Direction on Health and Safety Measures in Workplaces issued by the Minister in terms of Regulation 4(10) of the National Disaster Regulation.

e) Only the latest version/ revision of the applicable legislation, acts and regulations throughout the duration of the contract, is applied at Vanderkloof Power Station. Not limited to the following below, the legislation, acts and regulations that the *Contractor* complies with are:

   i. Compensation for Occupational Injuries and Diseases Act 130 of 1993
   ii. National Water Act 36 of 1998
   iii. Occupational Health and Safety Act and Regulations (85 of 1993)
   iv. Disaster Management Act 57 of 2002.
   v. National Environmental Management Act 107 of 1998
   vi. Applicable South African National Standards (SANS)
   vii. National Road Traffic Act 93 of 1996
   viii. Basic Conditions of Employment Act 75 of 1997
   ix. National Veld and Forest Fire Act and Regulations 101 of 1998
   x. Environmental Conservation Act and Regulations 73 of 1989
   xi. Committee of Land Transport Officials (COLTO)

xii. SACPCMP Act no. 48 of 2000

xiii. Radiation Protection Act

f) The *Contractor* establish and adheres to the health and safety of his own employees and those of its sub*Contractor*s so that high standards of personnel health and safety are achieved and maintained. The *Contractor* exercise and adheres to all necessary care and measures to preclude exposure of personnel, labour, and nearby residents (if any) to potential health hazards and environmental pollutants.

g) The *Contractor* ensure that all persons who are employed and or deployed to work on site undergo police clearance and are certified to have no criminal records. This is required before any of the *Contractor's* employees are allowed or given access to start work on site.

SHE File

The *Contractor* is required to compile a SHE File to comply with the *Employer's* specification. The SHE file is submitted to the *Project Manager* for review and acceptance, 60 days before the commencement of the *works* on site and includes, but are not limited to the following:

a) Safety, Health and Environmental Plan (SHE Plan)

b) SHE organization within the Company-Responsibility & Accountability

c) OHS Incident management Procedure (32-95)

d) Planning of conduct of work activities including planning for changes and emergency work (Operational Plan)

e) Management of PPE - Personal Protective Equipment (Procedure with the matrix)

f) Emergency planning and fire risk management

g) Vehicle and driver behaviour safety (Competency, Traffic Management, etc.)

h) Subcontractor or supplier selection and management

i) Key personnel competency, training, appointments

j) Communication and awareness Plan

k) Behavioural Based Safety Procedure

l) *Employer's* Baseline SHE Risk Assessment (BRA).

m) *Contractor's* Baseline Risk Assessment in line with the *Employer's* BRA (Identification, assessment and management of Safety, Health and Environmental risks related to the scope of work. The methodology used for the risk assessment is provided together with the BRA.)

n) Valid Letter of Good Standing (COIDA or equivalent)

o) SHE policy signed by CEO/ MD - Complying to OHS Act Section 7 or ISO 45001

p) Occupational hygiene and health risk assessment

q) Medical surveillance

r) Method Statements/ Safe Working Procedures

s) COVID-19 Risk Assessments and Workplace Plan

t) In addition, reference is made to Health and Safety Specification, for documents and policies which the *Contractor* is required to adhere to.

Environmental constraints and management

The *Contractor* complies with the environmental criteria and constraints stated below:

a) Vanderkloof Power Station is ISO 14001 compliant. All spillages (whether oil, grease, diesel, chemical, etc) are prevented at all times and where accidents occurred in line with any spillages, immediate remedial actions are taken to clean-up the affected land using the appropriate spill-cleaning chemicals/absorbents.

b) It is the responsibility of the *Employer* to ensure that the *Contractor* obtains copies of the Environmental Policy of Vanderkloof Power Station, a copy of the legal register applicable to his area of responsibility, a copy of aspect register, and Vanderkloof Power Station procedures applicable to the *Contractor's* area of responsibility to assist the *Contractor* and his/her employees to prevent pollution and comply with legislative requirements, and to familiarize themselves on such procedures, within 30 days from the date of commencement of work at Vanderkloof Power Station. Copies of the above-mentioned documents are obtained from the Eskom Agent and/or Environmental Officer on the first day prior to commencement of work at Vanderkloof Power Station.

c) The *Contractor* submits proof to the Environmental Officer of Vanderkloof Power Station

d) That he and his employees has done all the necessary training on procedures and Policies supplied to them and that they do understand the contents of the procedures, registers and policies and adheres to them at all times.

e) The non-adherence to the following rules will result in a non-conformance:

i. Provide sufficient storage containers, labelled depicting general or hazardous waste and store in a designated storage area.

ii. No hazardous waste may be stored for a period of more than 90 days on the Vanderkloof Power Station premises.

iii. Ensure that all hazardous waste is disposed of at a licensed class H disposal site.

iv. A copy of the hazardous waste disposal certificate is submitted to the *Project Manager*.

v. Ensure that all other general waste is disposed of at the local municipal waste dump.

vi. Ensure that your site does comply with the general good housekeeping practices

Quality assurance requirements

a) The Quality Plan manages the overall quality of the project's main activities/milestones. It lists detailed activities in order of execution where each activity is described and references the associated work packages or specifications with witness-, hold- and verification points.

b) The QCPs make provision for signatures indicating Completion by the *Contractor* and acceptance by the *Employer* at the end of each activity.

c) The *Contractor* complies with all quality requirements as set out in 240-105658000- Supplier Quality Management Specification.

d) The *Contractor* complies with all quality requirements as set out.

e) The *Contractor* complies with the latest version of the ISO 9001 Quality Management System Requirements.

f) The quality requirements are as per 240-105658000- Supplier Quality Management Specification.

g) The *Contractor* defines the level of QA/QC or inspection imposed on his Subcontractors and *Contractors*.

h) The programming of inspections, hold and witness points are agreed between the *Employer* and the *Contractor* prior to undertaking any work or inspections.

i) All technical design and implementation documentation and PQP are submitted to the *Employer* for Acceptance 4 weeks prior to the commencement of any *Works* or inspections.

Quality Plan

The Quality Plan manages the overall quality of the project's main activities/milestones. It lists detailed activities in order of execution where each activity is described and references the associated work packages or specifications with witness-, hold- and verification points. The QCPs make provision for signatures indicating completion by the *Contractor* and acceptance by the *Employer* at the end of each activity.

a) The *Contractor* provides a Quality Plan which is signed off following the completion of a task.

b) QCPs to list the following minimum hold points for acceptance when completed: (The *Contractor* can also add additional points as per their own format):

c) Basic Design Freeze

d) Detail Design Freeze

e) Engineering Training

f) Factory Acceptance Testing

g) Implementation Approval

h) Site Acceptance and Commissioning

i) Training of Operating and Maintenance Staff

j) Project Completion & Handover

Work Packages

For all site related work, the *Contractor* is required to submit a work package before any type of work can commence on the *Employers* plant. The required format of the work package is

accordance with template 167A/158-A and a signed copy is provided by the *Contractor* after the *Employer* has reviewed and accepted the Work Package as final prior to any work.

Programming constraints

a) The *Contractor* submits a bar chart programme (in MS Project format) detailing how the works are executed within the stipulated dates, including weekends and public holidays,

b) The *Contractor* submits the program which indicates the start, Completion Date, duration and dependencies of each activity,

c) The *Contractor* notifies the *Employer* of any changes made to updated programme.

d) The *Contractor* submits the program within two weeks after contract award,

e) The program is updated and submitted weekly to the *Employer* for Acceptance,

f) The program indicates the start date, Completion Date and duration of each activity,

g) The program is updated and submitted every four weeks during the manufacturing process and

h) Daily during Site implementation or sooner depending on the urgency of the matter.

Contractor's management, supervision and key people

a) The *Contractor* provides an organogram depicting the resources on site and their lines of authority and communication.

b) The *Contractor* does not modify any plant or materials unless accepted by the *Employer* prior to implementation.

c) The *Contractor* notifies the *Employer* at least two days in advance of a Hold or Witness point on the Works.

d) The *Contractor* informs the *Employer* of any defect found and notify the *Employer* at least two days in advance of a Hold or Witness point on the Works.

e) The *Contractor* does not operate any Equipment on Site, unless specific authorisation is obtained from the *Employer*.

Invoicing and payment

a) Within one week of receiving a payment certificate from the *Project Manager* in terms of core clause 51.1, the *Contractor* submits a tax invoice to the *Employer*, showing the amount due for payment equal to that stated in the *Project Manager's* payment certificate.

b) The *Project Manager* to be copied in on all electronic invoices emailed.

c) Failure to submit the invoice to the correct address could result in delays in payment.

d) The *Contractor's* Tax Invoices comply with the requirements as stated in clause Z7 of the Contract Data.

e) Invoices are submitted electronically to:

i. Local Eskom Invoices - invoiceseskomlocal@eskom.co.za

ii. Foreign Eskom Invoices - invoiceseskomforeign@eskom.co.za

f) Details required when submitting invoices and additional data:

i. The subject line on your email should only contain your vendor number.

ii. Each invoice in PDF should be named with your invoice number only.

iii. All electronic invoices must be sent in PDF format only.

iv. Attach the proof of delivery to your invoice.

v. Where applicable, supporting documents must be attached to the scanned PDF invoice as

vi. one attachment.

vii. A copy of the signed assessment certificate.

viii. CPA calculation sheet.

ix. Retention Certificate where it is a retention invoice.

x. Any other appropriate documents, e.g.

1 For shipping invoices, please ensure the following documents are attached

2 Invoice (this should only reflect the shipping cost)

3 Commercial invoice

4 Delivery note

5 Your shipping costs calculation relevant to that invoice – not a generic calculation (The amount of the shipping costs calculation must balance on the amount on the invoice.)

6 Forwarding agent's invoice

7 The customs document

xi. Please do not attach unnecessary as this will make the file too large.

g) Other requirements:

i. For foreign invoices, suppliers will still be required to physically deliver hard copies of original documents to the respective Document Management centres even though the invoices have been submitted electronically.

ii. Ensure compliance with the tax requirements for submitting invoices electronically.

iii. Each PDF should contain one credit note, one debit note or one credit note only. More than one invoice can be submitted per email.

iv. Any CPA applicable must be invoiced separately, so that if there are issues on the CPA, the

v. rest of the invoices can be paid while the CPA issues are resolved.

h) Include the following information on the Invoice:

i. Name and address of the *Contractor* and the *Project Manager*.

ii. The contract number and title,

iii. *Contractor's* VAT registration number,

iv. The *Employer's* VAT registration number 4740101508,

v. Total amount invoiced excluding VAT, the VAT and the invoiced amount including VAT,

vi. *Contractor's* company registration number if applicable

vii. *Contractor's* banking details

viii. Name and address of recipient

ix. Tax invoice number and date of issue,

x. Description of goods/service provided,

xi. Quantity or volume of goods/services

xii. Period time for which the Tax Invoice is being rendered,

xiii. Relevant Task Order Number (commencing with a 45 prefix),

xiv. Relevant line item number,

xv. Statement whether value added tax is included or excluded.

Insurance provided by the *Employer*

Insurance provided by the *Employer* is managed in accordance with clause 87 of the core clauses in ECC3.

Contract change management

Contract change management is managed in accordance with core clause 6 in ECC3.

Provision of bonds and guarantees

The form in which a bond or guarantee required by the *conditions of contract* (if any) is to be provided by the *Contractor* is given in Part 1 Agreements and Contract Data, document C1.3, Sureties.

The *Employer* may withhold payment of amounts due to the *Contractor* until the bond or guarantee required in terms of this contract has been received and accepted by the person notified to the *Contractor* by the *Project Manager* to receive and accept such bond or guarantee. Such withholding of payment due to the *Contractor* does not affect the *Employer*'s right to termination stated in this contract.

The *Contractor* provides the bonds and guarantees as specified in the Contract Data within 2 weeks of the Contract Date.

Records of Defined Cost, payments & assessments of compensation events to be kept by the *Contractor*

In order to substantiate the Defined Cost of compensation events, the *Employer* requires the *Contractor* to keep records of amounts paid by him, in the following format:

Type of cost	**Type of Record**

People employed by the *Contractor* (labour)	Signed timesheets
Plant	Running hours for Plant
Materials	Register of materials used
Work subcontracted by the *Contractor*	Sub*Contractor's* costs
Equipment	Register of Equipment used

- **Table 3: Defined Cost of compensation events**

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 as detailed in the sections below. 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*.

General

a) The *Contractor* provides training on the Plant and Material and systems included as part of the Works to the various categories of the *Employer's* technical staff for the duration of the Works.

b) Training provided by the *Contractor* is directly applicable to the actual Plant and Material supplied for the Works.

c) Generalised training based on similar Plant and Material is not acceptable.

d) Engineering training is provided prior to Factory Acceptance Testing of the equipment.

e) All pre-FAT training is conducted at the *Contractor's* local test facility and all operating and maintenance training is conducted at Vanderkloof.

f) The local facilities for training provided by the *Employer* are a suitably sized air-conditioned room, to accommodate 8 trainees as well as trainee and trainer desks, an overhead projector and flipchart or white board.

g) The *Contractor* submits to the *Project Manager* for acceptance a detailed training program as well as a prospectus for each course one month before each training session.

h) The number of participants that are to be trained is as indicated in Schedule A&B.

i) The *Employer* bears the cost of salaries, accommodation, travelling expenses and other allowances of his personnel during the training, but all other training costs are borne by the *Contractor*.

j) The *Contractor* provides 3 additional (repeat) training courses as and when instructed by the *Project Manager.*

k) The *Contractor* provides training as stipulated in Schedule A&B.

l) As part of this contract, practical hands-on training is included for each individual trainee forms an integral part of each of the following courses:

   i. Operating Training

   ii. Maintenance Training

iii. Engineering / Commissioning Training

m) The Engineering and Commissioning training are of such a standard that experienced staff are able to commission and re-engineer some parts of the system after such training has been obtained.

Operating Training

a) The training includes the following aspects as a minimum:

i. Familiarisation with documentation including drawing configuration logic.

ii. Operator interface familiarisation such as operational functions, alarms etc.

iii. Equipment data usage, management, storage and archiving, as well as associated system logs

Maintenance Training

The maintenance training includes the following aspects as a minimum:

a) Familiarisation with documentation (maintenance plan, procedures etc.)

b) Operator interface familiarisation e.g., operational functions, alarms etc.

c) Hardware familiarisation

d) Hardware maintenance

e) Remote interrogation and analysis of information

f) Software development, configuration, testing and debugging

g) Database management.

Engineering Training

Engineering training consists of a formal training programme prior to and during the implementation of a project. The Employer's engineer/s must be involved by the *Contractor* during engineering, implementation and commissioning phases of a project to gain valuable on-job training and experience to ensure competence on the plant. The Engineering training includes the following aspects as a minimum:

a) Familiarisation with documentation (maintenance plan, procedures etc.)

b) Operator interface familiarisation e.g., operational functions, alarms etc.

c) Hardware familiarisation

d) Hardware maintenance

e) Changes and addition of function blocks

f) Time stamping protocols

g) Interfacing to the future systems

h) Full commissioning understanding

Training Documentation

a) The *Contractor* incorporates all necessary technical data, design data literature and drawings into his training manuals.

b) The course material is in English and includes all third party documentation.

c) A copy of the training documentation is supplied for each trainee.

d) The supply of drafts, pre-print proofs and printed copies of training documentation is planned by the *Contractor* in such a way that the required training is complete before FAT of the protection scheme is completed.

e) Training manuals are continuously updated by the *Contractor* up to the date of issue of the Defects Certificate for the whole of the Works.

Engineering and the *Contractor's* design

EMPLOYERS DESIGN - PROTECTION SYSTEM

Employer's operating philosophy

Operating Design

The operating concepts are described below

a) Operating modes influenced:

i. Standstill mode

ii. Generator mode

b) Shutdown operations

i. Normal shutdown

ii. Quick shutdown/control shutdown (Mechanical fault – de-load generator before disconnecting from grid)

iii. Emergency shutdown (Electrical fault – trip all sources of supply)

c) Abnormal operation

i. Any operating condition that requires manual intervention

ii. Operating modes, CB statuses and loading must be displayed on the IED or on the LCD display of IED.

Control Philosophy

Generator & Generator Transformer Protection Scheme

The intended use of the protection system is the disconnection of sources of supply from systems that have been detected as faulty for maintaining a stable system and to limit damage to plant. Main functions include limiting of damage to the generating unit under fault conditions in the quickest and safest manner; and responding to external inputs while the generating unit is disconnected.

Synchronising Scheme Interface

The intended use of the synchronising system is the connection of Generator to the Grid. Synchroniser Scheme complies with Standard: 240-56357419: Eskom Standard: Generator Synchronizing and Network Synchronism Check Standard.

The synchronising signals for the Control systems, Governor and Excitation interface with the bay processor within the protection panel at Vanderkloof Power Station. These signals are as follow.

Employer Responsibility

a) Synchroniser selection Auto originating from VDK control system

b) Synchroniser selection Manual originating from VDK control system

c) Synchroniser selection Off originating from VDK control system

d) Control System Synchroniser ON CMD (Auto & 220kV BRK open, TX permission to SYNCH)

e) Control System Synchroniser OFF CMD (Stop Sequence)

f) Control System Black Start Select VT MCB Trip to Control System

g) Control System Synchroniser Ready to Start (No errors)

***Employer's* requirement specification**

System Breakdown Structure

Vanderkloof Protection, Synchronising and Transmission Protection systems to be modified are divided into the following SBS (System Breakdown Structure)

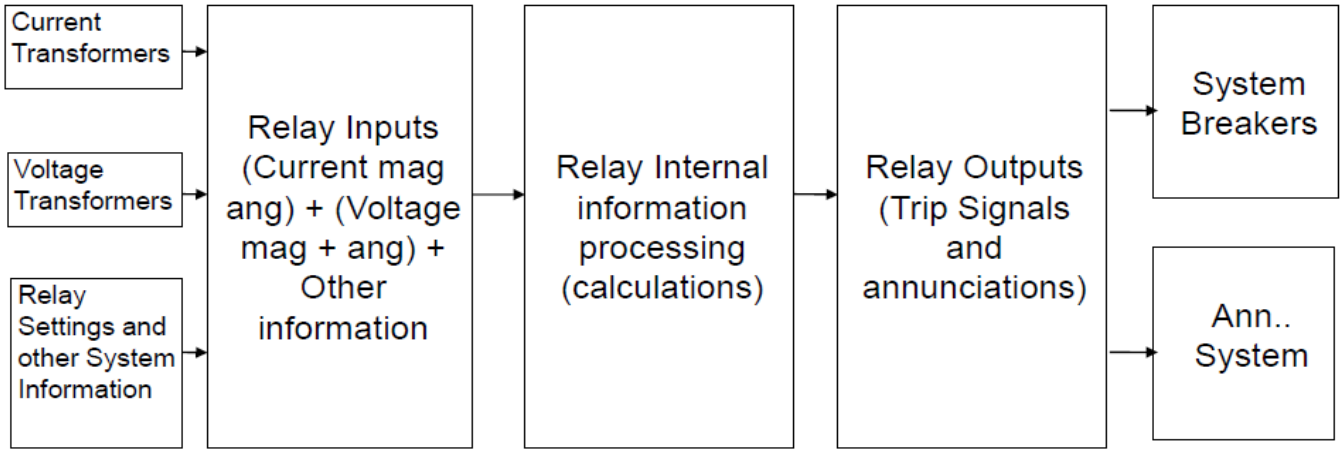
KKS System Code	System	Location	Scope performed by
10 MKY10	Generator and Generator Transformer Protection Scheme (Including Bay Processor)	Vanderkloof Power Station	*the Contractor*
20 MKY10	Generator and Generator Transformer Protection Scheme (Including Bay Processor)	Vanderkloof Power Station	*the Contractor*
10 CPB10	Synchronising Scheme	Roodekuil Sub-Station	*the Contractor*
20 CPB10	Synchronising Scheme	Roodekuil Sub-Station	*the Contractor*
10 ARK10	Transmission Line Protection Scheme	Vanderkloof Power Station	*the Contractor*
20 ARK10	Transmission Line Protection Scheme	Vanderkloof Power Station	*the Contractor*
10 ARK20	Transmission Line Protection Scheme	Roodekuil Sub-Station	*Others*
20 ARK20	Transmission Line Protection Scheme	Roodekuil Sub-Station	*Others*
*	Project Cabling	Vanderkloof Power Station	*Others*

- **Table 4: System Breakdown Structure**

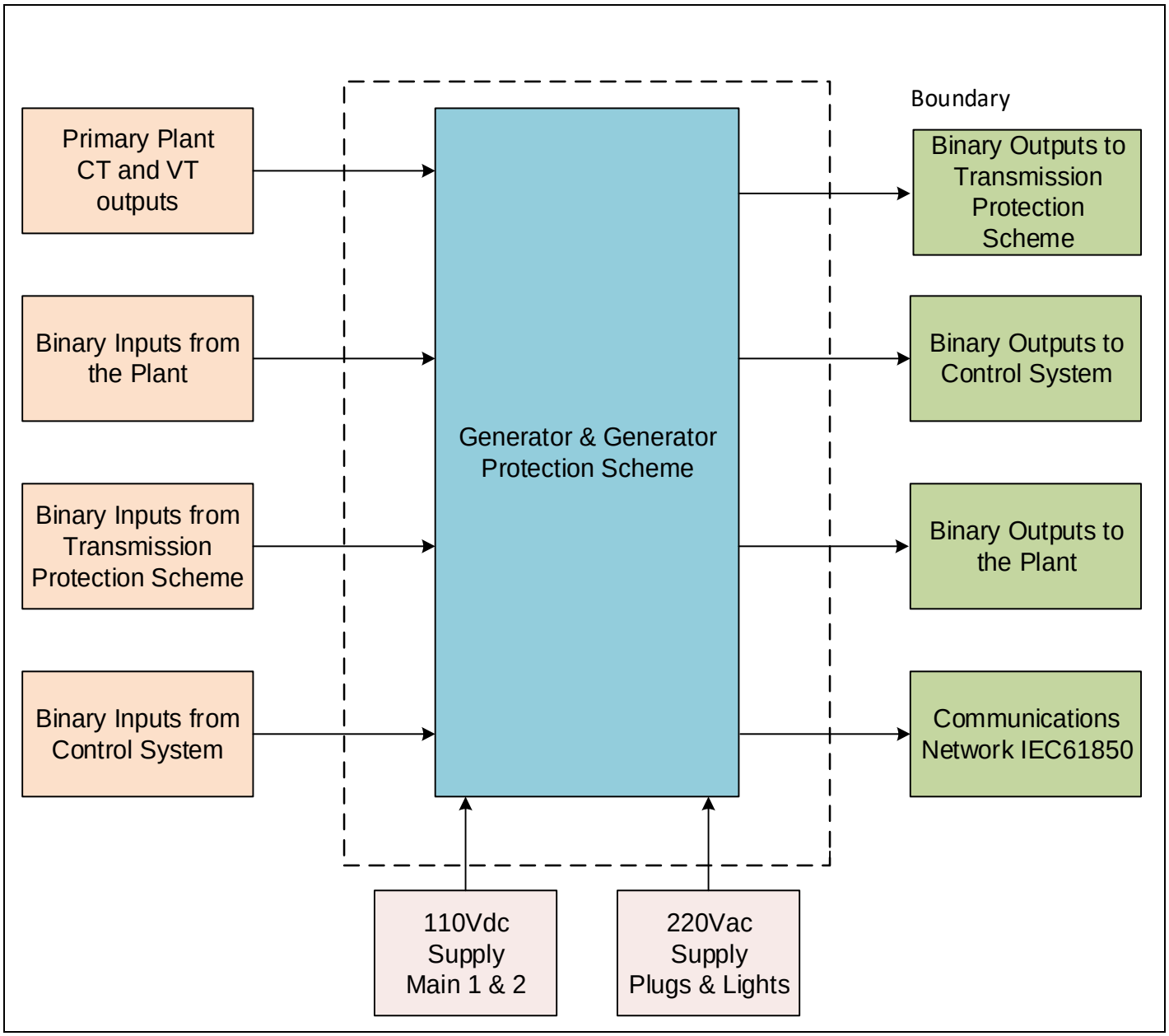
Process Description

a) Generator and Transformer Protection Scheme

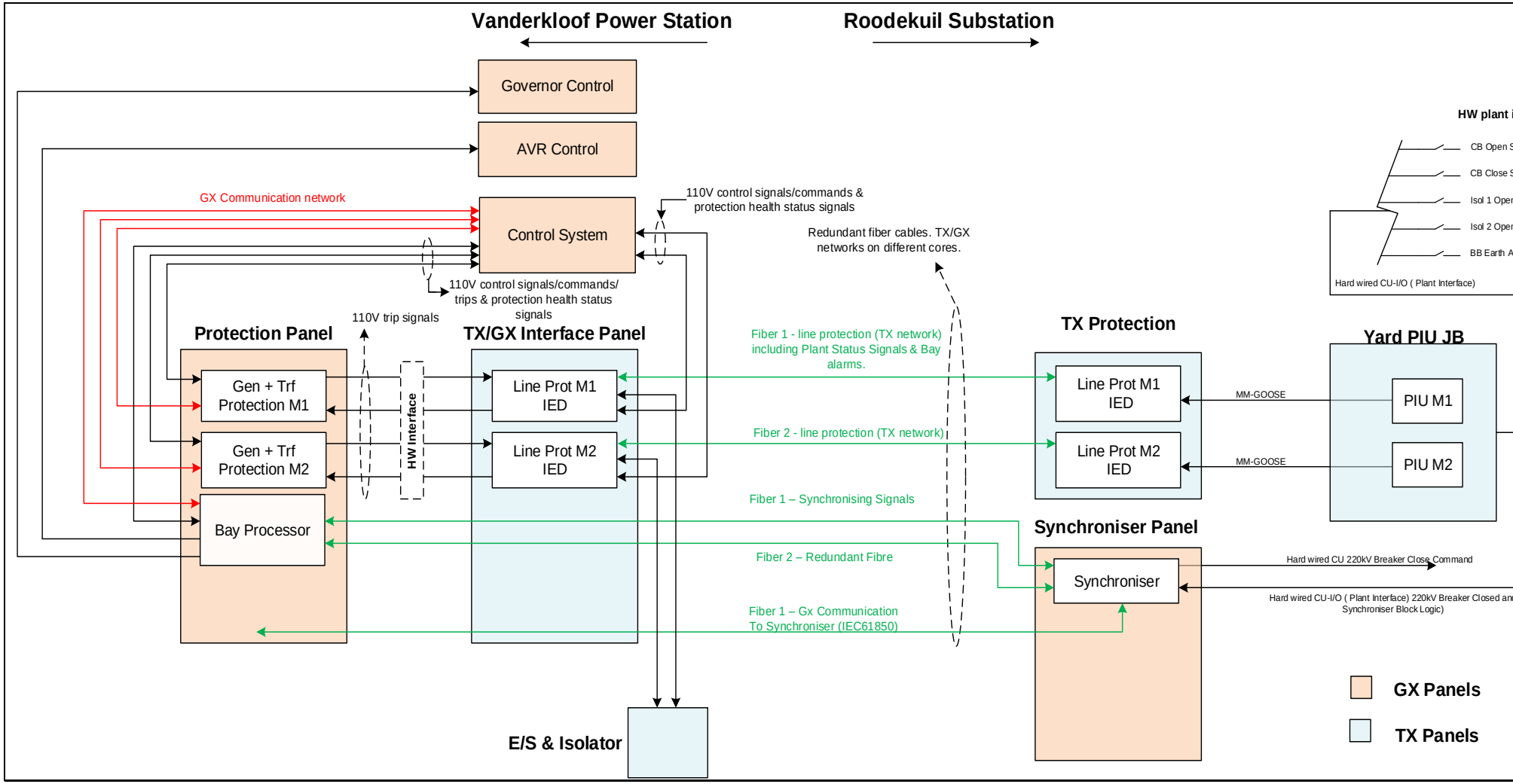
i. The existing Primary Equipment, namely Current and Voltage transformers used for Protection Scheme feedbacks are re-used.



- **Figure 1: Generator and Transformer Protection Scheme.**



- **Figure 2: Diagram of external interfaces showing the boundary**



- **Figure 3: Synchronising Scheme Concept Block Diagram**

ii. The Major Components of the system consist of fully redundant identical Main 1 and Main 2 Protection IED's (Generator and Generator Transformer Protection) with the following features:

1 Programmable capability

2 Analogue Inputs (single & three phase VT's and CT's)

3 110Vdc Binary Inputs

4 Binary Outputs (Dry Contacts)

5 Communication protocol (IEC61850)

6 Fault Recording Capability.

7 Local Display

8 Network Capability

iii. Other components of the Protection Scheme at Vanderkloof consist of the following:

1 Bay Processor (Interface to Roodekuil synchroniser panel)

2 Dual 110Vdc from Battery Bank 1 & 2 directly to IED's via Circuit Breakers

3 Automatic Secure Supply Modules

4 DC Fail Monitoring

5 Test-Blocks (single & three phase CT's and VT's)

6 220Vac Supply (Lights, plugs and Heaters)

7 Auxiliary relays for annunciation, repeater and chop over circuits

iv. Components of the Synchroniser Scheme at Roodekuil consist of the following:

1 Synchroniser and all associated equipment (standalone panel)

b) Fault Recorder

i. The existing fault recorder (Siemens P531) will be decommissioned completely. The fault recording functionality is incorporated into the new protection IED's.

Equipment required to be included in the *works*

a) Refer to Schedule A&B.

Engineering and special tools

a) A detailed list of tools required to maintain or perform any other work on the IED's is supplied by the *Contractor* to the *Employer* before delivery.

b) The notebook PCs are rigorously tested by the *Contractor* to choose the appropriate hardware dedicated to the equipment ensuring driver compatibility.

c) The *Contractor* provides special tools required to recover and repair failed devices due to software or firmware failures.

d) All engineering software required to perform IED configuration as well as IEC 61850 configuration

e) Test equipment (test handles, plugs special tools etc)

f) Engineering laptop x 1

g) The *Contractor* provides any special tools or keys that may be required for maintenance or affecting adjustments. This includes software configuration tools.

h) A detailed list of tools is supplied by the *Contractor* to the *Project Manager* before delivery.

i) Maintenance tools are not used for erection of the contract.

j) Interface Cables.

k) Refer to Schedule A&B.

Parts of the Works which the *Contractor* is to design

The *Works* provides a complete redundant protection scheme with fault recording capabilities without compromising any of the existing protection functions and applied philosophies. The *Works* further provides for a complete synchroniser scheme that will be installed on a separate panel at Roodekuil substation.

Functional Requirements for the Works

The following are descriptions of devices and functions that are to be built into the *Works* or that the *Works* is capable of doing:

a) The protection and synchronising functionality is supplied with IED's.

b) All IED's are IEC61850 compatible and configurable to annunciate pre-defined alarm and event signals to the unit SCADA system.

c) Each Main protection scheme incorporates protection functions for both the synchronous generator and generator transformer.

d) The *Contractor* assesses the existing protection scheme and associated equipment. The *Contractor* removes the obsolete equipment and places it in the *Employer's* store at Vanderkloof Power Station. This should be done in conjunction with the *Employer*.

e) If required some of the existing cabling is re-used and is clearly marked before disconnecting from the existing equipment.

f) The *Contractor* performs the design and detailed engineering with documentation of the plant and material detailed in schedule A and in conjunction with the *Employer* who will assist with the plant interface design.

g) The plant and material provides comprehensive schemes and embraces all features, accessories and auxiliary plant and material necessary to make a complete installation.

h) The equipment is easily maintained and repaired, ensuring continuous operation of the Unit by means of the same supplier and type device to minimise spares holding.

i) Refer to Schedule A&B for additional requirements.

Functional Requirements of the Protection & Synchroniser Schemes

Voltage Transformers

a) The existing instrument transformers will provide the required voltage analogue quantities to the IEDs.

b) Refer to Schedule A&B.

Current Transformers

a) The existing instrument transformers will provide the required current analogue quantities to the IEDs.

b) Refer to Schedule A&B.

Protection Scheme

a) One panel (redundant Main 1 and Main 2 schemes) are dedicated to the protection of a generating Unit. The existing DC supply application will be utilised between the protection schemes.

b) All auxiliary relays, timers and connections that are necessary, will be provided inside the panels.

c) Programming facilities for all configuration and parameters of protection functions will be provided by means of a menu driven software program. The required software program tools, licences and interface connectors must be provided. The required software tools allow changing of logics, device configurations and settings.

d) Communication with, and programming of the protection equipment are possible with the protection equipment on-line and off-line.

e) Refer to Schedule A&B for additional requirements.

Protection Functions

a) The protection functions configured and dedicated for the synchronous generator and generator transformer will include and adopt all existing functional requirements. These functions are in compliance with the Eskom Generating Unit Electrical Protection Standard for Hydro PS (240-56356548).

b) *Contractors* specify and give written details of protection functionalities that are inherently part of their protection IED's that are not required by the performance specification.

c) The required specific protection functions are listed in Schedule A&B.

DC Fail and Self-Monitoring

a) Refer to Schedule A&B.

Output and Tripping Relays

a) Refer to Schedule A&B.

b) Output contacts of any relay, auxiliary or binary output card is able to carry the maximum load of the circuit it is used for without any damage.

c) Tripping is performed directly from the IED output to the trip coil of the associated equipment. No interposing or auxiliary relays are allowed.

d) High-speed heavy-duty tripping contacts are provided.

e) Adequate potential free alarm contacts are provided to the unit control system to accommodate all required information exchange and to provision is made for future modifications.

AC Analogue Inputs

a) The voltage inputs are supplied from voltage transformers as specified in Schedule A&B.

b) The voltage input for 95% stator earth fault is supplied from the existing earthing transformer and earthing resistor arrangement connected on the machine star point. The function includes 3rd harmonic restrain capability

c) The current inputs to the multi-function relay are provided from CTs with ratings as specified in Schedule A&B

Synchroniser scheme

a) General Arrangement

i. The Synchroniser is located 2.6km away from the Power Station at Roodekuil Sub Station

ii. The signals to Vanderkloof Power Station will be transmitted via Single Mode Fibre provided by Others.

iii. At Vanderkloof Power Station a Bay Processor interfaces with the primary plant equipment, via binary input and outputs signals, hardwired to the equipment. The Bay Processor acts as an interface via a fibre network to the Synchroniser at Roodekuil transmitting the needed signals for the equipment to fulfil its operating requirements.

iv. At Roodekuil the Synchroniser interfaces direct to the primary plant via hardwire.

v. Both units' synchronisers and associated equipment installed in one panel. The equipment is arranged such that access to only one unit's equipment can be permitted at a time, to perform work without any risk or affecting the other unit's equipment.

vi. Refer to Figure 3 for Synchronising Scheme Concept Block Diagram.

b) Synchroniser Panel at Roodekuil Sub Station

The automatic synchroniser is provided with:

a) A speed matching unit with adjustment for maximum slip, breaker operating time compensation and speed control pulse length.

b) A voltage matching unit with adjustment for voltage, voltage difference and voltage control pulse length.

c) It must be a three-phase synchroniser

d) Other forms of adjustments are also considered these should be fully described.

e) The equipment offered will only allow one closing attempt thereafter will indicate a failure to close and prevent any further closing.

f) The equipment offered will be deselected once a successful closing was performed.

g) The equipment offered will allow adjustment to enable synchronising only when the generator speed is within tolerance higher or lower than the system as well as the generator voltage.

h) Delivery of speed raise and lower signals to the Governor Panel to VDK. (N/O contact)

i) Delivery of voltage raise and lower commands to Excitation Panel in VDK. (N/O contact)

j) Delivery of synchroniser in progress signals to control system in VDK

k) Delivery of synchroniser Error signals via serial communication to VDK

l) Activation of Synchroniser Start at specified percentage of the Gen Line Voltage

m) All the required interlocking to ensure safe selection and operation of the plant.

n) The synchroniser should interface in such way that if it requires additional equipment other than the synchroniser for the functionality to be correct, that should be for seen.

o) The full-on functionality of the device with all inputs and outputs should be able to be tested locally on the device as per the design (Roodekuil).

p) The full-on function testing facility should therefore be provided.

q) The equipment offered complies to the *Employer's* standard, 240-56357419.

r) The equipment offered is *Employer* approved according to the 240-56357419 standard.

These signals are then transmitted to the synchroniser housed at Roodekuil, where the synchronising and closing of the breaker will be managed. All required plant input and output to safely connect the breaker, for example, breaker position, fuse fail (MCB) for voltage supply to the equipment is monitored, as well as the required interlocking permitting the safe operation of the equipment.

c) Test facilities

The synchroniser includes test facilities on the panel outgoing terminal strip, which interfaces to the plant. These test facilities has pull type plugs, which isolate the following circuits:

i. Voltage raise and lower control to the Excitation Control System

ii. Speed raise and lower control to governor

iii. Circuit Breaker/s closing circuit

Test blocks comply with 240-70975231, housing the following:

iv. Incoming VT supply

v. Running VT supply

d) Bay Processor at Vanderkloof Power Station

i. Bay Processor installed inside the Generator Protection Panel

ii. Binary inputs and outputs functionality is required however all signals that needs to be transmitted should be configured correctly via the Fibre to Roodekuil Sub Station.

Control and Monitoring of the Protection and Synchronising Schemes

Unit Control System and SCADA Interface

a) The *Contractor* provides a detailed signal list as per the project requirement for approval. All protection functions alarm locally on the relay and via a data communication link to the unit SCADA system.

b) The protection and synchroniser interfaces with the Unit SCADA system reporting alarms, events, disturbance record files, and analogues generated from the IED's using IEC61850 protocols. The interface provides data in the form of value, time and quality that replicates the exact attributes and values from the generated source. No commands or setting changes are allowed to be done from the IEC61850 SCADA communication.

c) The *Contractor* provides the data communication network, network interface cards and switches, device driver software, software licenses and fibre requirements between the IED's, network switches and station SCADA interface point as

determined by the *Employer*. The *Employer* provides the SCADA computer hardware according to the *Contractor's* minimum hardware specifications.

d) The IEC 61850 configuration file to be supplied to the *Employer* to directly import into the SCADA system. The *Contractor* demonstrates that the IEC 61850 protocol interface is functional, reliable and secure before or during the FAT opportunity.

Other Interfacing Requirements

The *Contractor* allows enough time in order to achieve proper interfacing between all the Employer's Engineers and the *Contractor*. The *Contractor* is involved in clarifications and technical queries regarding interfacing and be actively involved during interfacing sessions.

The following external systems will be mainly affected:

a) Excitation system
b) Station and Unit AC/DC supplies
c) KKS layout of the station
d) Grid code requirements
e) Generator
f) Generators step up transformer
g) Transmission Protection Panels
h) HV switchgear on the Transmission system
i) Neutral earthing transformer
j) Neutral earthing resistor

Panel Design

a) Vanderkloof

i. The *Contractor* is made aware that the panel frame is fixed and cannot be removed.

ii. It is the *Contractor's* responsibility to design a new protection scheme that consists of the following:

1 Trunking
2 Terminals
3 Wiring
4 Equipment (IED's, Lights, Switches, Relays, Circuit Breakers, Test Blocks etc)

iii. The designed equipment is housed in the existing panel outer cabinet, not dismantled after FAT and transported and installed as a single unit.

iv. Panel layout is provided in drawing 0.39/1061, the *Contractor* verifies panel dimensions to ensure equipment is adequately housed within the outer cabinet.

b) Roodekuil

i. The *Contractor* is made aware that this is a new panel. (Dimensions: 600 x 600 x 2400mm)

ii. It is the *Contractor's* responsibility to design a new synchroniser scheme that consists of the following:

1 Trunking

2 Terminals

3 Wiring

4 Equipment (IED's, Lights, Switches, Relays, Circuit Breakers, Test Blocks etc)

iii. The designed equipment is housed in the existing panel outer cabinet, not dismantled after FAT and transported and installed as a single unit.

EMPLOYERS DESIGN – TRANSMISSION PROTECTION PANEL

The bespoke Transmission-Generation interface panels, designated 6FC-2910, to be installed at Vanderkloof are documented in Eskom drawing 0.52/30655. Information in this section and the Eskom drawing 0.52/30655 is used as the basis for a commercial enquiry for the construction of the panels.

Employer's operating philosophy

The Transmission protection scheme provides the following functionality in a dual main (fully redundant) configuration:

a) Fibre optic line differential protection;

b) Emergency trip of the Roodekuil 220kV circuit-breaker (mushroom push button); and inter-trip to Generation;

c) Inter-trip send and receive between Roodekuil and Vanderkloof;

d) Line isolator (1 off) and earth switch (2 off) indications and interlocking;

e) Line isolator control (via National Control, local control switch and from Generation);

f) Line isolator discrepancy;

g) Hardwired signal interchange with Generation;

h) COMTRADE disturbance recording functionality and sequence of events logs; and

i) IED HMIs including an active/adaptive single line diagram showing the status of all primary plant equipment between the Roodekuil 220kV busbar and the Vanderkloof transformer primary side bushings. The IED single line diagram is identical to that on the corresponding 7SL87 IED at Roodekuil.

Employer's requirement specification

This section provides a detailed technical specification for the bespoke Transmission-Generation interface protection schemes to be manufactured for Vanderkloof Power Station (**Figure 4**).

a) Two 6FC-2910 Transmission-Generation interface protection schemes are required for Vanderkloof Power Station: one per 220kV feeder to Roodekuil Transmission Substation.

b) The protection schemes operates using dual 110Vdc supplies and rated accordingly. A 230Vac supply is provided for the panel unhealthy indications.

c) The 6FC-2910 schemes is manufactured in accordance with Eskom drawing 0.52/30655 and this specification.

d) Except for the free-issued material described in Section 3.2.4.1, the *Contractor* supplies all material required to construct complete panels. The *Contractor's* scope of work excludes configuration and setting of the free-issued electronic devices.

e) The *Contractor* supplies and install multimode fibre optic patch leads between the IEDs and Ethernet Switch, and between the front panel ports and Ethernet switch in accordance with Eskom Drawing 0.52/30655.

f) The *Contractor* is not required to supply the fibre optic patch boxes indicated in Eskom Drawing 0.52/30655 but provides suitable horizontal DIN rails on the panel side walls for the mounting of patch boxes. The *Contractor* is not required to provide single mode fibre optic patch leads.

g) The schemes is manufactured by the same *Contractor* as appointed by Generation Peaking for the Generator/Transformer protection scope at Vanderkloof Power Station. The purpose of using the same *Contractor* is to ensure a uniform look and feel between the Transmission and Generation panels at Vanderkloof. In particular, the *Contractor* applies a uniform philosophy in respect of:

   i. Fitting the protection schemes to the existing panels at Vanderkloof.

   ii. The colour(s) of the panels match the existing panels.

   iii. Labelling fonts, font sizes and label locations is applied consistently across the Transmission and Generation panels.

Equipment required to be included in the works

a) Refer to 0 below and to Schedule A&B.

Parts of the Works which the *Contractor* is to design

The Transmission panels (**Figure 4**) that will be installed in the Vanderkloof relay house are to be manufactured by the same panel *Contractor* as is to be appointed by Generation Peaking for their scope and leads the technical and financial responsibility of Transmission.

This section describes the design philosophy of the proposed protection schemes.

a) The panel uses standard Phase 6 EHV feeder protection IEDs from the Siemens CORP3158 contract. The IEDs will be purchased from the Transmission contract and free-issued to the panel builder. The Ethernet switch and SecuControl 4-way CT test blocks will be purchased from the same contract and will similarly be free issued to the panel builder.

b) The protection schemes will be constructed by the panel builder into new panel fascia's to be installed on the existing panel frames at Vanderkloof. Transmission will use the same *Contractor* as will be appointed by Generation Peaking for their scope of work. Transmission will oversee construction and FAT of the Transmission panels and will pay all associated costs. Transmission is responsible for the configuration and setting of the feeder protection IEDs and Ethernet switches.

c) The design is for fully redundant Main 1 and Main 2 protection and control schemes per feeder. The Main 1 and Main 2 schemes are kept separated from each other as much as is practical but are installed in the same panel. In keeping with the redundant scheme design, each main will provide redundant signalling to Generation, based on inputs derived from its own main. The Generation control system must determine which main to "listen to". Similarly, the Vanderkloof line isolator control inputs are provided redundantly from the Main 1 and Main 2 systems, and the Generation control system determines which main to issue a command to.

d) The panel will be provided with Main 1 and Main 2 110Vdc supplies from Generation. A 230Vac supply is provided by Generation for the Panel Not Healthy local indication circuits.

e) The panel includes a secure/common DC supply which is used to power the Ethernet switch and for the motorised isolator/earth switch indication and control circuits. Isolator and earth switch indications are wired to the common DC supply so as not to require duplicated status contacts from the existing primary plant.

f) A line isolator rotary control switch is provided on the front panel to allow Transmission staff to operate the line isolator without having to access the IED HMI/menus. This is consistent with the Transmission Phase 6 protection scheme design philosophy whereby the IED HMI is not the primary local operating interface to the panel.

g) The panel includes indication lamps for the open and closed states of the remote 220kV circuit breaker, consistent with the Transmission Phase 6 design philosophy. The panel includes an indication supply MCB which allows for the lamps to be changed without requiring an outage on the panel.

h) The panel includes a latched Emergency Trip mushroom button, consistent with the Transmission Phase 6 design philosophy. This does not preclude Generation including their own Emergency Trip push buttons on their own panels, interfaced via the "Generation Protection Trip" binary inputs on the Main 1 and Main 2 protection circuits.

i) The line differential protection is interlocked with Teleprotection Isolate (TPIS) and Test-Normal (TNS) switches according to the standard Transmission philosophy. Selection of the local TNS to “Test” blocks the differential protection. Selecting the local TNS to “Test” while the remote TNS is on “Test 2” re-enables the differential protection for testing. The local TNS only has one test position as the panel does not provide for breaker fail protection.

Free-issued material

The following material is free-issued by Eskom Transmission for inclusion in the two panels constructed and installed by the *Contractor*.

a) 4 x Siemens 7SL87 line differential protection IEDs,

b) 4 x SecuControl 4-way CT test blocks, and

c) 2 x Ruggedcom RSG2100 Ethernet switches.

Transmission Panel requirements

a) The scheme to be mounted in an existing fixed frame panel. The *Contractor* is to provide a new front facia, and all sub-assemblies for successful implementation.

b) Panel colour: to match existing panel colour on site.

c) Scheme wiring terminated at inside side of terminal strips (towards the front of the panel).

d) Electromagnetic Compatibility earthing: IEDs, ethernet switch and CT circuit earths to each be individually connected to the panel earthing bar using 2.5sqmm green/yellow wire. General safety earthing: all metal plates, rotary switches and terminal rails to be earthed to the panel earthing bar using 2.5sqmm green/yellow wire. These earth connections may be daisy-chained.

e) Vicinity of fibre patch boxes (FBP) to be clear of wiring socks.

f) Front panel to comply with SANS/IEC 60529 IP41, rear panel to be IP2X (no contact with hazardous parts with a finger).

g) MCBs is wired with the source supply on top and respecting any polarity requirements.

h) Eskom drawing 0.52/30655 lists suggested brands of MCBs and auxiliary components. The *Contractor* may substitute these with other brands, provided the alternative meets the same or higher specification/performance and quality criteria. The purpose of substituting components is for availability and consistency between the Transmission and Generation panels.

i) The Emergency trip push button is a latching mushroom button which is fitted with a guard to prevent inadvertent operation by leaning or falling against the panel. Operation is reset by twisting the button.

j) Rotary control switches complies with the following requirements:

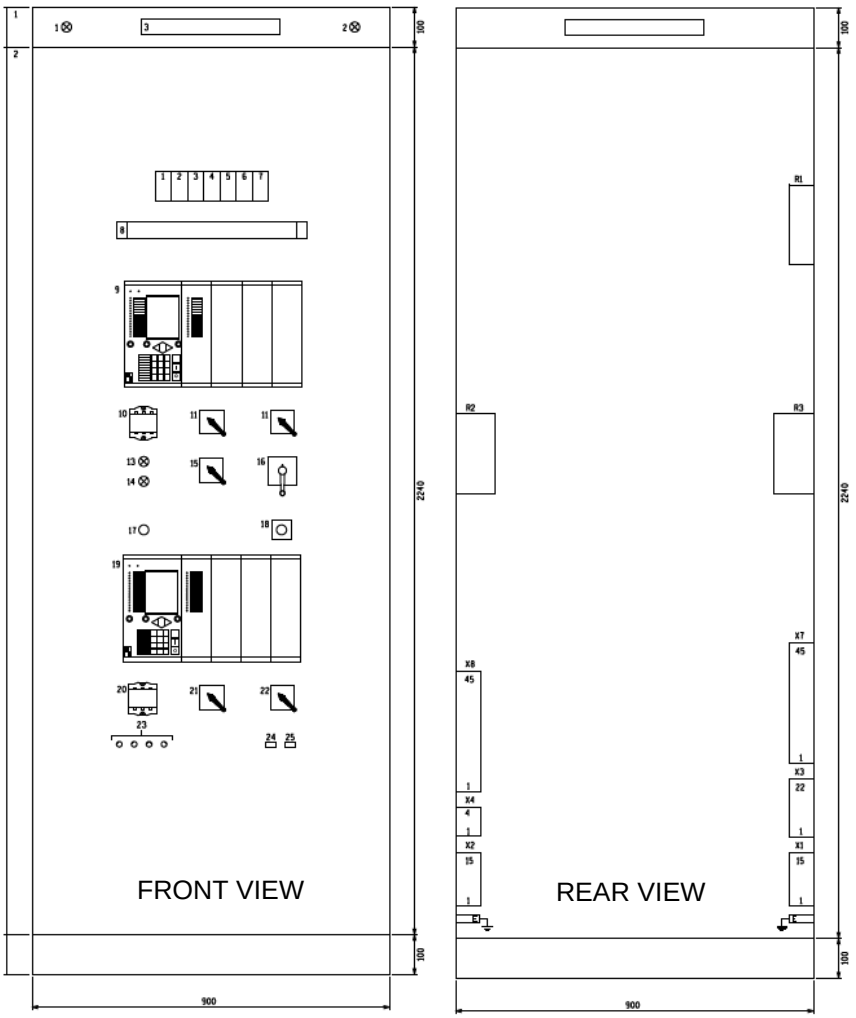
   i. Escutcheon plates dimensions are 75mm x 75mm with engraved labels for positions. The switch abbreviation (e.g. SIS, TPIS, TNS) is engraved at the top vertical position.

   ii. Supervisory Isolate and Teleprotection Isolate Switches has latched positions: OFF (-45 degrees from vertical) and ON (+45 degrees from vertical).

   iii. The Line Isolator Control Switch has the NEUTRAL position at top vertical, OPEN (-45 degrees from vertical) and CLOSE (+45 degrees from vertical). The switch has automatic spring return to the NEUTRAL position.

Panel finishing

After fabrication is complete, the metal surfaces is finished in accordance with Eskom Standard240-75655504 [16]. The paint colour of the interior and exterior matches the existing panels on site.



- **Figure 4: Transmission Protection Panel layout**

EMPLOYERS DESIGN – METERING SYSTEM

Employer's operating philosophy

Operating Design

The Vanderkloof Power Station operating concepts are described below

a) Operating mode influenced:
   i. Generator mode

mode	Condition
Generator mode	• Generator is generating, with active energy (Mwh) exported and reactive energy (Mvarh) exported. • Generator is generating, with active energy (Mwh) exported and reactive energy (Mvarh) imported.

Table 5: Mode definition

EMDAS, Metering and Measurement System Operating Philosophy

a) The energy meters and transducers obtain analogue inputs from the current and voltage transformers of the generator, unit transformer and excitation transformer. The outputs of the energy meters is routed to the EMDAS system where it will be distributed to different locations that requires the information.

b) The metering and measurement system must comply to Metering and Measurement Systems for Power Stations in Generation standard (240-56359083), NRS 057 Electricity Metering - Code of Practice (SANS 474), The South African Grid Code (The Metering Code) and all other applicable standards. The EMDAS system to comply to the latest version of the Generation Energy Management and Data Acquisition System (EMDAS) Standard (240-62581162).

Employer's requirement specification

System Breakdown Structure

Vanderkloof metering and measurement systems to be modified are divided into the following SBS (System Breakdown Structure):

KKS System Code	System	Location	Scope Performed by
10 CFA10	Unit 1 Metering and Measurement System	Vanderkloof Power Station	the *Contractor*
20 CFA10	Unit 2 Metering and Measurement System	Vanderkloof Power Station	the *Contractor*
00 CFA00	EMDAS System	Vanderkloof Power Station	the *Contractor*

Table 6: EMDAS and Metering System Breakdown Structure

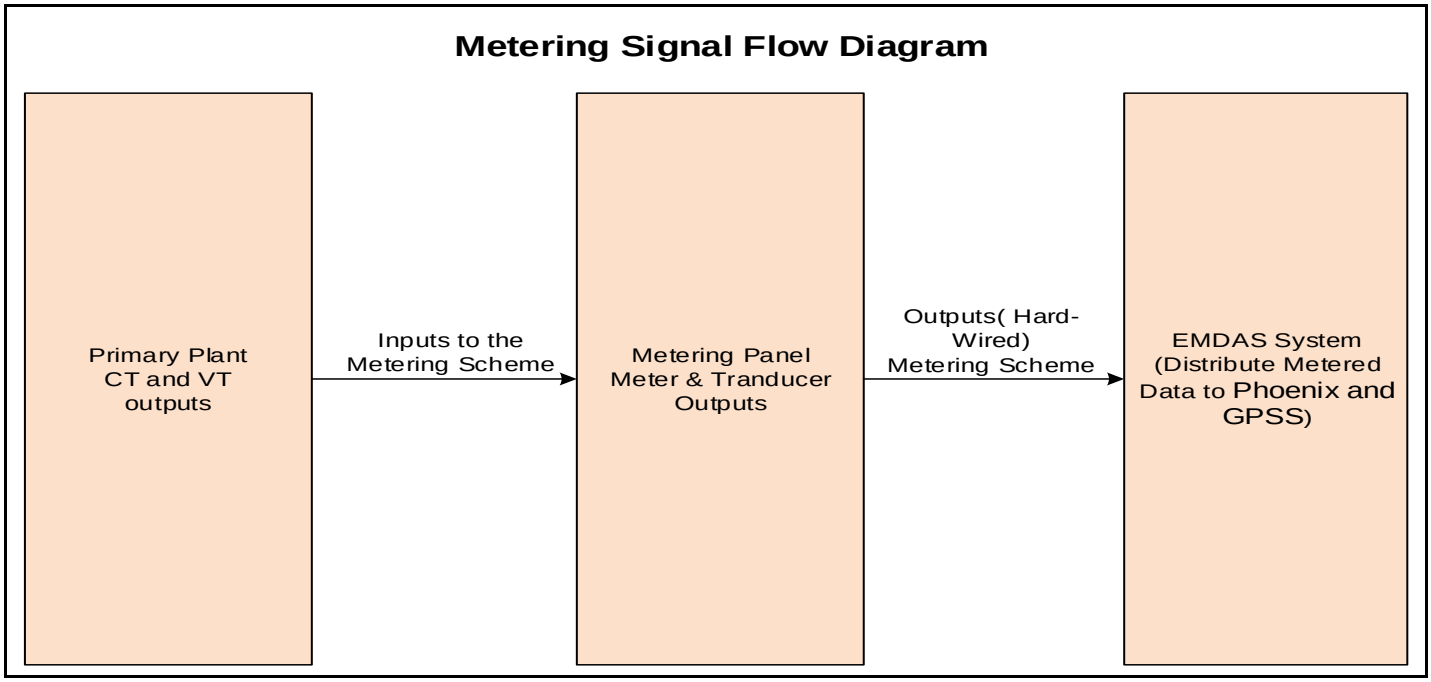
Process Description

a) Existing Primary Equipment, namely Current and Voltage transformers used for Metering and Measurement feedbacks are re-used. The existing system will be decommissioned (by Others – Protection *Contractor*) completely and replaced by a new metering and measurement system and a complete new EMDAS system.

b) Rating of existing equipment for the metering and measurement system is provided in Schedule A&B. The new metering and measurement system on each unit consists of the following components:

Item	Component	Function
1	Main Generator PQ Energy Meter	MWh & MVArh
2	Check Generator PQ Energy Meter	MWh & MVArh
3	Main Generator Transducer	MW, MVAr, V, I, Frequency & Power Factor
4	Back-Up Generator Transducer	MW, MVAr, V, I, Frequency & Power Factor
5	Unit Transformer PQ Energy Meter	MWh & MVArh
6	Unit Transformer Transducer	V & I
7	Excitation Transformer Main PQ Energy Meter	MWh & MVArh
8	Excitation Transformer Back-Up PQ Energy Meter	MWh & MVArh

- **Table 7: New Metering and Measurement System Components**



- **Figure 5: Signal Flow Diagram**

Equipment required to be included in the works

a) Refer to Schedule A&B.

EMDAS Software and licensing

a) All licenses required for the EMDAS system is provided, including all standard software and application licenses.

b) The EMDAS systems is supplied with configuration software.

c) All software supplied with the is documented comprehensively, with all the features and functions discussed, including a set of examples as to how the energy meters can be configured for different tariff structures and applications. Included in the documentation is a list of possible problems and how to solve them.

d) Training is provided for all relevant staff by the Contractor of the energy meter. This training covers the installation, maintenance, replacement and operation of the system and the configuration software.

e) The Contractor provides the Employer with an Eskom wide licence agreement for all software offered.

f) Future revisions of software supplied complies with the Eskom standard 240-76624509.

g) Upgrades of software and the associated licenses throughout the life of the system is catered for.

h) For systems implemented on the Microsoft platform, the accompanying communication source code is required, in order that any energy meters added to the system at a future date can be interfaced to the EMDAS without the need for additional licenses.

i) The Employer receives a fully functional open database connectivity (ODBC) driver with all relevant licenses to ensure that all connectivity requirements can be met. To mirror the data on EMDAS 1 and EMDAS 2 within a Relational Data Base (RDB), with duplication being handled via an ODBC connection.

Parts of the Works which the *Contractor* is to design

EMDAS, Metering and Measurement System

The *Works* provides a complete new EMDAS system and a redundant metering and measurement system without compromising any of the existing plant functions and applied philosophies. The *Contractor* is responsible for the following:

a) Design of a new EMDAS system and the Metering and Measurement System,

b) Manufacturing of equipment within the design constraints,

c) Configuration of equipment,

d) Factory Acceptance Test,

e) Transport,

f) Delivery,

g) Offloading,

h) Existing panel refurbishment to accommodate new equipment.

i) Installation,

j) Commissioning,

k) Documenting & Reporting,

l) Certification and verification,

m) Training.

Functional Requirements for the Works

The following are descriptions of devices and functions that are to be built into the *Works* or that the *Works* is capable of doing:

a) The metering functionality is supplied with the energy meters.

b) A metering system that is capable of determining the direction of active and reactive energy transfer and measuring these quantities as per the geometrical representation as per standards IEC 60375 and DST 32-326.

c) The Protection *Contractor* accesses the existing metering and measurement system and associated equipment. The Protection *Contractor* removes the obsolete equipment and places it in the *Employer's* store at Vanderkloof Power Station in conjunction with the *Employer*.

d) If required some of the existing cabling is re-used and is clearly marked before disconnecting from the existing equipment.

e) All fibre optic communication cabling and LAN cabling to EMDAS panels is provided, installed spliced and terminated by the *Contractor*.

f) The *Contractor* performs the design and detailed engineering with documentation of the plant and material detailed in schedule A and in conjunction with the *Employer* who will assist with the plant interface design.

g) The plant and material provide comprehensive metering and measurement system and embraces all features, accessories and auxiliary plant and material necessary to make a complete installation.

Functional Requirements for Metering and Measurement System

Operating Mode Requirements

Energy meters are required to meter generating mode of Vanderkloof generating units, for import and export megawatt-hours and megavar-hours (MWh and MVArh) in two quadrants. There must be a cumulative energy register enabled for generating mode of operation. Energy meters must be user-configurable to cater for the mode described in Table 5 above.

Voltage Transformers

a) The existing voltage transformers will provide the required voltage analogue quantities to the energy meters and transducers.

b) Metering voltage transformer circuits is suitably protected via miniature circuit breakers or fuses.

c) Refer to Schedule A&B.

Current Transformers

a) The existing current transformers provides the required voltage analogue quantities to the energy meters and transducers.

b) Current transformer circuits is earthed in the metering panel.

c) Refer to Schedule A&B.

AC Analogue Inputs

a) The voltage inputs are supplied from a three phase plus neutral voltage transformers as specified in Schedule A&B.

b) The current inputs to the energy meters and transducers are provided from current transformers with ratings as specified in Schedule A&B.

Metering System Requirements

The accuracy of equipment complies as specified in Table 8 and Table 9 below. The *Contractor* to further provide energy meters that meet the requirements of IEC 62053-22, IEC 62053-24, SANS 474/ NRS057, The South African Grid Code, Eskom 240-56359083 Metering and Measurement Systems for Power Stations in Generation and all other applicable standards and codes.

Plant	Instrument Transformers		Meters		Transducers	
	Main	**Check**	**Main**	**Check**	**Main**	**Check**
Generating Plant	Required	1. Required	Required	2. Required	Required	3. Required
Governor Control (MW)	Required	4. Required	Not required	Not required	5. Required	6. Required
Unit Auxiliaries	Required	7. Required	Required	8. Required	Required	Not required
Excitation Transformers	Required	9. Required	10. Required	11. Required	Required	Not required
Generator Transformers (Tx/Dx)	Required	12. Required above 1 MVA	Required	13. Required above 1 MVA	Required	Not required
Station Boards	Required	14. Required above 15. 1 MVA	Required	16. Required above 17. 1 MVA	Required	Not required
Loop Supplies	Required	18. Not required	Required	19. Not required	Required	Not required
MV Boards	Required	20. Not required	Not required	21. Not required	Required	Not required
Diesel Generators	Above 200kVA	22. Not required	Required above 200kVA	23. Not required	Required	Not required
Extraneous Supplies	Required	24. Not required	Required	25. Not required	Required	Not required

- **Table 8: Metering and Measurement Requirements**

	SIZE OF LOAD	
	<50MVA	**50MVA and above**
Active Energy Meters	0.2S	0.2S
Reactive Energy Meters	1	0.2S
Transducers	0.5	0.5
Current Transformer	0.2	0.2
Voltage Transformer	0.2	0.2

- **Table 9: Metering and Measurement Accuracy Class Requirements**

Energy Meter Mechanical requirements

a) The mechanical and climatic requirements for the energy meter complies with SANS 62052 part 11.

Energy Meter Ingress Protection Rating

a) The energy meter's electronic circuitry under the meter cover is suitably protected against the ingress of solid objects and liquids.

b) The Ingress Protection (IP) rating of this part of the energy meter is IP52 or better.

Energy Meter Insulation

a) Energy meters meets the insulation requirements of protective class II.

Energy Meter Markings

a) All rating plates complies with SANS 62052 part11.

b) The energy meter's serial number complies with the requirements of SANS 474/ NRS057 and is presented in barcode format.

c) All markings are indelible, distinct and legible on the outside of the meter.

d) Terminal markings is clearly indicated on the energy meter itself.

e) Energy meter connection diagrams is in accordance with SANS 62052 part11 and is fixed inside the terminal block cover.

Metering system Wiring

a) The wiring of metering system is in accordance with the wiring diagram in drawing D-DT-5804.

b) The wiring of metering system complies with the wiring diagram in drawing D-DT-5804.

c) Joints and splices in the wiring are not acceptable.

d) Not more than two conductors are connected to either side of a terminal.

e) All VT inputs from the HV yard is wired to the top of the terminals or miniature circuit breakers.

f) Metering system panel wiring meets the following requirements.

i. 2.5mm^2 nominal cross-sectional area, 40 to 50 strands for the current, voltage and auxiliary supply conductors.

ii. 1,5mm^2 nominal cross-sectional area, 15 to 30 strands for all other circuits

iii. All wiring is flexible, and PVC insulated

iv. 600V graded

v. Phase voltage and current wires are Red, White and Blue

vi. Earth wires are green/yellow

vii. Wire labels or ferules used for wiring identification (clip on versus interlocking slip on) colour are black on yellow or white.

n) The wiring between the transducer terminals and rack terminals is 2,5mm^2 multi-strand for the CT, VT and auxiliary circuits.

o) The wiring between the transducer and rack for all other circuits is at least 1 mm^2 multi-strand.

Meter Pulse Requirements

a) Each energy meter must be able to generate pulse output in each quadrant, proportional to a fixed quantity of units of electrical energy.

b) The pulses must be transmitted to the EMDAS for immediate and automatic evaluation of the energy conversion process.

c) Each of the pulse outputs from the energy meters will be assigned in such a manner that the above cumulative registers can be checked and verified during operation in EMDAS.

d) The energy meters has a minimum of four pulse outputs provided by potential free contacts for retransmission of parameters.

e) For the retransmitting of active and reactive energy, the contacts is fully configurable in terms of the measurand being indicated and the energy value of each pulse.

f) These output contacts complies with the following rating:

i. A power rating of at least 50 VA.

ii. Switching voltage of at least UDC = 110 V and/or UAC = 230 V.

iii. A life expectancy of at least 10 to 15 years.

g) The pulse retransmission contacts are normally open contacts. It is preferred that these contacts are not commoned with each other.

h) The energy pulse output has a nominal duration of 80ms ± 20ms.

i) All contacts are bounce free.

j) All relays used for external signalling has a minimum isolation of 2 kV between the relay coil and the contacts.

Metering Accuracy Class Requirements

a) Table 8 provides the minimum requirements for metering and measurements system. The accuracy of equipment complies with Table 9 and in accordance with the minimum requirements of NRS 057.

b) The energy metering devices are precision class 0.2S multi-function energy meters. This is used in a main and check metering configuration.

c) To achieve the required accuracy, the three-phase four-wire measurement principle is used in all cases.

d) Individual components, where applicable, is calibrated by an accredited calibration laboratory before installation.

e) Only meters that appear on the List of Approved Electronic Devices to be used on Eskom Power Stations Standard 240-56227589.

Generator Metering

a) These devices are user configurable and measure import and export watt-hours and var hours in two quadrants.

b) The following cumulative registers need to be enabled:

   i. +A (active energy export)

   ii. +Ri (reactive energy Lag Q1)

   iii. -Rc (reactive energy Lead Q4)

c) The energy meters produce output pulses that are proportional to a fixed quantity of units of electrical energy. Each of the above registers has a pulse output assigned to them.

d) The information from energy meters is transmitted to the EMDAS for immediate and automatic evaluation of the energy conversion process.

e) Energy meters conforms to the requirements of Table 8 and Table 9 above.

Unit Transformer Metering

a) The Unit Transformer connected to the generator bus bar is metered on the same voltage level as the generator, with P1 of the CTs facing towards the Unit Transformer.

b) Main energy meters of class 0.2S conforms to the requirements of Table 8 and Table 9.

Excitation Transformer Metering

a) The excitation transformers is metered on the high voltage side (generator terminals) for the correct electrical parameters required for operational and monitoring purposes with particular attention to energy.

b) Class 0.2S precision user configurable energy meters are used for the main and check metering of the excitation transformers. Check energy meters are required as Vanderkloof excitation transformers are greater than 1MVA rating (see Appendix B).

Communication Requirements

a) Energy meters must have bus interface capabilities, using open published communication protocols, such as Modbus TCP/IP, DLMS/COSEM or DP. Applicable driver software and sample source code with which to access the meter via the relevant protocol is provided.

b) The design includes the appropriate communication protocols required to integrate with the Eskom LAN interfaces.

c) Transducers must have communication functionality, such as Modbus TCP/IP or IEC61850, with IEC61850 being the preferred protocol to allow for automation compatibility.

d) RS485 serial and Ethernet TCP/IP have been earmarked as the preferred methods of connecting to energy meters in the field. The EMDAS design allows for the use of both communication mediums simultaneously.

Metering Time Synchronisation Requirements

a) Time synchronisation is required for all energy meters and the source of synchronisation must be EMDAS via NTP and/or SNTP.

Measurement Transducer Requirements

a) As a minimum, any transducers used for measurement, control and alarm purposes must comply with IEC 60688 as well as the Specification for Digital Transducer-based Measurement System for Electrical Quantities Standard (240-51999977).

b) Only transducers that appear on the List of Approved Electronic Devices to be used on Eskom Power Stations Standard 240-56227589 to used.

c) Where measurement redundancy is required, two or more separate transducers are used i.e., it is not sufficient to use two outputs of one multi-output transducer.

d) The transducers must have a live zero feature so that there is a greater than zero value of output for the low limit of measurement. For example, 4 to 20 mA for zero to full value of measurement respectively.

e) The live-zero feature is used to detect signal failure. For bi-directional quantities of Watt and Var, 12 mA will be zero, 4 mA maximum negative and 20 mA maximum positive.

f) All transducers with a 4 to 20 mA output must have a calibration over-scale of 120%. For example, 4 mA equals zero or minimum and 20 mA equals maximum or 120%.

Transducer Input Terminals

Terminal blocks used meets the following requirements and conventions:

a) Terminals for Current Instrument Transformer, Voltage Instrument Transformer and auxiliary supplies are the screw type and conforms to SANS/IEC 60947-71.

b) Clamping screws do not bear directly onto the lugs.

c) Terminal identification is provided and subject to *Employer's* written approval.

Transducer output terminals

Terminal blocks used meets the following requirements and conventions:

a) Analogue output terminals are the screw type and conforms to SANS/IEC 609477-1.

b) Terminals are capable of receiving blade- or pin-type crimp connectors.

c) Clamping screws are not bear directly onto the lugs.

d) Terminals are spring loaded such that the actions of the springs are independent of the action of the terminal screws

e) All control system interface terminals are spring loaded link type terminals.

Transducer Interfacing ports

a) Refer to section 0

Transducer Terminal block layout

The wiring to the input terminals on the DIN-rail are in accordance with the following convention and order:

a) Red phase – current in, voltage, current out.

b) White (yellow) phase – current in, voltage, current out.

c) Blue phase – current in, voltage, current out.

d) Neutral voltage

e) Ground

f) Supply

The wiring of the output terminals (milliamp outputs) on the rack or DIN-rail are in accordance with the following convention and order:

a) Analogue output 1 – positive terminal, negative terminal.
b) Analogue output 2 – positive terminal, negative terminal.
c) Analogue output 3 – positive terminal, negative terminal.
d) Analogue output 4 – positive terminal, negative terminal.
e) Analogue output 5 – positive terminal, negative terminal.
f) Analogue output 6 – positive terminal, negative terminal.

Transducer CT and VT inputs

a) The standard nominal voltage for the transducer is 110 V phase to phase.
b) The standard nominal current is 1 A for a 1 A transducer.
c) All transducers using one or more CT input(s) withstand 120% of the nominal value of the current continuously.
d) All transducers using one or more CT input(s) withstand 20 times the nominal value of the current for 1 s and repeated 5 times at 300s intervals.
e) The maximum burden on the CT inputs are not more than 0,3 VA for 1 A rating. and 0,9 VA for 5 A rating.

f) The *Contractor* must provide calculations to verify that the CTs are adequate and if burdening is required for the entire metering system.

g) All transducers using one or more VT input(s) has to withstand and not be adversely affected by the input(s) rising to 120% of the nominal value of voltage continuously.

h) All transducers using one or more VT input(s) has to withstand 200% of the nominal value of the voltage applied for 1s and repeated 10 times at 10s intervals.

i) The maximum burden on the VT inputs does not be more than 0,5 VA.

Transducer Auxiliary supply

a) The transducer has to operate normally on an AC auxiliary supply ranging from 95 V to 265 V, 50 Hz and/or a DC auxiliary supply ranging from 100 V to 230 V.

b) The digital transducer's auxiliary supply input has a maximum burden of 10 VA.

Transducer Milliamp outputs

a) The mA range output of the transducers required at Vanderkloof is 4mA to 20mA output.

b) Under no circumstances do output current exceed twice the nominal value.

c) The analogue outputs are able to drive a maximum of 500Ω resistive load at nominal output current of 20mA.

d) Any variation in the burden resistance within the limits of 0kΩ and 2kΩ does not cause the output to change by more than 0,1%.

e) The open-circuit voltage of the analogue outputs does not exceed 15 V.

f) Ripple content: The maximum ripple content in the output signal does not exceed twice the class index.

g) Response time: The analogue output has reached 90% of the nominal output value in < 500ms for a step input of zero to nominal.

Accuracy class requirements

The accuracy class of all transducers are as detailed on the following tables (Table 9 to Table 17):

26.	**Digital transducer output**	
Measurand	**Analogue (% of FSD)**	**Display (% of FSD)**
True rms voltage	± 0,5	± (0,5% + 1 LSD)
True rms current	± 0,5	± (0,5% + 1 LSD)
Active power (Watt)	± 0,5	± (0,5% + 1 LSD)
Reactive power (var)	± 0,5	± (0,5% + 1 LSD)
Frequency	± 0,5	± (0,1% + 1 LSD)
Power factor	± 1,0	± (1% + 1 LSD)

Phase Angle	± 1,0	± (1% + 1 LSD)

- **Table 10: Maximum allowable error for measurand on the analogue and display output of digital transducer**

27.		**True rms current**
28. Effective Range (referred to nominal) (Range over which accuracy class holds)		10% to 120%
Operating Range		0% to 150%
Nominal Output Range		4 mA to 20 mA
Accuracy Class Index Table 1:	Analogue (% of FSD)	± 0,5
	Digital (% of FSD)	± (0,5% + 1 LSD)

- **Table 11: True rms current specific measurement requirement**

True rms Voltage		
29. Effective Range (referred to nominal) (Range over which accuracy class holds)		80% to 120%
Operating Range		0% to 120%
Nominal Output Range		4 mA to 20 mA
Accuracy Class Index (over accuracy range 80% to 120%):	Analogue (% of FSD)	± 0,5
	Digital (% of FSD)	± (0,5% + 1 LSD)

- **Table 12: True rms voltage specific measurement requirement**

30. **Active power**		
Effective Range (referred to nominal)	Voltage	80% to 120%
	Current	10% to 120%
	Active Power	10% to 120%
Principle of Operation		DSP
Nominal Output Range		4 mA to 12 mA to 20 mA
Calibration		± 200 W = ± 5 mA, (export = +5 mA)
Measuring Method		Three element
Measuring Formula		E.I.cos(φ). √3
31. Accuracy Class Index Table 1:	32. Analogue (% of FSD)	± 0,5
	Digital (% of FSD)	± (0,5% + 1 LSD)

- **Table 13: Active power specific measurement requirement**

33. **Reactive power**		
34. Effective Range (referred to nominal) (Range over which accuracy class holds)	Voltage	80% to 120%
	Current	10% to 120%
	Reactive Power	10% to 120%
Principle of Operation		DSP

Nominal Output Range		4 mA to 12 mA to 20 mA
Calibration		± 100 var = ± 5 mA, (lag = +5 mA)
Measuring Method		Three element
Measuring Formula		E.I.cos(φ). √3
Accuracy Class Index Table 1:	Analogue (% of FSD)	± 0,5
	Digital (% of FSD)	± (0,5% + 1 LSD)

- **Table 14: Reactive power specific measurement requirement**

Power Factor		
35. Effective Range (referred to nominal) 36. (Range over which accuracy class holds)	Voltage input	80% to 120%
	Current	10% to 120%
Principle of Operation		DSP
Nominal Output Range		4 mA to 20 mA
Calibration		37. 0,001 lag to 1 to –0,001 lead = 0 mA to 2,5 mA to 5 mA
Measuring Formula		pf = arc tan(P/S), where S = $\sqrt{P2+Q2}$
Accuracy Class Index Table 1:	Analogue (% of FSD)	± 1,0
	Digital (% of FSD)	± (1% + 1 LSD)

- **Table 15: Power factor specific measurement requirement**

Phase Angle		
38. Effective Range (referred to nominal) (Range over which accuracy class holds)	Voltage input	80% to 120%
	Current	10% to 120%
Principle of Operation		DSP
Nominal Output Range		4 mA to 12 mA to 20 mA
Calibration		39. -90 to 0 to 90 = -5 mA to 0 mA to 5 mA
Measuring Formula		φ = arc tan(P/Q)
Accuracy Class Index Table 1:	Analogue (% of FSD)	± 1,0
	Digital (% of FSD)	± (1% + 1 LSD)

- **Table 16: Phase angle specific measurement requirement**

Frequency		
Effective Range		45 Hz to 55 Hz
Principle of Operation		DSP
Nominal Output Range		45 Hz to 50 Hz to 55 Hz = 4 mA to 12 mA to 20 mA
Accuracy Class Index Table 1:	40. Analogue (% of FSD) 48 Hz to 52 Hz	± 0,5

	41. Digital (% of FSD) 48 Hz to 52 Hz	± (0,1% + 1 LSD)

- **Table 17: Frequency-specific measurement requirement**

Generator Transducers

a) A real-time transducer measurement scheme for indication purposes is required for each generator.

b) Transducers conforms to the accuracy requirements of Table 9 to Table 17.

c) The real time measurements are as shown in Table 18.

Required by	Analogue Signals
Electrical Operating Desk (EOD)	Active power bi-directional (MW) Reactive power bi-directional (MVar) 3 x Current (kA) 3 x Voltage (kV) Generator frequency (Hz) Power factor (cos phi)
42. 43. 44. Unit Operating Desk	Active power bi-directional (MW) Reactive power bi-directional (MVar) 3 x Current (kA) 3 x Voltage (kV) Generator frequency (Hz) Power factor (cos phi)
45. 46. National Control and Automatic Generator Control (AGC)	Active power bi-directional (MW) Reactive power bi-directional (MVar) 3 x Voltage (kV) Generator frequency (Hz)
47. 48. Performance & Condition Monitoring 49.	Active power bi-directional (MW) Reactive power bi-directional (MVar) 3 x Current (kA) 3 x Voltage (kV) Generator frequency (Hz) Power factor (cos phi) Excitation current (A) Excitation voltage (V)

- **Table 18: Real Time Measurements for Generators**

Unit Transformer Transducer

a) The real time measurements for each unit transformer are as per Table 19 below.

b) Transducers conforms to the accuracy requirements of Table 9 to Table 17.

Required by	Analogue Signals
Unit Operating Desk	Active power bi-directional (MW) Reactive power bi-directional (MVar) 3 x Current (kA) 3 x Voltage (kV)
50. Performance & Condition Monitoring 51. Note: Values received via DCS	Active power bi-directional (MW) Reactive power bi-directional (MVar) 3 x Current (kA) 3 x Voltage (kV)
52. National Control, Automatic Generator Control (AGC)	Active power bi-directional (MW) Reactive power bi-directional (MVar)

- **Table 19: Real Time Measurements for Unit Transformers**

Governor Control Transducer (MW)

a) The Governor Control only requires Watt quantity (MW).

b) The range of the Governor Control power measurement is -50MW to 150MW

c) Transducers, VTs and CTs for governor control conforms to the requirements of Table 8 to Table 17.

d) The governor control transducer are housed within the generator measurement panel itself, provided that the transducer is securely separated from other equipment to prevent accidental interference.

EMDAS Functional Requirements

A standardised dedicated stand-alone Energy Management and Data Acquisition System (EMDAS) is to be installed so that accurate, reliable and auditable metering data can be provided. The new EMDAS system must interface to Phoenix and GPSS as stipulated on the latest Generation Energy Management and Data Acquisition System (EMDAS) Standard 240-62581162.

The function of the EMDAS data server will be as specified on the EMDAS standard which includes but not limited to the following:

a) To mirror the data on EMDAS 1 and EMDAS 2 within a Relational Data Base (RDB), with duplication being handled via an ODBC connection.

b) Provide automated hourly reports to Phoenix and GPSS,

c) To provide access to the mirrored data to authorised users throughout Eskom, in the form of user-defined customised reports,

d) To send out one-directional emails to a specific address, via the Eskom SMTP system, to report on any system irregularities.

e) To prevent direct access to EMDAS 1 and EMDAS 2 via Firewall 1 (Figure 6).

f) Ethernet ports for connection to Firewall 1 and Firewall 2 (Figure 6),

g) Support for Intel architecture,

h) Phoenix and GPSS Interfaces

NOTE FOR INFORMATION PURPOSES:

Phoenix is an application which runs on a client/server architecture, used for the reporting of generated hourly values and hourly sent out energy values throughout Eskom. Phoenix is managed and maintained by Eskom IT and does not form part of the EMDAS scope. EMDAS is required to send metering data to Phoenix on an hourly basis or manually, as and when required.

i) An independent application is provided for transferring hourly data to systems such as Phoenix and GPSS as per the example format in Appendix D.

j) Generator energy data is configured in a specified text format within the EMDAS data server and made available using FTP/SFTP to Phoenix and any other users that may require data in the same format via the Eskom LAN.

k) The file format is specified in the following document:

1 "INTERFACE SPECIFICATION: Phoenix Interface for Power Stations EMDAS."[14]

2 The latest version of this document is used and the file format is user configurable to accommodate future requirements.

l) Sending of the text file is automated, which has to occur as soon as possible after the hour with a user-definable time setting. If the first attempt fails, it is reattempted with a user definable interval and retry limit.

m) EMDAS data server within the DMZ is capable of transmitting and receiving a session via Relational Data Base (RDB) specific protocol with the GPSS system.

n) The Metering Data Management System (MDMS) shown in Figure 6 and is the future Eskom System which does not form part of this project.

The *Contractor* to provide for the following:

o) EMDAS Data Server has the capability to receive an old FTP file from Phoenix on an hourly basis (file originally sent to Phoenix by old EMDAS).

p) EMDAS has to have the ability to analyse and extract the relevant energy data from the retrieved FTP file, combine this with energy data from units connected to the new EMDAS, recompile this data into the new file format and send it back to Phoenix.

q) This functionality is implemented within the EMDAS Data Server, in such a way that no risk is posed to EMDAS 1 and EMDAS 2.

r) EMDAS 1, EMDAS 2 and the EMDAS Data Server has dual internal power supplies.

EMDAS Data Server

With reference to Figure 6 below, an EMDAS Data Server within a secure De-Militarised Zone (DMZ) is employed to provide controlled EMDAS data access to authorised users on the Eskom LAN. The function of the EMDAS Data Server is as follows:

a) To prevent direct access to EMDAS 1 and EMDAS 2 via Firewall 1 (Figure 6).

b) To mirror the data on EMDAS 1 and EMDAS 2 within a Relational Data Base (RDB), with duplication being handled via an ODBC connection.

c) To provide automated hourly reports to Phoenix in the format specified in the Interface Specification: Phoenix Interface for Power Stations EMDAS [14].

d) To provide access to the mirrored data to authorised users throughout Eskom via Firewall 2 (Figure 6), providing user-defined customisable reports, supporting a minimum of ten simultaneous remote connections.

e) To send out one-directional emails to user defined address, via the Eskom SMTP system, to report on alarms and any system irregularities.

Technical specifications for the EMDAS Data Server must include the following as a minimum:

f) Ethernet ports for connection to Firewall 1, Firewall 2 and EOW (Figure 6).

g) Dual redundant hard drive storage, capable of storing 36 months of raw metering data locally EMDAS 1, EMDAS 2 and the EMDAS Data Server.

h) Support for Intel architecture.

i) Controlled access to USB inputs and/or DVD drive once installed.

Interface Architecture

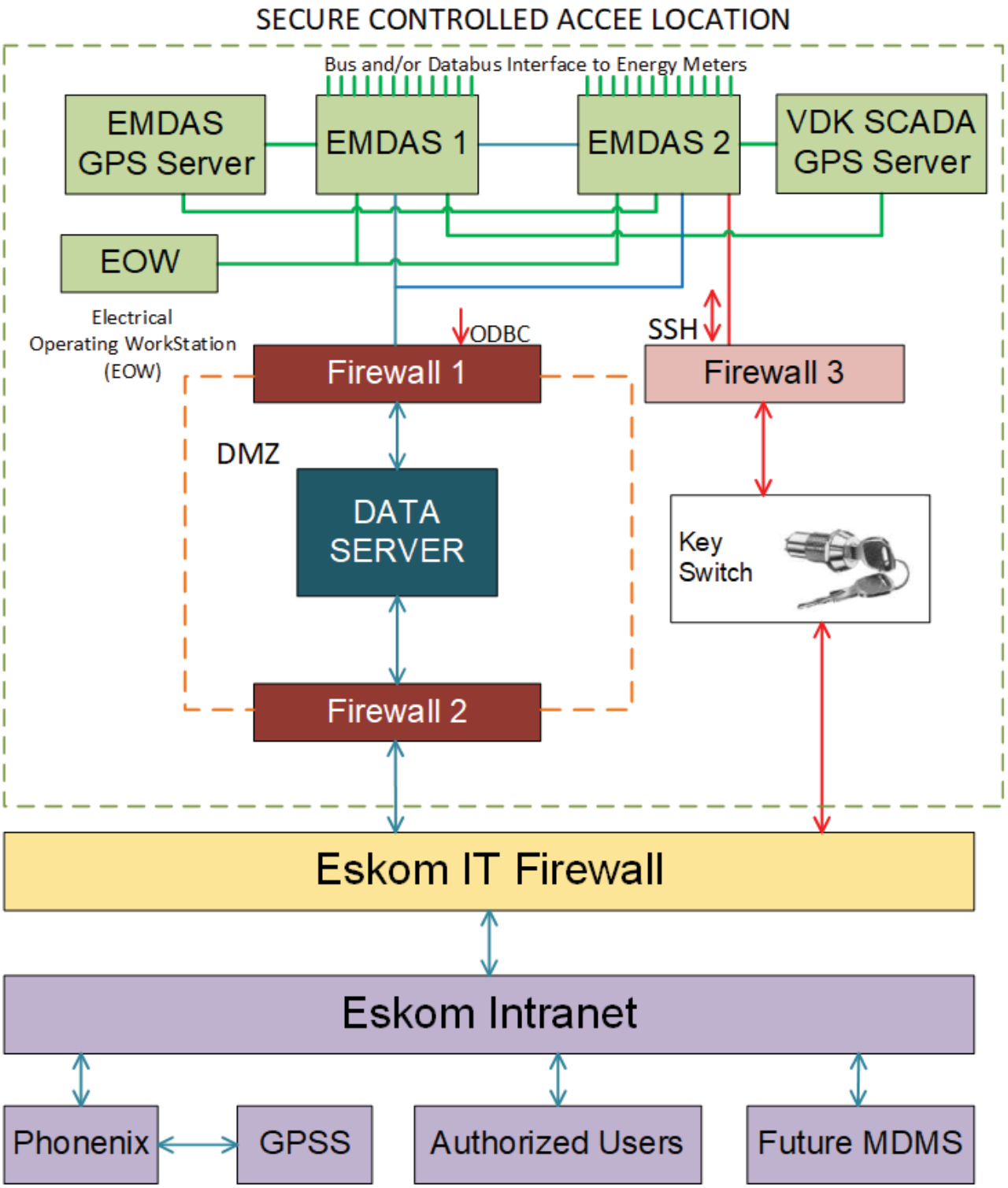
Figure 6 shows the conceptual architecture, with everything inside the larger dotted-line box falling within the boundaries of EMDAS.

a) EMDAS Data Server within the DMZ to initiate FTP and/or SFTP connections to Phoenix.

b) EMDAS Data Server database is accessible to authorised users on the Eskom LAN, via web interface. This is Read-Only access for general users.

c) Remote access via Key Switch is required via the Firewall 3 (Figure 6) device to EMDAS 1 and EMDAS 2 directly, for providing administrative engineering assistance to power station staff when required.

Note: All traffic passing through the Eskom IT firewall to and from the EMDAS Key Switch route can be monitored by Eskom IT System Security, to ensure that any unauthorised access is detected.



- **Figure 6: EMDAS and Eskom IT Interfaces**

EMDAS Interface requirements

The EMDAS interface requirements are as set out on the Generation Energy Management and Data Acquisition System (EMDAS) Standard 240-62581162. The following interfaces with the EMDAS must be provided as shown on Figure 6 and under Annexure E conceptual metering and EMDAS layout:

a) From energy meters to EMDAS 1 and EMDAS 2 via hardware frontend for pulses and databus.

b) From EMDAS 1 and EMDAS 2 to EMDAS Data Server, via Firewall 1 (Figure 6).

c) From EOW to EMDAS Data Server via the Eskom LAN and Firewall 2, with EOW not connected to EMDAS 1 and EMDAS 2.

d) From EMDAS Data Server to Phoenix via Eskom LAN and Firewall 2, using FTP and/or SFTP.

e) From Eskom LAN to EMDAS Data Server via web interface and Firewall 2.

f) From Eskom LAN to EMDAS 1 and EMDAS 2 via Key Switch and Firewall 3, for Remote Desktop access in emergency situations (local operator intervention required via Key Switch, which allows monitored access via Firewall 3).

g) From dedicated GPS clock source to EMDAS for time synchronisation, using NTP and/or SNTP.

h) From Station GPS clock source to EMDAS for time synchronisation, using NTP and/or SNTP.

i) From EMDAS to energy meters for meter clock synchronisation, using a suitable clock synchronisation protocol, with NTP and/or SNTP as a minimum.

j) Latest stable version of Open SSL to be employed and updated manually as required.

Required Fields for FTP File sent from EMDAS Data Server

a) Table 25 and Table 26 included in 6, provide a summary of the fields that need to be catered for in the FTP file sent from the EMDAS Data Server on an hourly basis. The *Contractor* is required to test this transfer functionality in collaboration with the *Employer*, to ensure that existing systems such as Phoenix are able to read the generated FTP file.

b) The *Contractor* must provide a method by which fields can be added or removed from the FTP file by Vanderkloof power station operating staff, in order to cater for future requirements.

c) Further background is included in 240-56359083 [23], 240-62581162 [15], 474-10721 [16] and PHOENIX EMDAS Interface for Power Stations Specification [14], which has to be used in conjunction with this document.

EMDAS Interface to Phoenix

a) EMDAS has to initiate an FTP connection via the Eskom LAN and transfer hourly metering data to Phoenix. FTP file format is specified in [14].

b) The latest version [14] has to be used and the file format the user configurable to accommodate future requirements.

c) Sending of the text file to be automated, which must occur after the hour with a user definable time setting. If the first attempt fails, it has to be reattempted with a user definable interval and retry limit. Manual sending of text file has to be provided for.

Electrical Operating Workstation (EOW)

a) Energy metering data has to be made available to the Power Station operating and maintenance staff via an Electrical Operating Workstation (EOW), which will be a dedicated workstation situated at the Vanderkloof Power Station EOD, not connected to any other systems other than EDMAS 1 and EMDAS 2.

b) The EOW comprises of a tower, a flat-screen monitor, a keyboard and a mouse. The tower has to be secured in a locked enclosure to prevent access to USB ports and CD/DVD drives.

c) The EOW to comprise of a tower, a flat-screen monitor, a keyboard and a mouse. The tower is to be secured in a locked enclosure to prevent access to USB ports and CD/DVD drives.

d) A printer has to be provided at the EOW in the event that an operator needs to print out reports. such reports are allowed for a user-defined rounding factor, with the default set to 3 decimal places while employing a MWh or Mvarh scale.

e) The EOW to provide a summary of real-time energy values from EMDAS 1 and EMDAS 2.

f) The EOW allows for manual entries to be made into EMDAS 1 and EMDAS 2, as described in Section 5.2.5.910 below.

g) The *Contractor* must provide unique login credentials on the EOW when manual entries are made into EMDAS 1 and EMDAS 2.

EOW Hardware Requirements

a) The EOW desktop minimum requirements are as follow:

i. Mid Tower Case

ii. Intel Core i7 12th Gen

iii. Motherboard with Sound & LAN

iv. 16GB DDR4 RAM (2 x 8GB)

v. 1TB NVMe or SATA SSD

vi. 24x DVD-RW SATA Internal Optical Disk Drive

vii. Intel Shared Graphics

viii. MS Windows 10 Professional

ix. Standard wired keyboard

x. Standard wired mouse

b) The EOW monitor minimum requirements are as follow:

i. 27” Flat Screen Monitor with 75Hz refresh rate and 1920x 1080 resolution

c) Printer minimum requirements are as follow:

i. Colour Laser MFP 179fnw Printer

EMDAS Manual Data Entry

a) Manually entered has to be entered to EMDAS Data Server, either locally into EMDAS Data Server itself, via Electrical Operating Workstation (EOW) by operators who must have login credentials or via an authorised user with access to EMDAS Data Server via the Eskom LAN (EMDAS 1 and EMDAS 2 are reserved solely for raw data retrieved from energy meters).

b) Manual entries via EOW to be carried out according to an authorisation process, with EMDAS recording both the automatic and manually entered values. Manual data forwarded on to GPSS to replace any existing data sent through previously.

c) Locally produced reports indicates any instances of manually entered data, via a suitable method such as colour coding.

In all cases where data is corrected or altered, a journal has to be automatically generated and archived with the following as a minimum:

d) Operator ID.

e) Date of correction/alteration.

f) Time of correction/alteration.

g) Reasons for correction/alteration.

Common Mode Failure

a) Where possible, the system design is to eliminate common mode failure, with the failure of any single device or module not resulting in a total system malfunction at any given time.

b) The system has no less than 99.9% availability, which equates to 8 hours per annum. Techniques and interventions used to achieve this performance has to be clearly stated by the Supplier.

c) In the event of a loss of supply to EMDAS 1 only, automatic changeover to EMDAS 2 is to take place, and vice versa.

EMDAS Fault diagnostics, Alarms and Reminders

a) Fault diagnostic routines are included for both EMDAS servers. The interpretation of alarms has to be clear and understandable, so that site maintenance personnel are able to do speedy and effective fault finding.

b) In order to ensure satisfactory maintenance and swift resolution of system malfunctions, EMDAS has to be able to raise alarms and issue periodic reminders, customisable by those with administrator rights.

c) EMDAS hardware alarms has to be incorporated into the system as well (e.g., power supply fail, CPU failure, communication module failure, GPS failure etc), to allow for total user supervision of the system.

d) All alarms are relayed to the EMDAS database. In the event that one EMDAS server is unable to raise such alarms due to catastrophic failure, the second EMDAS server is raises the relevant alarms, alerting operators of the failure.

e) In order to ensure satisfactory maintenance and swift resolution of system malfunctions, EMDAS has to be able to raise alarms and issue periodic reminders, customisable by those with administrator rights.

f) The status of EMDAS, including alarms and reminders, are viewable both locally on EMDAS 1 and EMDAS 2, as well as via the EMDAS Data Server to the Eskom LAN.

g) The EMDAS Data Server has to be capable of sending out immediate one-directional emails to a specific address, to report on any system irregularities that are deemed to be critical.

h) A monthly report of all faults experienced on any EMDAS installations, submitted by site to the *Contractor* during the guarantee period, to be submitted to the *Employer*' s Metering and Measurement technical personnel, as well as the relevant *Contracts Manager*.

EMDAS Time Synchronisation

a) EMDAS includes a dedicated GPS master clock and GPS aerial. The GPS master clock identifies itself and synchronise via NTP and/or SNTP as a minimum. Cabling and cable installation details are included.

b) EMDAS accepts timing inputs for synchronisation via NTP and/or SNTP and allows regular synchronisation with a dedicated GPS master clock, ensuring that the difference in time between its internal clocks and the external source never exceeds one second. Deviation exceeding one second is alarmed.

c) The EMDAS data server will be periodically synchronised via secure side to EMDAS 1 and EMDAS 2, which themselves will be linked to dedicated GPS clocks.

d) EMDAS data server uses the station clock and any other available time sources with proven reliability. The time synchronisation mechanism allows for time cross-checking and automatic switching of time sources for the sake of redundancy. In the event that the

available time sources fail or be judged as faulty, each EMDAS has the capability of independently switching over to an internal free-running clock, refusing requests to synchronise with other servers. Such a condition are treated as serious, for which an alarm requiring manual intervention is raised.

e) From EMDAS to energy meters for meter clock synchronisation, using a suitable clock synchronisation protocol, with NTP and/or SNTP as a minimum.

f) A manual time correction facility has to be available in the event that reliable time sources are not available.

g) EMDAS is capable of synchronising the internal clocks of energy meters, in the event that a suitable interface is present.

EMDAS Energy Reporting

a) Energy metering data is made available to the power station operating and maintenance staff via the EOW interface.

b) Operator screens and/or reports are user-definable and have the facility for selecting and viewing the metering period as hourly, daily, weekly, monthly and annually, as well as between any two user-defined dates and times.

c) A facility is available for producing summaries for each metering point of the following quantities for both Import and Export for the selected period:

1) Gross active and reactive energy production/consumption, for each unit.

2) Total Gross active and reactive energy production/consumption for the station.

d) The facility is provided to compare any channel and differences greater than a user defined percentage value (format NN.NN%) is flagged on the reports and displays as soon as the data is available.

e) Reports are available for the following from EMDAS 1 and EMDAS 2, the EOW and the EMDAS Data Server:

i. Current hour (dynamic per integration period),

ii. Last hour (historical per integration period),

iii. Current hour daily (dynamic per integration period),

iv. Last day hourly (historical per integration period),

v. Quarterly report for energy generated.

vi. Annual report for energy generated.

f) The visual report data for MWh and Mvarh are dynamic and user-definable for current hour and daily hour including historical data from the archive.

g) The visual reports are available locally to authorised personnel via the EOW and via the EMDAS Data Server over the Eskom LAN for authorised users.

h) All data is summated then rounded for reports such as day totals.

EMDAS User Access

a) EMDAS metering data is confidential and the access thereof has controlled and password protected. Security measures, such as a hierarchical password system to prevent the configuration information of the database from being changed by unauthorised personnel.

b) A complete audit trail exists for all data gathering, validation and processing functions, as well as when manual entries are done. This audit trail is applied to all archived data for the Life of Plant.

c) The integrity and consistency of the EMDAS data is critical and required strict governance of the database in order to track any undesirable activity. Documentation is provided by the *Contractor* indicating how this will be achieved.

d) In correcting any working data i.e., reports, the original data in EMDAS 1 and EMDAS 2 is protected from being changed. In cases where data needs to be changed, both original and modified data are archived. Data estimation is required where raw meter data is not available.

Summary of EMDAS Reporting Requirements

Utilisation Reporting

Local utilisation reports are made available for:

a) 24 hour, 7 day, 30 day, 365 day moving window reports, as of time of query.

b) User definable period.

c) Utilisation expressed as a percentage of rated machine capability per generator.

General Reports

General EMDAS reports are as per the example formats included in Appendix C, and also includes options for:

a) Last hour, last day, last month.

b) Any user selectable period.

Efficiency Reporting

Efficiency reporting for Generation is available for:

a) 24 hour, 7 day, 30 day, 365 day moving window reports, as of time of query.

b) Any user selectable period.

Efficiency expressed as a percentage per generator, calculated as the sum of all auxiliary load divided by generated power.

Control and Monitoring of the Metering and Measurement System

Unit Control Console and SCADA Interface

a) The measurement system (transducers) has a dedicated interface port for Supervisory Control and Data Acquisition (SCADA) purposes that is configurable for RS232/RS485/Ethernet. It is possible to communicate to multiple transducers from a single SCADA device (multi-dropping/cascading).

b) It has an engineering port RS232/RS485/Ethernet/Universal Serial Bus (USB) for configuring and maintenance purposes.

c) Multi-dropping should be easily accomplished by an appropriate multi-dropping communications cable between successive transducers, thereby ensuring a single communications cable between the first transducer and the SCADA device.

d) An engineering port RS232/RS485/Ethernet/Universal Serial Bus (USB) for configuring and maintenance purposes.

e) Figure 7 illustrates the Vanderkloof metering and measurement conceptual interface, which include hardwired interface to the control system, control console and governor, and software interface to the SCADA system.

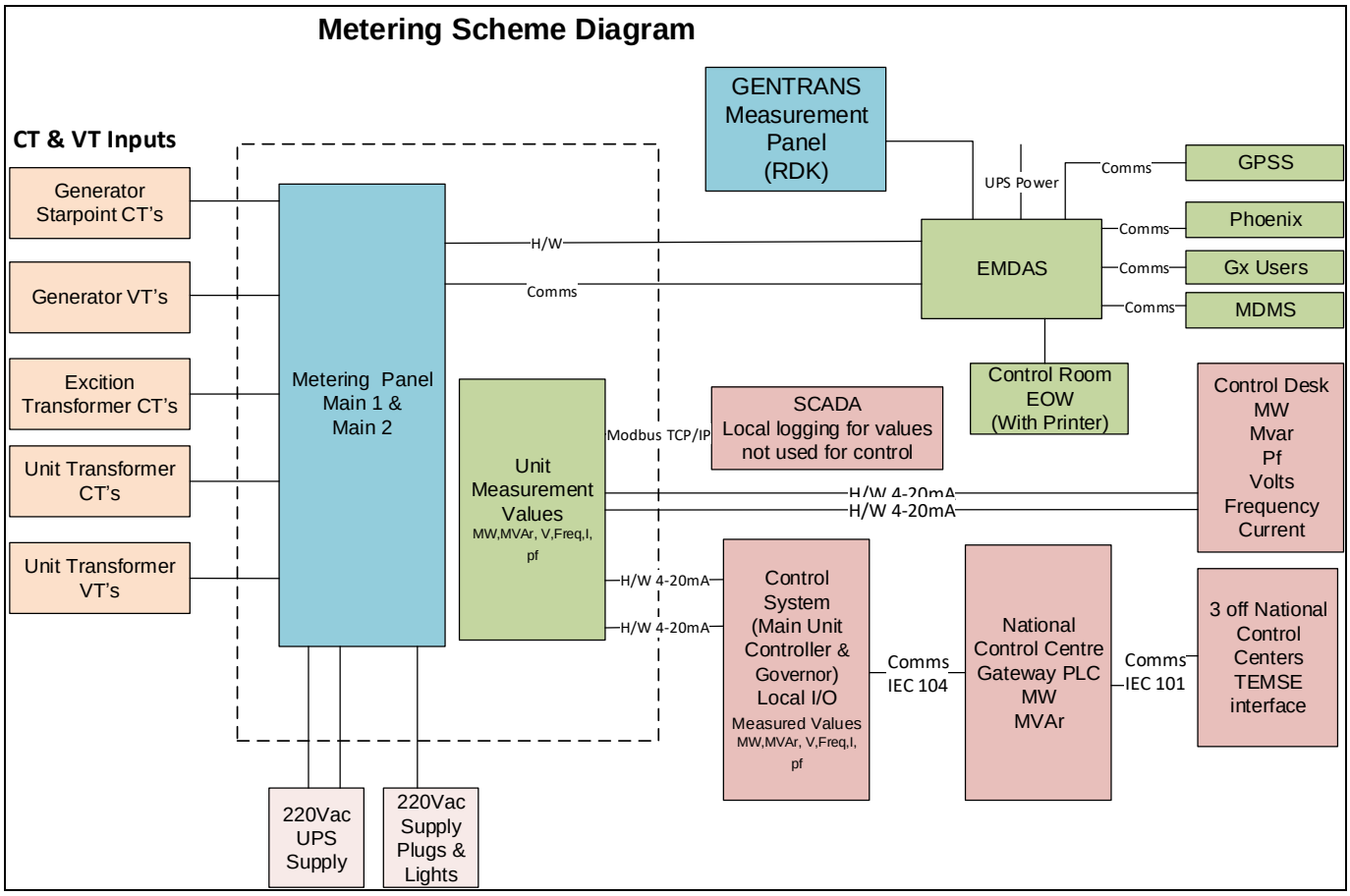
f) The *Contractor* allows enough time in order to achieve proper interfacing discussions and requirements between all Stakeholders and the *Contractor*. The *Contractor* is involved in clarifications and technical queries regarding interfacing and be actively involved during interfacing sessions.

g) The *Contractor* provides a detailed signal list as per the project requirement for approval.

h) The *Contractor* provides the data communication network, network interface cards and switches, device driver software, software licenses and fibre optic communication requirements between the energy meters, EMDAS system, network switches and station SCADA interface point as determined by the *Employer*. The *Employer* provides the SCADA computer hardware according to the *Contractor's* minimum hardware specifications.

i) The *Contractor* provides any fibre optic cables, connections, splices, splice boxes and fibre optic fly leads between the energy meters, EMDAS system, network switches and the station SCADA communication network.

j) The *Contractor* to provide energy meters that meet the requirements of IEC 62053-22, IEC 62053-24 and Eskom 240-56359083 Metering and Measurement Systems for Power Stations in Generation.



- **Figure 7: Vanderkloof Metering and Measurement Conceptual Interface diagram**

GenTrans metering interface to EMDAS

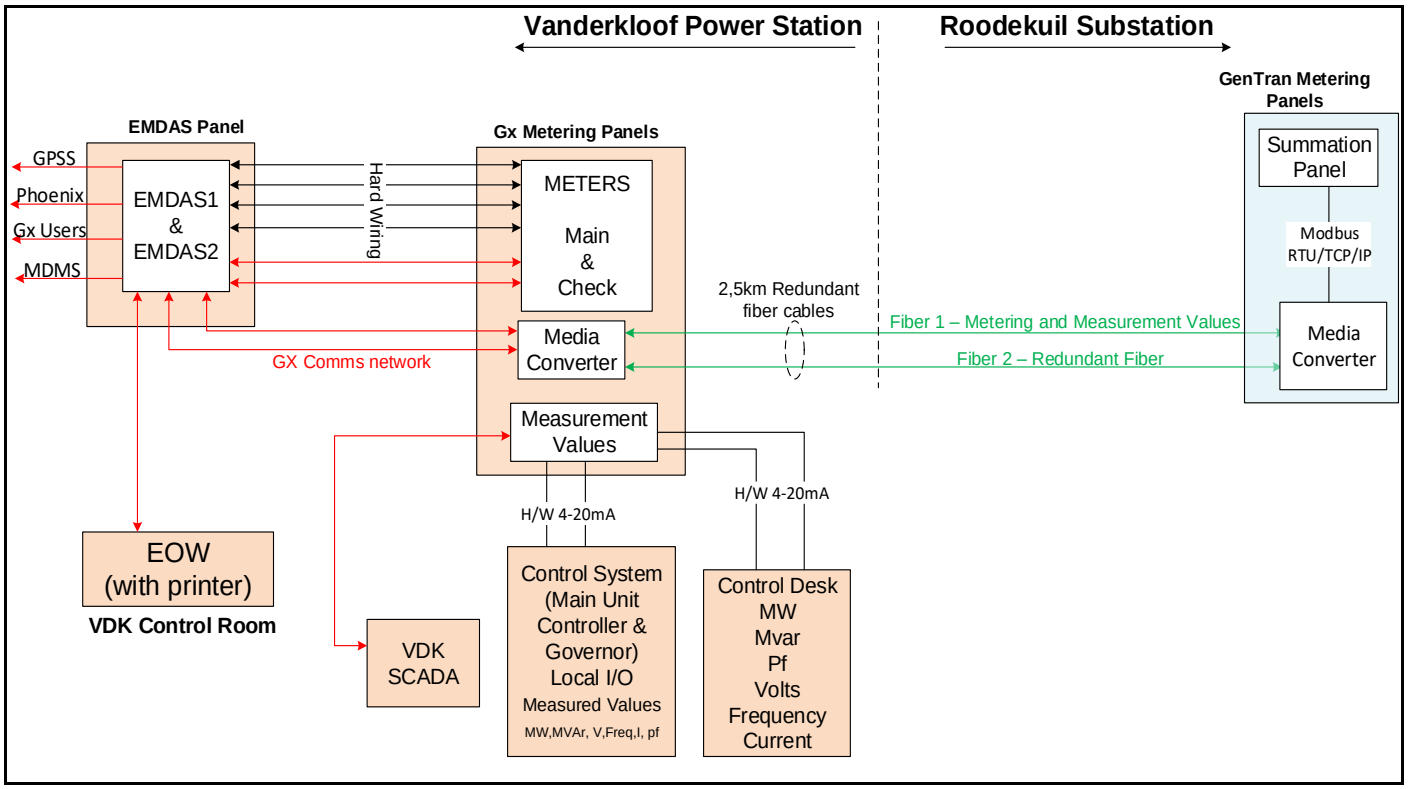
a) The GenTrans metering panels are located at Roodekuil substation which is 2.6km away from Vanderkloof Power Station.

b) The metering data will be transmitted via a redundant fibre optic communication bus cable provided by Others (Transmission Protection *Contractor*) to Vanderkloof hydro Power Station.

c) The point of HV yard metering is before the HV breaker at Roodekuil substation. These values are available from the HV yard and interfacing to the EMDAS front-end is via a fibre optic cable bus communication system.

d) Any HV yard interfaces complies with the South African Grid Code. All these signals has catered for in EMDAS.

Figure 8 below shows the Roodekuil-Vanderkloof conceptual metering and measurement Interface diagram.



- **Figure 8: Conceptual Diagram for RKD – VKD interface**

Other Interfacing Requirements

The *Contractor* allows enough time in order to achieve proper interfacing between all the stakeholders and the *Contractor*. The *Contractor* is involved in clarifications and technical queries regarding interfacing and be actively involved during interfacing sessions.

The following systems will be affected:

a) Excitation system

b) KKS layout of the station

c) Grid code requirements

d) Generator

e) Main Unit Control

f) Phoenix Interface

g) GPSS Interface

h) Metering panel

i) DC supply

Panel Design

The Existing Panel Frame

a) The *Contractor* is made aware that the panel frame is fixed and cannot be removed.

b) It is the *Contractor's* responsibility to design a new metering and measurement system that consists of the following:

   i. Trunking

   ii. Terminals

   iii. Wiring

   iv. Equipment (Energy Meters, Lights, Switches, Relays, Circuit Breakers, Test Blocks etc)

c) The supplied equipment is housed in the existing panel outer cabinet and does not be dismantled after FAT and is to be transported and installed as a single unit. This applies to both the metering and measurement panel and EMDAS panel (see **Figure 12**).

d) Panel layout is provided in drawing 0.39/1061, the *Contractor* is to verify panel dimensions to ensure equipment will be adequately housed within the outer cabinet.

e) Marks up the existing drawing to reflect proposed changes.

f) Internal and external surfaces of the metering and EMDAS panels are painted G29 (light grey), of SANS 1091

Gland Plates

a) The removable gland plate is punched and plated. Provision is made for the fitting of a minimum of twenty-five (25) number 1 glands (20mm holes) and 2 number 2 glands (25mm holes).

b) Each unused hole is blanked with a plastic plug.

EMDAS Configuration Software

a) All configuration software for the EMDAS system is supplied, documented comprehensively, with all the features and functions as stated in this document.

b) Included in the documentation is a list of possible problems and how to solve them.

c) Software is kept as simple as possible and designed specifically to enable personnel to reliably operate it with minimum training, with software that is menu-driven.

d) All licenses required for the EMDAS system is provided, including all standard software and application licenses.

e) Upgrades of software and the associated licenses throughout the life of the system is catered for.

f) The *Employer* is supplied with a fully functional ODBC driver with all relevant licenses to ensure that all connectivity requirements can be met.

EMDAS Reliability

a) EMDAS is fully redundant from front-end hardware I/O level up to and including EMDAS 1 and EMDAS 2. Two identical systems are provided, with both systems having identical inputs and outputs. Redundancy is not applicable to Key Switch, Firewall devices, EMDAS Data Server and DMZ.

b) In order to minimise the risk of data loss:

i. EMDAS 1 has to make automatic local backup of EMDAS 2 database on a daily basis.

ii. EMDAS 2 has to make automatic local backup of EMDAS 1 database on a daily basis.

c) In the interests of storage space, these backups works on a 3-day revolving cycle (i.e., backup done on Day 4 are overwrite the backup done on Day 1, backup done on Day 5 has to overwrite the backup done on Day 2, etc).

d) Transfer from EMDAS 1 to EMDAS 2 and vice versa does not cause an interruption of availability nor result in inaccurate data processing.

EMDAS Relational Database

a) Bus communication method is either be open source or licensed to Eskom. For systems implemented on the Microsoft platform, the accompanying communication source code is required, in order that any energy meters added to the system at a future date can be interfaced to the EMDAS without the need for additional licenses. For systems implemented on the Linux platform, with Debian being the preferred distribution, accompanying source code in at least C and/or Python are required. The source code is tested by the *Employer*.

b) EMDAS software allows for all raw metering data to be time-stamped, stored and archived in a Relational Database (RDB), together with the data for each integration period (per hour or user defined).

c) The system is capable of storing 36 months of raw data locally on EMDAS 1, EMDAS 2 and the EMDAS Data Server.

d) EMDAS is capable of manual archiving of energy meter data onto an external source, with a suitable method provided for achieving this.

e) The database accommodates a minimum of ten simultaneous users via the EMDAS data server interface.

f) Energy data is stored in at least two independent tables. The first table will store data at a fixed interval of 1 hour at the end of each hour and with a time accuracy of better than 1 per unit (pu) of the 0.2 accuracy class. The second table is a user-adjustable time interval which should allow for data storage down to 1-minute intervals.

g) ODBC is employed for connecting to the RDB, which will be supplied with sufficient connectivity licenses to ensure unhindered operation for existing energy meters and a spare capacity of 10%.

h) The database maintains backup files of the configuration information and of the metering value. It is possible to store these backup files on an appropriate reliable external medium. This function, together with an automated Disaster Recovery Process, are integrated within the software.

i) A manual Disaster Recovery Procedure is also provided, in both hardcopy and softcopy formats, allowing a trained technician to restore EMDAS in the event of critical system failure.

Energy Metering Retrieval and Storage Requirements

a) EMDAS allows for the full accounting of gross energy generated, net energy sent out, energy imported and consumption by auxiliaries, on a unitised basis.

b) EMDAS allows for the creation of user customisable fields, linking stored data and allowing for full mathematical manipulation, such as for calculation of station Gross Generated and Sent Out totals and other quantities that are not metered directly. Calculated values are stored in the EMDAS database.

c) EMDAS allows for interfacing with energy meters, via both pulse and open protocol databus transmission. Pulse data and cumulative register reading from the metering device has to correlate within one pulse over the integration period.

d) When databus communication with the metering device is used, the energy quantities represented by the energy meter register values are read and stored by EMDAS. The cumulative register data is used to calculate the interval value, which is stored in an interval table. In addition to this, the cumulative register is stored in its own table for meter tracking reasons and to allow for manual cross-checking if required.

e) RS485 serial and Ethernet TCP/IP have been earmarked as the preferred methods of connecting to energy meters. EMDAS allows for the use of both communication mediums simultaneously. DLMS COSEM has to be included as a minimum for communication between EMDAS and energy meters.

f) EMDAS is capable of reading energy meter output pulses directly into the EMDAS frontend. This frontend comprises of a suitable hardwire interface and pulse counters, with both of these forming part of EMDAS. Pulse counter modules are capable of detecting pulses at a

minimum rate of 5 per second and totalise the pulses for up to 60 minutes for each channel. Energy representation of the pulses are stored in the database by means of ODBC.

g) Where pulses are used, these are captured, counted and processed using the correct Unit Per Impulse (UPI) value, with the resultant energy value stored in the database per integration period. Pulse counter modules are capable of detecting pulses at a minimum rate of 5 per second and totalise the pulses for up to 60 minutes for each channel.

h) Pulses are detected on the rising edge, achieved by using a normally open contact and a fixed time period of typically 80ms. EMDAS allows for user-definable UPI value, with a Mark/Space ratio of 1:1.5 by default (typically 80:120ms). The acquisition and accumulation of pulses are continuous and acquisition for each input or channel sstarts from zero after every integration period.

i) EMDAS has the capability to distinguish between inactive/faulty energy meters and errors due to deviation or inaccuracy. Failed or inactive energy meters are detected and alarmed. The energy values from the main and check energy meters are compared continuously and the difference alarmed if it exceeds twice the energy meter class accuracy.

j) Alarms are displayed locally on EMDAS 1 and EMDAS 2, displayed via the web interface on EMDAS Data Server, as well as via one-directional emails sent from the EMDAS data server to a user-defined contact list. Daily email is sent out with summary of any alarms that require investigation, as well as a summary of the daily total of active and reactive energy produced/consumed, in MWh and Mvarh.

Metering System software requirements

a) The metering systems are supplied with configuration software.

b) All software supplied with the system are documented comprehensively, with all the features and functions discussed, including a set of examples as to how the energy meters can be configured for different tariff structures and applications. Included in the documentation is a list of possible problems and how to solve them.

c) The *Employer* is given an Eskom wide licence agreement by the *Contractor* for all software offered.

d) Future revisions of software are supplied in terms of a contract and are submitted in accordance with Eskom standard 240-76624509.

Security within the software

a) Security measures, such as a hierarchical password system prevent the configuration information (in the energy meters and EMDAS system) and the configuration software, from being changed by unauthorised personnel.

b) Three levels of security will be provided within the software to enable the following functions:

i. Read only mode whereby all the registers within the energy meter may be read.

ii. Reading and programming access to the energy meter.

iii. Reading, programming, reprograming and configuration access.

General Requirements

Materials and Construction

a) Moulding materials are self-extinguishing, or resistant to flame propagation, substantially non-hygroscopic, and do not carbonise when tested for tracking. The mouldings are dimensionally stable and have high impact strength. The materials used are to be of the flexible type to avoid cracking of terminals.

b) Mouldings are mechanically robust, of flexible material and withstand the maximum possible torque that may be applied to the terminal screws. Terminals where pressure is applied to the moulding when tightening the terminal screw or nut are not acceptable.

c) Steel parts, other than stainless steel, are plated and passivated. Current carrying parts are non-ferrous and plated. All plating is compatible with other parts of terminations and lugs. Screws into steel are steel, stainless steel or phosphor bronze. Steel screws are plated and passivated. All plating complies with the standards ISO 4042:1999 and ISO 2081.

d) Tapped holes have not less than 1 full thread. Separate terminals are provided on each unit for incoming and outgoing connections and their contact pressure is independent of each other.

e) Terminal covers or shrouds and barriers, are of insulation material, self-extinguishing or resistant to flame propagation, mechanically robust and preferably clip into the moulding.

f) Closing of panel/floor/cable entries is by means of fireproof/flame retardant material

Wiring and Wiring Identification

a) A wire adopting its termination point in a terminal rail as its wire number is not acceptable.

b) Ferrules with wire identification numbers read from left to right (the right way up) on vertical terminal strips and from top to bottom.

c) The slack appears as close as possible to the component in the form of a loop.

d) Wires to plant and material on swing doors are so arranged as to give a twisting motion and not a bending motion to wires. It is required that robust wiring looms at doors are used with clamps on both ends (Clamp on the door and a clamp inside the panel).

e) Where this wiring is connected to current transformers, protection of the terminations is provided.

f) There are specific rule governing the ferrule numbers for wires. A comprehensive list is made available during design phase.

Power Supplies

a) The DC supply for the equipment is provided from one redundant external battery/battery charger system.

b) The AC power is provided from one redundant external Uninterrupted Power Supply (UPS).

c) Redundant power cabling from the point of supply are provided by the *Employer*.

d) The *Contractor* specifies the power supply requirements in Schedule A&B

e) Power supply ratings provided as per Schedule A&B

Supply Interruptions

No equipment mal-operates if the DC auxiliary supplies are switched on or off permanently or repeatedly at a random rate for periods of 5, 10, 50, 100, 200 and 500ms. Refer to the *Employer*s Standard 240-64685228 for the required equipment performance under electrical disturbances.

Auxiliary Relays and Timers

a) Auxiliary relays, logic functions and timers that form part of the scheme are preferably software function blocks, forming an integral part of the numerical IED.

b) The application of auxiliary trip relays, surge proof inter trip relays and contact multiplication relays is minimised without compromising the functionality of the scheme. When used, it conforms to the *Employer*s Standard 240-64685228 and 32-333 and the general requirements specified in Schedule A.

c) Special notice should be taken if such auxiliary relays are to perform tripping functions. All relays should be of the demagnetising type.

d) All plug-in type relays have bases where the termination of wires up to 1.5mm2 can be connected and up to a maximum of two wires per termination point.

e) Plug in relay bases do not cause wires entering the outermost terminals to interfere with an adjacent relay base.

f) All plug in type relays have metal, rust resistant retaining clips to prevent the relays from dislodging either accidentally or due to vibrations. Spacing between relay/relay bases are adequate to allow for individual relay removal without disturbing adjacent devices.

g) Inter trip relays and solid state devices (e.g., opto-couplers) which connect to one or more cores of an external cable and which have the potential to cause a trip of any of the protection trip channels are surge proof as set out in the *Employer*s Standard 240-64685228. They are not made surge proof by connecting external devices in parallel or series with the coils or solid-state devices.

h) It is customary to use auxiliary relays with a mechanical forcing plunger. Such plungers are removed before final commissioning and the holes plugged with a suitable plug to prevent dust ingress into the relay contact area.

i) All auxiliary relays type test or OEM certificates/specifications are submitted to the project management for approval prior to ordering the components. Specifications include the contact's DC breaking capability.

Test Blocks

a) Current and Voltage transformer signals are routed via test blocks before entering the devices. Under no circumstances will voltage and current signals be present in the same test block.

b) Test blocks are installed such that the test handle can be inserted without interference. The test handle are allowed more than one lead to be connected to a connector. Repeated Insertion and removal of the test handle not compromise the integrity of the shorting mechanisms or the mechanical stability of the assembly (or adjacent assemblies).

c) The test block connections permits access to voltage and current circuits for testing purposes while the equipment may still be in normal service.

d) The preferred test blocks for each system are specified in the A&B schedule

e) Test blocks are suitably labelled to indicate voltage or current circuits.

f) Sealing of test blocks is not required for Eskom generation

g) The mechanical and electrical requirements are specified in 240-70975231 Specification for current and voltage transformer test blocks.

h) Voltage transformer circuits are suitably protected via miniature circuit breakers or fuses.

IED Interface

a) Plant Interface

i. The protection and synchroniser scheme facilitates secondary injection without the need to disconnect any wiring.

ii. All analogue inputs can be accessed without interference with the primary plant such as but not limited to open CT circuits, and shorted VT circuits.

iii. All analogue I/O and contact I/O are be routed via terminals that allow measuring (current and voltage) and isolation using standard tools.

b) IED Interface

i. Configuration, interrogation and testing of the IED's are done via communication ports available as a minimum in the front of the panels.

ii. A single reset facility per IED to be insured

iii. The operation of any protection function is individually monitored and measurable.

iv. The IED configuration (or testing) tool or interface allows single setting changes and allow simulation and monitoring of contact I/O.

v. Accidental short circuits between measurement points and/or earth should not result in any damage or malfunction of the equipment.

Numerical Type IED's

a) Only numeric relays listed on the approved electronic devices to be used on Generation Power Stations (240-56227589) will be considered. They have continuous self-monitoring functions for both hardware and software. Any fault or irregularity is immediately alarmed to an output contact.

b) All numerical relays are pre-programmed with the logic approved by the *Employer* that enables the scheme to comply with the specification as provided during the engineering phase and provided as part of the scheme drawings. No logic programming is required after delivery, only the application of conventional functional settings.

c) All software required for engineering and maintaining the equipment is provided. These relays have software that conforms to the *Employer's* requirements as stated in 240-56356630. The *Contractor* submits the details of the PC hardware and operating system, port and protocol requirements to be supplied by the *Contractor* to the *Employer* to enable the *Employer* to interface via the software with the supplied equipment.

d) All recalls, upgrades and modifications are communicated timeously to the *Employer*. Any malfunctions of similar equipment experienced by other users or known to the *Contractor* are communicated timeously to the *Employer*.

e) The state of flip-flops and value of counters are stored in non-volatile memory in the IED so as to be maintained at its previous state/value upon cycling of the auxiliary supply to the IED.

f) IEDs are equipped with a user-programmable logic facility suitable for their intended application. These include logical gates (AND, OR and NOT) as well as delayed pick-up and delayed drop-off timers, flip-flops and counters, etc.

g) It is possible for the user to configure IED functions to operate virtual or actual output contacts in accordance with the scheme's operating philosophy.

h) Have a proven service record of at least two years. The equipment is designed for a minimum-working lifetime (Refer to Schedule A&B). Written guarantees to this effect are made available on request. The *Contractor* makes a statement regarding re-calibration of the equipment to keep it in perfect working order or any other required intervention by the *Contractor*, subsequent to the sale of equipment that has a financial impact on *Employer*.

i) A mimic on the IED reflecting the plant status is provided (i.e., the whole single line diagram)

Notes for tenderer

An international and national relay reference sales list is required from the *Contractor* with tender submission

IED Configuration and Communication

a) Programming facilities for all configuration and parameters of functions is provided by means of a menu driven software program.

b) The main network backbone are designed in a ring topology for reliability purposes.

c) The equipment allows for connection of a monitoring system and/or a local personal computer.

d) Required software and interface connectors to be provided by the *Contractor* for all functions and communication configuration.

e) All recorded data is retrieved by means of a personal computer operating in a Microsoft Windows environment directly from the device. The data is also retrieved via the interface with the SCADA system at the control room workstation and to remote users on the *Employer*s Wide Area Network.

f) Licensed copies of the software package are provided for performing the following functions:

   i. Retrieving the stored event and disturbance recorder data.

   ii. Displaying and analysing the data graphically.

   iii. Configuration changes via a personal computer.

   iv. Setting and configuration comparison tool.

   v. Engineering of the IED

g) The following hardware is provided by the *Contractor*

   i. A secure and reliable communication link between the Control System HMI and the respective IED's.

Device Settings

a) A comprehensive set of setting tools and example-setting details to cover all user settable configurations/functions in the module is provided.

b) The software tools include a comprehensive comparison tool that allows online and offline comparisons.

c) The relay configuration is seen as part of the scheme as it is imperative that it is in accordance with the scheme design in order for the scheme to function correctly. All scheme related method of calculated settings/configuration is pre-programmed and all production schemes are delivered pre-programmed in accordance with the scheme design. The

settings/configuration is seen as integral parts of the scheme documentation and is provided as part of the documentation as well as in software format in the file type as required by the associated relay.

d) The *Employer* provides the detailed protection and synchroniser settings for the *Contractor* to apply.

Software

a) The *Contractor* supplies the latest compatible version of all required software and installation files with their respective licenses not limited to the operating systems, device drivers, proprietary software, open-source software, and third-party software to perform maintenance, configuration changes and system recovery,

b) The *Contractor* provides two copies of the operating system software, application software and drivers on separate USB flash sticks for the *Employer* to retain.

c) The support period required for the equipment out last any operating system's life expectancy.

d) The *Contractor* has contingency plans in place when operating systems become obsolete to ensure that their own applications are either migrated to a new platform and that the necessary software drivers are compatible with new hardware as well.

e) Software that allows fault recordings analysis, sequence of events, settings and configuration tools is deemed to be an integral part of the required scheme functionality. All software related to a particular IED vendor is contained in one software package.

f) To meet the requirements of future contracts based on this specification, if microprocessor-based equipment is offered, the *Contractor* supplies 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.

g) Software to be compatible with Windows 10 as a minimum.

h) The *Contractor* informs Eskom of any and all new releases. The latest software version is always compatible with the installed base of relays, which originally were compatible with the previous version of software that was compatible with the previous Microsoft Windows operating system.

i) The IED operating and analysis software has capabilities to:

    i. Configure and set the IED in offline and online modes.

    ii. Validate the configuration and settings.

    iii. Hide or "grey out" settings associated with functions that are set as disabled. This requirement is applied equally to the settings display from the IED front panel.

iv. Compare configuration, settings, Configured IED Description (CID) and IED HMI configuration files (where applicable) between a saved file on a PC, and the active file on an IED.

v. Export an IEC61850 IED Capability Description (ICD) and CID file.

vi. Import IEC61850 Substation Configuration Description (SCD) and System Exchange Description (SED) files from third-party configuration software.

vii. Import setting and configuration files, event records and oscillographic recordings from an IED.

viii. When installed on the engineering server, have the capability to poll all the IEDs to upload and store, to a user selectable folder, all new events and fault records, and

ix. Allow IED project to be exported as XRIO and or XML format to be used in testing and setting tool.

Licensing

a) The *Employer* does not accept hardware with the *Contractor's* corporate licensed operating system software.

b) All further firmware, software and licensing updates are provided to the *Employer* for the duration of the support period of the specific equipment.

c) All software licenses provided are valid for the life of the equipment which is in excess of 20 years.

IED Firmware

a) Information regarding the estimated data retention time of EPROM's or FLASH ROMs used in the relays is provided to the *Employer* via the *Project Manager* as well as the typical rewrite cycles.

b) A label stating the relay firmware version is fixed to all numerical IED's.

c) Information regarding the estimated data retention time of EPROM's or FLASH ROMs used in the IED's is provided to the *Employer*.

d) Once the first FAT is completed no firmware updates will be allowed as all Units stay on same firmware version throughout the project.

e) Spares are on the same firmware version as on the plant.

f) All future IED or its firmware upgrades and modifications are communicated timeously to the *Employer*. All IED's provided for this contract to be equipped with same firmware version, if a newer version of firmware is published during the duration of the contract, the older version is immediately replaced by the *Contractor* at no cost. Any malfunctions of same equipment

experienced by other users or known to the *Contractor* are communicated timeously to the *Employer*.

Event Recordings

a) The trigger conditions for the event recorder has to be programmable.

b) IEDs are incorporate an oscillography analogue and digital signal recorder.

c) The event and waveform recordings are stored in non-volatile memory and are time-stamped to the nearest millisecond.

IED Self Supervision

a) All IED's incorporate self-supervision features to detect DC supply fail, equipment faults and software errors.

b) All IED's have self-diagnostic capability to access and retrieve at any time.

c) All IED's performing a measuring function are of numerical design and provided with comprehensive, continuous self-monitoring.

d) Supervision and indication of the status of wiring and signals from the tripping relays to the external trip coils is required.

Time Synchronisation

a) The time synchronization mechanism ensures that every data item is time stamped at the source and therefore time synchronised with the GPS clock. The transmission and processing of data will not influence the time attribute of the data item and preserve its time value.

b) The GPS clock installed at Vanderkloof Power Station SCADA is used for time synchronising of the protection and synchroniser schemes. (Refer to schedule A&B)

Cyber security

a) Both the Unit's protection and synchronising schemes (all IED's), including engineering Laptop and OT (Operational Technology System) will be on a SCADA process network.

b) Anti-virus packages will be installed by the *Employer* and updated periodically on all Microsoft Windows based equipment installed.

c) Access to the IED HMI are protected by password control to register persons for different levels of access, such as equipment and switchgear operating (control).

d) To prevent unauthorized access to the alone-standing network from any installed network switch, IED, server, etc, port security methods are used to prevent access.

e) Events and disturbance records must be possible to be downloaded from any IED (Protection, synchroniser, bay controller, etc.). Layers of interfaces and access (password control and privileges) prevent accidental changes in the IED when records are downloaded.

f) Parameter and configuration changes are possible by persons registered on the system with the necessary privileges.

g) Changes to parameters and configurations must only be possible with an additional action, locally at the relevant panel performed such as a switch or similar action to enable permission for changes.

h) Cyber security must be ensured to include firewalls (software, hardware or both). Access to different layers and interfaces in the system must use security controls in the form of passwords. Different features for example are:

   i. Parameters editing,

   ii. Configurations editing,

   iii. Downloading of event and disturbance records from the IED's.

Procedure for submission and acceptance of *Contractor's* design

a) The design phase documents are submitted in a PDF copy format. Drawings to be submitted in Bentley Micro-station version 8 format and text documentation to be at least in PDF but Microsoft Word 2013 or later is the preferred format for ease of review and commenting.

b) After the submittal of the Design phase documents, the *Employer* reviews it and provide acceptance (or provides comments because it is not accepted) within 21 working days. This process will be applicable for all the design phases of the project until the system is commissioned and handed over to the *Employer*.

c) Some of the Basic Design elements are already requested during the negotiating phase of the project for evaluation purposes.

d) After the acceptance of the full Basic Design, the *Contractor* proceeds with the detail design.

e) After detail design has been approved by the *Employer*, the *Contractor* proceeds with manufacturing based on the approved design.

f) The final detail design is presented to the *Project Manager* for acceptance prior to manufacturing.

g) After FAT any changes will be corrected on the documentation before the equipment is shipped to site. All relevant documentation needs to be submitted for acceptance as well. Hard copies of the final drawings after FAT needs to be submitted to the *Project Manager* to be use on site during installation.

Process for submission of documents

The *Contractor* is made aware that all documentation or designs (including drawings' requirements) submitted for review to the *Employer* for acceptance requires a process of review as stipulated in the Engineering Change Management Procedure. The review process consists of:

a) Basic Design Review

b) Detail Design Review

c) FAT Documentation review

d) Implementation/ Execution Documentation review

e) Ad-hoc reviews due to updates

The *Contractor* submits all documentation according to the accepted engineering management plan. The process for the submission of documentation is described below and applicable to each end-of-phase design review:

f) The *Contractor* submits the documents/drawings to the *Project Manager* with the appropriately reference Design Review Template.

g) The *Employer's* Document Controller registers the documents

h) The *Employer's* Document Controller supplies the documents/drawings to all relevant parties within the *Employer's* project team.

i) The *Employer's* project team reviews the documents/drawings and submits all comments or inputs to the *Project Manager* and the *Project Manager* submits to the *Contractor* for consideration.

j) The *Contractor* revises the design, documents and/or drawings to address the *Employer's* comments and resubmits to the *Project Manager*.

k) Once all the *Employer's* comments have been addressed and no major deficiencies are found, the *Contractor* arranges a Design Review session.

l) If no fundamental errors are found in the design during the Design Review session, the *Contractor* compiles the Design Review minutes or report and submits it to the *Project Manager.*

m) The *Employer's* Document Controller registers the report.

n) The *Employer's* project team reviews the *Contractor's* report/minutes. If the report/minutes are not acceptable, the *Contractor* revises the report/minutes and resubmits to the *Project Manager.*

o) The *Project Manager* accepts the *Contractor's* design once the report/minutes are accepted by the *Employer's* project team.

p) After the acceptance of the full Basic Design, the *Contractor* proceeds with the Detail Design.

q) After Detail Design has been accepted by the *Employer*, the *Contractor* proceeds with manufacturing of the equipment based on the accepted Detail Design.

r) The *Contractor* submits all technical documentation and drawings for acceptance by the *Employer* prior to manufacture.

General documentation requirements for acceptance of the *Contractor's* design

a) All documentation complies with the NRS 002, 240-86973501, IEC61355 and 240-54179170 standards.

b) The *Contractor* provides documentation in the electronic media using Microsoft Office, unless otherwise stated.

c) Documentation is supplied in South African English and SI units are used.

d) The *Employer* does not accept scanned electronic copies of documentation or drawings.

e) The *Contractor* provides the electronic copies of drawings in Bentley MicroStation Ver. 8 in *DGN.

f) Multilayer drawings are not acceptable.

g) All documents and drawing submissions are prepared and signed-off by suitably qualified personnel.

h) The drawings reflect all reference drawings and include descriptions.

i) The *Employer* allocates numbers to the documentation and drawings which the *Contractor* indicates on the documentation and drawings.

j) The *Contractor* uses the pre-approved templates provided by the *Employer* for documentation and drawings. The drawings make provision for the Eskom border.

k) All documentation (Drawings, Manuals, Procedures) reflect the KKS coding that has been applied.

l) The pin out diagram, designation and description of components are shown including accurate referencing of the contacts and coils.

m) All documentation required at the various acceptance stages are submitted in a pdf format during design phases and on request in DGN format. For final handover of drawings. (See schedule A & B)

n) The *Contractor* is responsible for updating the documentation until after the guarantee inspection of the last unit. The *Contractor* provides an updated version of the documentation after each update.

o) Implementation approval documentation is required at least 60 days prior to the commencement of the Works.

p) 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.

q) The *Contractor* Submits all documentation throughout the design phases of the project in electronic format to the *Project Manager*

r) The *Contractor* submits the final documentation on a formal transmittal form to the *Project Manager*. All correspondence is sequentially numbered. (Refer to schedule A & B)

s) The *Contractor* adheres to Employers Documents and Record Management Procedure (240-53114186) for all documents submitted.

t) 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 components.

Basic design documentation requirements for acceptance of the *Contractor's* design

a) The *Contractor* provides a detailed operating philosophy document on the operation of the equipment including the operating sequence thereof. The philosophy document includes a comprehensive system technical description and functional descriptions.

b) Single line diagram indicating the new equipment, voltage, current, ratio and apparent power ratings of equipment.

c) Block diagram of the installed schemes and plant interfaces.

d) Physical layout drawings indicating the dimensions for the panels, to allow the *Employer* to evaluate if the installation can be accommodated, both in terms of rigging and space.

e) Overall cubicle layout and panel design drawings indicating the weight and dimensions of the respective sections.

f) Bill of proposed materials/components including datasheets of all components.

g) Type test certificates of all equipment, components and/or assemblies.

h) Communication network basic design which includes the basic design to the unit SCADA system.

i) Drawings indicating the basic designs for the power supply distribution, the AC and DC power circuit, tripping.

j) Documentation detailing the usage of the existing panels including proposed modifications and refurbishments.

Detail design documentation requirements for acceptance of the *Contractor's* design

a) The final drawings (electrical and mechanical) of the complete schemes including plant interfaces updated on the drawings.

b) The detail design drawing set incorporates:

c) List of symbols used in the drawing set

d) List of components with values, tolerances, ratings, type numbers, purchasing specification numbers, manufacturer and circuit reference numbers

e) Internal panel wiring drawings with device numbers, KKS coding, component descriptions, referencing etc.

f) Cable block drawings indicating cabling from the installed equipment to the plant interfaces including the allocated cable numbers, and cable type.

g) Cable racking drawings indicating cable racking route, existing cable rack usage, new cable racks and additional fixture details.

h) Cable gland plate layout drawing.

i) Termination drawings showing all terminations on the panel terminal blocks. The signal description, wire number, and core identification colour is indicated. Internal panel wiring terminations are also shown.

j) Exploded view drawings Installation/Assembly drawings.

k) A detailed list of all specifications for each piece of equipment supplied using Microsoft Office Excel including device number and page reference.

l) Power distribution drawings.

m) Physical panel arrangement drawings.

n) Internal logic diagrams showing signal names and descriptions including a flow chart of the internal logic.

o) Software program files and the necessary software to review the program.

p) All calculations and specifications of the proposed equipment.

q) Design calculations of all power cable requirements.

r) List of all cables to be installed (Cabling Schedule).

s) At a minimum, the following information schedules are provided in Microsoft Excel format:

   i. Termination schedules indicating; wire number, signal description, and termination points

   ii. Instrument schedules indicating; type, functional description, input range, and output range.

   iii. Component schedules indicating; type, and functional description.

   iv. Input/Output list indicating; name, and description.

   v. Alarms, trips and indications list indicating; name, description, and alarm/trip value, and alarm response taken by and plant operator on the occurrence of this event.

   vi. Cable termination schedules indicating; KKS code, cable number, cable type, cable length, source, destination, number of cores, core number, core identification colour, termination point, signal description, number of spare cores and route identification.

   vii. SCADA tag list indicating; name, description, range, data type and address.

t) The *Contractor* provides a Quality Control Plan which is signed off following the completion of a task. The Quality Control Plan details the checks that were conducted to ensure that the task was completed satisfactorily as well as the acceptance criteria or document.

u) Factory acceptance testing procedures for review and acceptance by the Employer.

v) Method statements of how the Works is completed.

w) Type test certificates of all components and equipment used within the protection and synchronising system. Type test certificates are in English and contain a list of back-up documentation.

x) Type test certificates as well as back-up documentation is certified by an internationally approved test authority.

y) The *Contractor* validates the IEC61850 interface with Protection and Synchroniser IEDs and provides a model validation report.

z) After *Contractor* validated the IEC61850 interface of the Protection and Synchroniser IEDs, and there after testing of the interface to the Employer's SCADA application can be performed.

Implementation Approval documentation requirements

a) Completed & signed off FAT defects lists.

b) Completed & signed of FAT test reports

c) Pre-delivery checklist which includes the status of long lead items delivered to site.

d) Completed and signed off on-site inspection check list of all equipment required to complete the Works checking for damage and confirming full and correct inventory.

e) The *Contractor* submits a detailed site testing and commissioning program for acceptance by the Employer in accordance with the Employer's requirements. The Employer integrates the hot commissioning activities program into the overall commissioning program.

f) The *Contractor* provides work packages/instructions using the Employer's template. All Works whether once off or repetitive are formally documented in a work package/instruction inclusive of any associated check sheets and recording sheets used for quality control purposes. Each of these work packages/work instructions has a section for acceptance by the responsible person. At a minimum the following work packages/instruction are provided but not limited to:

i. Protection Scheme and metering system decommissioning and removal work package

ii. Cabling disconnecting work package

iii. Enclosure refurbishment work package

iv. Installation work package

v. Cabling installation & testing work package

vi. Cable racking work package

g) Two identical sets of marked up drawings for site installation.

h) After FAT and the equipment is shipped to site, the drawings are corrected/updated before any installation should occur. During site work, no further updates other than red line drawings should be manage between both parties, until commissioned and hand-over.

i) Cold commissioning testing procedure after installation which includes but not limited to mechanical checks, assembly checks, loop and component resistance tests.

j) Hot commissioning testing procedure with control supply (Live loop checks & function tests with machine at standstill)

k) Offline and Offline Live commissioning testing procedure (Function tests with the machine running).

l) All relevant QCP steps signed off by the *Contractor* where applicable at the time.

m) Implementation plan in Microsoft Office project showing key dates and tasks in the project and incorporates a detailed Works implementation plan showing high level and low level tasks. The duration and resource requirements for each task are shown on the implementation plan.

n) The *Contractor* provides preliminary settings and configuration documents for every configurable device supplied. The settings and configurations contained in the protection and synchronising system settings document are specific to Vanderkloof Power Station and Roodekuil Sub-Station.

o) The *Contractor* uses the Employer's template for the application system settings. The minimum content of the settings document is described in 240-56227426.

p) The *Contractor* provides individual signed-off test certificates for all equipment used for acceptance by the Employer. The test certificate contains:

   i. the full description of the item of equipment tested

   ii. the details of the tests conducted

   iii. results obtained during the tests,

   iv. and the standards to which the equipment was tested indicating if the equipment passed or failed.

q) The *Contractor* provides procedures to operate and maintain every piece of equipment used in the protection and synchronising system. These procedures include but are not limited to:

   i. Operations procedures detailing the procedure for safe operation of the plant and equipment.

   ii. Isolation procedures detailing the procedure for the safe isolation of the plant or equipment for maintenance or testing purposes

   iii. Replacement of defective/failed components procedures

iv. Procedures to access the protection and Synchronising system IED's to configure, make changes and download recordings

v. Alarm and trip response procedures detailing actions that need to be taken by the operator in the event of an alarm or trip

vi. Emergency operating procedures

r) Protection and Synchronising system operating and maintenance manual complete with:

i. Power station name and order number

ii. Contents list

iii. List of reference drawings

iv. Details of all components

v. Maintenance, operating testing requirements (including special tools required)

Engineering Changes during Site Implementation

a) Project Engineering Change Management Procedure 240-53114026.

Other requirements of the *Contractor's* design

a) The *Contractor* for the Works are of the OEM and equipment experts of the major equipment such as the IED's.

b) All Plant and Materials provided are new.

c) All electrical installations of 220V and above are carried out by a qualified electrician.

d) The new electrical cabling if applicable is certified by the *Contractor's* electrician issuing a certificate of compliance (COC) before it is allowed to be connected.

e) All components comply with all relevant and associated international standards, unless otherwise stated.

Configuration Management

a) Vanderkloof Power Station subscribes to the KKS codification.

b) All KKS numbers or codes including component codes, communications signals and panel numbers need to be requested from or submitted to the *Project Manager* for issuing or approval.

Panel / Cubicle Labelling

a) Standard 240-62629353-Specifaction for panel labelling, applies to panel labels.

b) The *Employers* Plant Labelling Abbreviation Standard applies.

c) Due to Power Station's different requirement, there could be site specific requirement and therefore it is imperative for the *Contractor* to identify all labelling needs for the Works and submits it to the *Project Manager* in an Excel spreadsheet who allocates KKS codes and specify material, size, means of fixing etc. before ordering of such labels. An example is given below.

d) Sample only:

Ø1NG11S012
LH FD FAN INL VDK 2A
1ØHLA10AA103

- **Figure 9: Labelling sample**

e) Dimensions: Label: 160mm x 45 mm KKS Code: 11mm Text: 7mm

f) All sharp corners are removed. Where a backing plate is used, four 3/4mm diameter holes are to be drilled into the label, each 4/5mm from the outer edges, top left and right, bottom left and right.

g) Conductive labels or backing plates are not allowed on the inside of any electrical panels/cubicles.

h) All warning labels on panels, doors or other structures are pre-approved before printing and application by the *Contractor*. Warning labels will be in line with the labels as applied to the old system should it be required to replace or fit new labels.

Signal Lamps

a) Indicating lamps are of the LED type and are easily replaceable from the front of the panel without the use of special tools.

b) The voltage of the lamps is as per the circuit served.

c) The mounting of the lamp and resistor facilitates adequate ventilation.

d) Visual indication of alarms might also be served via scrollable LCD display or other type of visual display.

Earthing Requirements

a) The apparatus is adequately earthed.

b) All non-current carrying conductive parts including the entire panel frame, all removable covers, relays, gland plates, etc., are effectively connected to the earthing conductor by means of their mounting arrangement on the panel or by a separate earthing conductor.

c) This is done in such a way that the touch potential at any point on the panel due to a full phase to phase or phase to earth fault is limited to earth potential.

d) The earthing conductor is connected to the station earth mat at the designated earthing point of the panel.

e) The earthing conductor is pre-drilled to allow for connection to the station earth mat.

f) Should additional earthing conductors be required to meet the above requirements and specifications, the *Contractor* provides and installs such material.

g) All cable screens and spare cores are earthed one side only.

h) Compliance to standard 240-56356396 and 240-64100247.

i) All panels are connected to the station earth mat.

Terminals

a) Neither insulation displacement type connectors nor spring type connecter without screws are allowed.

b) The use of “fast-on” or push on connectors are not allowed on power circuits, voltage transformer circuits, current transformer circuits or earth connections.

c) The terminals are spring retained on the assembly rail complying with DIN EN 50045 and when mounted and wired in service, is closely fitted to avoid the accumulation of foreign matter between adjacent terminals.

d) End barriers or shields are provided for open sided patterns.

e) It is possible to replace any terminal in an assembly without dismantling adjacent units; it is permissible, however, to loosen any clamping device.

f) Screw retention of any component from the rear of the mounting rail is not acceptable.

g) All terminal blocks are readily accessible.

h) The terminals are of the rail mounted screw clamp spring-loaded insertion type where terminations or lugs are compressed between two plates by means of terminal screws.

i) Terminals are spring loaded such that the actions of the springs are independent of the action of the terminal screws.

j) Terminal screws are captive within the mouldings and their heads do not project above the mouldings when fully released.

k) Each terminal accepts up to two hooked blade type lugs.

l) Terminal entries are shrouded such that no current carrying metal is exposed when hooked blade lugs are fitted.

m) Springs withstand corrosion that might affect performance during their working life.

n) Springs do not carry any current.

o) Cross connection required for connecting two or more adjacent terminals are via wire loops. OEM supplied bridge pieces screwed down by the cage clamp is submitted to the *Project Manager* prior to use. Bridging from the top of the terminal to connect adjacent terminals invariably requires terminal insulation to be mechanically modified and bridging materials are not plated after punching and bending and allows for high resistance connections to develop over time. Should this be a preferred connection method it is submitted for approval prior to use on this project.

p) When used in current transformer circuits, the terminals are capable of accepting hooked blade lugs on 6mm² wires.

q) The terminals are sized to provide for pre-insulated lugs to fit after being crimped with the ‘flat’ crimp lying parallel with the rail.

r) The insulation impulse level and isolation requirements between individual terminals are guaranteed.

s) For stud type terminals two terminal studs are provided for each “way” and are of sufficient length to accommodate two ring tongue terminations in addition to a full nut and a locking device.

t) Loose links, where provided, are secured by a nut and washers, and are of tin-plated copper or brass. Barriers are provided between terminal “ways”.

u) These barriers project at least 3mm above the studs.

v) All types of commonly used terminals as shown on the drawing 18.48/5695 sheet 4. However, the type of terminal in which the screw bears directly onto the termination or the conductor, i.e., “pinches the conductor”, is not acceptable.

w) All control system interface terminals are spring loaded link type terminals.

x) Terminals are numbered sequentially from left to right and top to bottom.

Lugs

a) No bare wire connection to any terminal is allowed.

b) All lugs are of the compression type.

c) Control lugs and their application with different types of terminals are as detailed on the drawing 18.48/5695 sheet 4.

d) Crimping on power lugs is in accordance with BS 4579 Part 1.

e) Crimping tools are calibrated according to their manufacturer’s specifications. The crimped area is at least equal to 1.5 times the conductor square area.

f) Documented proof of conformance to IEC 61238-1 (2003-05) specification requirements for tensile force heat cycling, resistance and temperature measurement may be requested by the *Project Manager*.

g) Control wiring using bootlace ferrules is crimped with a crimping tool compressing the ferrule from four sides. Single sided indent type crimping is not allowed.

h) Push on/fast on lugs are not the preferred lug. Any use of push on lugs in the entire system is declared and for approval of the *Project Manager*. After judgment on merit and if allowed, only nickel-plated steel lugs are allowed and no tin plated brass or copper lugs are allowed due to their inferior longevity and contact resistance.

i) All lugs crimped onto wires of 6mm2 and above are of the hex crimped type. Indent (dimple) type crimping is not permitted.

j) The following lugs are used on the equipment wiring:

Connected onto:	Conductor size	Lugs	Colour
VT, CT and auxiliary circuit terminals	2,5mm^2	Hellermann hooked blade type T2HB or JST type FVDAH-2	Blue

Essailec CT circuit terminals (19" rack module)	2,5mm^2	Hellermann ring type T2R35A or JST type FVD2-M3	Blue
Essailec VT and auxiliary supply circuit terminals	2,5mm^2	Hellermann female disconnect type T2DF or JST type FVDDF2-250B	Blue
Essailec pulsing circuit terminals	1,5mm^2	Hellermann female disconnect type T1DF or JST type FVDDF1.25-250B	Blue
MCBs	2,5mm^2	Hellermann disconnect male type T2DM or JST type FVDDM2-250	Blue
PK 2 test blocks	2,5mm^2	Hellermann ring type T2R6 or JST ring type FVD2-6	Blue
Pulsing circuits	1,5mm^2	Hellermann pin type T1P10 or JST pin type FVDPC-1.25	Red

- **Table 20: Lugs, wire sizes and wire colours**

Miniature circuit- breakers (MCB)

a) Single pole circuit breakers are used for all voltage circuits, with circuit breakers rated to ensure correct grading of the circuits.

b) All miniature circuit breakers (MCB) for AC and DC circuits are DIN rail mount type

c) The MCBs to be used are fast curve, 13mm width which have provision for sealing the operating levers in the closed position

d) All miniature circuit- breakers (MCB) and fuses to has a monitoring capability

Trunking

a) Cable trunking, location and sizing, are provided in accordance with the respective drawings to accommodate the necessary cables

b) The trunking are fastened to the plate using rivets or screws.

Cable Installation

a) All other cables will be installed by Others and the *Contractor* is responsible for preparation and termination of all these cables

b) Items to note:

i. Cables which are accidentally damaged during installation are to be replaced to the satisfaction of the *Employer*. In no case is a cable, on which the outer sheath has been punctured, installed.

ii. Cable entry is from the bottom through the existing panel gland plate arrangement.

iii. Cables which are accidentally damaged during installation are to be repaired or replaced to the satisfaction of the *Employer*. In no case is a cable, on which the outer sheath has been punctured, installed.

iv. No tee offs nor jointing of cabling is to be done, other than at the terminals.

v. All gland plate hole arrangements will be pre-approved by the *Employer* before any drilling of gland plates take place.

vi. No cable is terminated directly to any interface card or printed circuit board.

vii. All cables are re-tested for their continuity and insulation resistance after they have been installed on the racks before they are finally terminated.

Use of *Contractor's* design

The *Employer* may use the *Contractor's* design for any purpose in relation to the protection scheme at the *Employer's* installations.

Design of Equipment

Design of Equipment is the sole responsibility of the *Contractor* and is submitted for acceptance.

As-built drawings, operating manuals and maintenance schedules

Drawings

a) All drawings are created electronically and 100% compatible with Micro station V8 software in a DGN file format.

b) 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.

c) The basic design is also be submitted in this format to evaluate both the design and the electronic format.

d) The electronic files are provided in A3 size and conform to the requirements of Standard 240-86973501.

e) All detail design drawings have the pre-approved title blocks and borders as provided by the *Employer*. The *Employer* provides samples of the pre-approved title blocks to be used by the *Contractor*. The *Contractor* completes the title block information as per drawing standard listed.

f) Graphical symbols are used in accordance with the NRS002 standard.

g) All drawings are submitted to the *Project Manager* for his acceptance.

h) The *Contractor* produces the following types of drawings:

i. Cover sheet

ii. Index sheet

iii. List of symbols

iv. List of components with values, tolerances, ratings, type numbers, purchasing specification numbers, manufacturer and circuit reference numbers

v. General layout drawing of the proposed panels

vi. Single line diagram

vii. Panel internal wiring drawings, including cross referencing and wire numbers

viii. Cable block diagrams with termination points

i) 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. Editable software copies of each sheet in *.dgn format are supplied by the *Contractor*.

Technical, Maintenance and Operating Manuals

a) All manuals are specific to Vanderkloof Power Station. 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.

b) The number of copies is as specified in Schedule A&B.

c) The technical, maintenance and operating manuals also contains the information and course material of the training manuals

d) All design information forming part of the *Works* Information is included in the manuals.

e) All documentation including drawings and operating and maintenance instruction manuals is uniquely identified and cross-referenced with all related documents.

f) The manuals are complete with:

i. Power Station name and order number

ii. content list

iii. list of reference drawings

iv. and details of all components

g) 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

i. Details and descriptions of all hardware and software

ii. Settings and configuration

iii. Detailed product descriptions and features

iv. System control philosophy

v. Datasheets of all components used

vi. Recommended spares lists

vii. Operating, maintenance and testing requirements

viii. Full system maintenance program

ix. Installation procedures of each component

x. Isolation procedures

xi. Alarm descriptions and responses

xii. Type tests certificates

xiii. Certificates of compliance to international standards

xiv. Calibration certificates from a SANAS accredited laboratory

xv. Where SANAS calibration certificates are not available, calibration certificates from international calibration laboratories that are part of the ILAC agreement, accredited in terms of IEC17025

xvi. Routine test results reports

xvii. Commissioning test results reports

xviii. Training information

xix. Technical tender submission information

h) Any special instructions pertaining to storage of spare parts or to their shelf life are included in the manual.

i) All drawings required for component location, dismantling, and re-assembly for maintenance is provided in the manual.

j) All special tools required for maintaining and operating the plant and material are identified in a schedule and described in the manual.

k) 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.

l) A schedule and identification of all special tools required for maintaining and operating the equipment is described in the manual.

Settings and Device Configurations

a) The Contractor provides the configuration information for each and every configurable device supplied.

b) All settings, configurations, alarm and tripping matrixes are configured as per recommendation by the *Contractor* and are reviewed by the *Employer* for final acceptance.

c) The *Employer* is responsible for the detailed calculation of all protection and synchronising settings and calculations. The applied settings within the protection and synchronising system are provided to the *Employer* by means of active windows or configuration files containing the settings which can easily be copied to a word document. If it is not possible to directly copy settings to a word document, the applied settings data are provided by means of a .pdf document in conjunction with the configuration/setting files.

Procurement

People

Minimum requirements of people employed on the Site

a) All personnel, especially foreigners, working on the Site needs to have the applicable required work permits.

b) All personnel have successfully completed the relevant training pertaining to their specific job output.

c) At the end of each month the *Contractor* provides the Employer details

i. Names and identity numbers of *Contractor's* working on site for the contract
ii. Number of hours each Contractor has worked per day
iii. Start and end times of Contractor's per day

BBBEE and preferencing scheme

a) The Contractor complies with and fulfils the Contractor's obligations in respect of the Broad Based Black Economic Empowerment (as per clause Z3 of ECC3).

b) The *Contractor* provides valid B-BBEE certificates to the *Project Manager* on an annual basis of himself as well as his subcontractors.

Accelerated Shared Growth Initiative – South Africa (ASGI-SA)

The *Contractor* complies with and fulfils the *Contractor's* obligations in respect of the Accelerated and Shared Growth Initiative - South Africa in accordance with and as provided for in the *Contractor's* ASGI-SA Compliance Schedule stated below.

[Insert the agreed ASGI-SA Compliance Schedule here]

The *Contractor* keeps accurate records and provide the *Project Manager* with reports on the *Contractor's* actual delivery against the above stated ASGI-SA criteria. [Elaborate on access to and format of records and frequency of submission etc.]

The *Contractor's* failure to comply with his ASGI-SA obligations constitutes substantial failure on the part of the *Contractor* to comply with his obligations under this contract.

Subcontracting

Preferred sub*contractor*s

None

Subcontract documentation, and assessment of subcontract tenders

The *Contractor* submits the proposed conditions of contract for each subcontract to the *Project Manager* for acceptance unless

a) an NEC contract is proposed or

b) the *Project Manager* has agreed that no submission is required.

The *Contractor* does not appoint a subcontractor on the proposed subcontract conditions submitted until the *Project Manager* has accepted them. A reason for not accepting them is that they will not allow the *Contractor* to Provide the Works or they do not include a statement that the parties to the subcontract will act in a spirit of mutual trust and co-operation.

Limitations on subcontracting

None

Attendance on subcontractors

Any subcontracto*r* is required to work under the direct supervision of the *Contractor*.
The *Contractor's* organograms indicates the lines of authority and communication of all the *Contractor's* site employees, including subcontractors.

Plant and Materials

Quality

a) All equipment provided by the *Contractor* should conform to the standards provided in the sections above.

b) The *Contractor* defines the level of QA/QC or inspection imposed on his *s*ubcontractors and suppliers.

c) The programming of inspections, hold and witness points is agreed between the *Employer* and the *Contractor* prior to undertaking any work.

Guarantee Inspection

a) The Contractor provides a warranty as specified in schedule A&B on the supplied equipment and workmanship from the date of handover. If during this guarantee period, Employer is dissatisfied with the goods or with any part/s thereof on account of materials being faulty, inferior quality or poor workmanship, or on account of the goods not being in strict accordance with the specification, the Contractor immediately remedy the said defect at no additional cost to Employer.

b) The *Contractor* plans for an inspection of the installed equipment of each unit at a time suitable to the *Employer*, before the warranty period is over.

c) The *Contractor* with the *Employer* inspects each unit and provides the *Employer* with an inspection report.

   i. The warranty inspection includes but not limited to:
   ii. General inspection of equipment for hotspots or signs of failure,
   iii. Tightness checks of wiring and equipment, and
   iv. Repairing or correcting of defects.

d) The guarantee also serve as a defect correction period for each installed equipment. Defects related to system design, functionality, installation and/or commissioning, as well as any defects arising due to damage to the system for which the *Contractor* is responsible, that occurring during the defect period is rectified by the *Contractor* at no additional cost to *Employer*.

e) In cases where defects need to be corrected, the *Contractor* does not attend to the defects alone, but is accompanied by an *Employer*'s representative at all times.

f) The correction period for individual defects are specified in schedule A&B. Should the *Contractor* delay remedial work, *Employer* may have such remedial work executed at the *Contractor's* expense, without any impact on guarantees and warranties.

g) In the event that changes are made to the designs by the *Contractor* during the contract period, previously installed system is back-fitted to match the new design, at the *Contractor's* expense, without any impact on guarantees and warranties. This includes changes made to system software, firmware and hardware.

Product Support

a) The Contractor clearly states, in writing, the limitations in product support beyond the specified warrantee period and what options there are to be considered as well as the cost involved regarding support beyond the warrantee period.

b) Beyond the warrantee period the *Contractor* has the ability to do repairs on faulty components. If this is not possible then the *Contractor* provides an exchange policy to the *Employer* where faulty electronic modules can be exchanged and a discount provided to the *Employer* for the new component.

c) The *Contractor* investigates and provides a fault report stating the reason for failure to the *Employer* of all faults and faulted equipment during the warrantee period.

d) All components and support for the installed equipment are available for a minimum as specified in schedule A&B

e) In the event that EMDAS support is no longer available, the *Contractor* provides all system information and licenses to the *Employer*, including but not limited to all EMDAS source coding and design information.

f) The *Contractor* investigates and provides a fault report stating the reason for failure to the *Employer* of all system faults and faulted equipment during the warrantee period.

Defects correction

a) The Employer provides the Contractor access to correct any post commissioning defects that may arise. It is the responsibility of the Contractor to rectify any defects within a reasonable time frame so ensure system stability

b) The Contractor is responsible to investigate, report, and resolve all related faults, trips and mal-operations during the warranty period.

c) The Contractor provides technical support for any faults, trips and mal-operation of the system during the warranty period and proposes possible solutions.

d) Any defect that requires a firmware update results in the complete re-commissioning of the equipment at the Contractor's expense.

e) The Contractor demonstrates that a defect is corrected by conducting appropriate testing of the equipment.

Plant *& Materials provided "free issue" by the Employer*

Refer to Section 3.2.4.1 in respect of free issued items provided by Eskom Transmission. There are no other free issue items.

a) *Contractor's* procurement of Plant and Materials

b) The Contractor provides a list of all suppliers used to supply components for the Works including the components that have been supplied by each supplier.

c) The *Contractor* ensures that all material, equipment and plant is adequately transported and delivered to the *Works* at least 45 days prior to the start of the *Works*.

d) The *Contractor* submits a completed pre-delivery checklist to ensure all prerequisites have been complied with for the equipment to be shipped to site. The *Project Manager* signs off on the checklist prior of equipment to be shipped to site.

e) The *Contractor* indicates the type of transport used and mitigation measures in place to protect the equipment and materials from damage.

f) The *Contractor* is responsible for offloading and movement of equipment and material to the storage area.

Spares and consumables

a) The Contractor submits an itemised list of the critical spares indicating a criticality factor rating required for each system.

b) The *Contractor* includes the itemised cost of the spares in the Tender and is part of the supply.

c) The *Employer* performs an assessment of the spares list provided by the *Contractor* and from this select spares that are retained by the *Employer* and is used in the event of failure.

d) The spares are available on-site from the commissioning of the first unit. Spares are tested and certified fit for service by the *Contractor*, thereafter the spares are repackaging, appropriately labelled and preserved by the *Contractor*.

e) All basic maintenance spares, in accordance with the *Contractor's* maintenance schedules, for example filters & fuses, are supplied to the *Employer* before the installation of each new equipment. All basic routine maintenance spares are locally available.

f) The *Contractor* has all critical spares at hand, as needed during commissioning, as to prevent the failure of any one component leading to delays of more than 24hrs during the commissioning period. These commissioning spares remain the *Contractor's* property.

g) The availability of spares is guaranteed for a minimum period of twenty years from completion of the whole of the *Works*.

h) When the *Contractor* intends to discontinue the manufacturing of spares, the *Contractor* gives written notice to the *Employer* of such intention two years prior to stopping of the production.

i) The *Employer* has the right within 18 months of receiving notice, to order at reasonable prices, the quantities of spares required.

j) As a minimum on the *Contractor's* recommended spares list, please refer to schedule A&BA complete recommended spares list includes the following details:

   i. Description
   ii. Part number
   iii. Special storage requirements
   iv. Replacement part or routine maintenance part
   v. Quantity
   vi. Cost
   vii. Lead time
   viii. Supplier's full contact details and address

Tests and inspections before delivery

Factory Acceptance Testing (FAT)

a) The Contractor will perform pre-checks and tests before the Employer is notified to be involved with FAT.

b) Before FAT will commence, a complete Factory Acceptance Test Procedure will be submitted by the *Contractor* to the *Employer*. The *Employer* will review the procedure and make updates where necessary.

c) The *Contractor* supplies two copies of all test certificates and data sheets prior to the commencement of the factory testing.

d) The *Contractor* gives the *Employer* at least 10 working days' prior notice of the date on which the equipment is ready for inspection and testing when these tests are to be done in South Africa and two months' notice if it is to be done outside the border of South Africa.

e) The *Employer* is provided with access to the *Contractor's* premises for the purpose of establishing compliance with the contractual requirements by means of inspections, surveillance, audits and witnessing the performance of any tests.

f) Communications testing will be conducted during factory acceptance tests. This inspection entails a full system check (functional and wiring checks) to ensure compliance with this specification, contract drawings and other applicable standards.

g) Should the FAT be found unsuccessful and non-compliant, time will be granted to rectify all the defects and the FAT to be repeated. This will be performed on the expense of the *Contractor*.

h) Allowance is made in the delivery time to cater for this requirement.

i) The system functionality is to be demonstrated by the *Contractor* to the *Project Manager*/*Supervisor* during Factory Acceptance Tests at the *Contractor's* facility for one unit's equipment. Only if noncritical defects are picked-up that cannot be rectified before the first unit's commissioning, will additional FAT continue on subsequent units on the same basis.

j) A complete Factory Acceptance Testing procedure is included in the design package.

k) The following tests (checks) are conducted by the *Contractor* as a minimum requirement and witnessed by the *Project Manager*/*Project Supervisor*, lead Engineers and site representatives:

    i. Check the nameplates, connections, torque all bolts and nuts on power cabling that will not require loosening and refastening on site.

    ii. Functional tests on circuitry, and the indication circuitry (checks include fuse ratings, labelling, ferrule numbers, crimping and tightness of all connections including lugs).

    iii. Alarms and indication checks

l) The Factory Acceptance Testing of the equipment is completed at the manufacturer's *Works* and accepted by the *Project Manager*, before dispatching the equipment to site.

m) A defects list needs to be kept as a live working document to capture any deviation from the *Works* information. These could be simple wiring errors or more serious functional requirements that are not met.

n) The *Contractor* is given a reasonable time to rectify wiring without delaying the completion of the FAT. When more serious defects are encountered, the *Contractor* needs to inform the *Project Manager* immediately about it, with an estimated time to resolution and testing of the function/requirement.

o) The complete schemes are fully assembled (including network interfaces that accommodates communication tests between IED's and station control system) at the *Contractor's Works* and tested in the presence of *Employer's* representatives before transportation to site i.e., Factory Acceptance Testing. All test files required to validate the scheme must be provided developed by the *Contractor*.

p) The program of routine and type tests is submitted to the *Employer*, for approval, two months before the equipment is ready for testing. The test covers those recommended in Specification 240-64685228.

q) The program of routine and type tests is submitted to the *Employer* for approval, two months

r) before the equipment is ready for testing.

Requirements for Delivery

a) To enable the project to be executed timeously and to minimize risks once on site, a checklist needs to be completed to ensure all prerequisites have been complied with for the equipment to be shipped to site. This forms part of quality and risk assessment and a number of these can be prepared well in advance. The Project Manager signs off on the checklist prior of equipment to be shipped to site.

b) The *Project Manager* arranges the onsite acceptance and verification of the delivered items.

c) The *Contractor* is responsible for:

i. Confirming that adequate and secure storage space is available on site before any deliveries are made.

ii. Providing adequate notice of equipment delivery and co-ordinating site access with responsible personnel.

iii. Checking of delivery contents, as well as packing and marking of equipment before dispatch.

iv. Delivery loading, transportation to site and unloading of the equipment once onsite.

v. Installing of the equipment and removal from site of any waste material associated with the delivery.

vi. In a case where the *Contractor* employs subcontractor/s, any disagreements between the *Contractor* and their sub*contractor*/s does not impact on service and/or delivery, such as the withholding of service and/or delivery in the event of a dispute that is independent of the *Employer*.

Transport Arrangement for Equipment forming part of the *Works*

a) This includes type of packaging and wrapping

b) Type of transport to be used (road, air etc.)

c) If by road, are vehicles with special shock absorbent load beds required etc.

Marking Plant and Materials outside the Working Areas

a) None

Contractor's Equipment (including temporary *Works*).

a) Safety barriers and access scaffolding is temporary Works and are the responsibility of the Contractor.

b) Core drilling machinery if required is provided by the *Contractor*.

Cataloguing requirements by the *Contractor*

a) The Contractor catalogues all spare equipment provided using the Employer's template.

b) The *Contractor* provides a customised catalogue of components and equipment specific and limited to the scope of supply.

Construction

Temporary *works*, Site services & construction constraints

Employer's Site entry and security control, permits, and Site regulations

a) Before work starts on Site, a Site inaugural meeting is held between the Contractor and the Employer, where details of the works are discussed and clarified.

b) The *Contractor's* Site Supervisor is on Site for the entire duration of the *works*.

c) General access to the power station is controlled and Site induction has to be completed before work will be allowed to start.

d) It is mandatory that the *Contractor* adheres to all security regulations in force during the period of the contract.

e) Before entry to the Site will be allowed, everyone will undergo an alcohol breathalyser test which needs to be passed. This is one of the five Life-saving Rules to which the *Contractor* is required to adhere to at all times.

Restrictions to access on Site, roads, walkways and barricades

a) The Contractor satisfies himself and complies with the Site conditions presented during induction

b) The *Contractor* is required to comply with all Site restrictions pertaining to the Site's roads, walkways and barricades.

People restrictions on Site; hours of work, conduct and records

a) Normal working hours:

   i. Monday to Thursday: 07h00 – 16h00

   ii. Fridays: 07h00 – 12h00

b) Outage working hours to be advised

i. Mondays to Sundays: 07h:00 – 17h:30

Health and safety facilities on Site

The health and safety facilities on Site is discussed in detail during the Site induction.

Title to materials from demolition and excavation

The *Contractor* has no title to plant and/or materials resulting from him carrying out the *works*.

Cooperating with and obtaining acceptance of Others

All activities are performed according to the Accepted Programme.

Publicity and progress photographs

No notice boards, advertising rights, media relations, photography and progress photographs is not allowed without appropriate authorisation.

***Contractor's* Equipment**

a) The Contractor provides the Employer with a complete list of materials, tools, equipment and machinery that does not permanently form part of the work before bringing it onto Site.

b) The *Contractor's* portable electrical tools are checked by the *Employer* prior to use.

c) Any electrical Plant or appliance used by the *Contractor* conforms to the applicable South African safety standards and is maintained in a safe and proper working condition.

d) The *Employer* has the right to stop the *Contractor's* use of any electrical Plant or appliance that in the *Employer's* opinion does not conform to the foregoing.

e) The *Contractor* provides and maintains all test and measuring equipment required for all tests to the required accuracy.

f) The type and class of equipment used is subject to the acceptance by the *Employer*.

g) The *Contractor's* measuring equipment is accompanied by valid calibration certificates from an approved authority.

h) The *Project Manager* may at any stage during the contract require such equipment to be checked by an approved laboratory or the South African Bureau of Standards.

Equipment provided by the *Employer*

a) Crane (main hoist = 100t, auxiliary hoist =25t) and lifting gear

i. A crane is available in the station main Machine Hall. It is the *Contractor's* responsibility to ensure that all necessary arrangements and preparations are made for the use of this crane.

ii. The Contractor ensures that the crane is capable of handling the loads to be lifted and any limitations with respect to height and operation.

iii. The Contractor notes that there is only one crane that services all units, and that the crane may be required for other work during the Outage.

iv. The Employer provides a qualified crane operator. The crane is operated only by the Employer.

b) No mobile crane is available on site.

c) No scaffolding is available at site. The *Contractor* is responsible for all scaffolding for the execution of the *works*. This includes the supply, erection, securing and dismantling of scaffolding.

Site services and facilities

a) Other that the services and facilities listed in this section the Contractor provides everything else necessary for providing the works.

b) Electrical supply

i. All points of supply are provided in terms of availability and location.

ii. The Employer indicates which supply points may be used.

iii. 220V/50Hz electrical supply is generally available in the Power Station complex.

iv. 380V supply is also available – the Contractor ensures they have the correct matching plugs.

v. The Contractor provides extension leads and additional points of connection as required

vi. Phase rotation may change during power supply breaks. The Contractor is responsible to check rotation of their equipment before recommencing of Work.

c) Potable Water

i. All points of supply are provided in terms of availability and location.

ii. The Employer indicates which supply points may be used.

d) Compressed Air

i. All points of supply are provided in terms of availability and location

ii. The Employer indicates which supply points may be used.

iii. The Contractor verifies compressed air hose requirements.

e) Station lighting

i. The working area is located indoors within the machine hall. The machine hall has fixed lighting fixtures.

ii. The Contractor provides additional lighting as required.

f) Storage

i. The *Contractor* is responsible for security of materials and equipment delivered to Site stored within the area designated by the *Employer*. The *Contractor* indicates storage requirements in Schedule A&B.

ii. Security to the *Contractor's* storage area is the responsibility of the *Contractor*.

iii. The area allocated to the *Contractor* is reinstated to their former condition on take-over of the w*orks*

g) The *Contractor* makes use of the *Employer's* ablution facilities in the Power Station.

h) The *Employer* is not able to offer office space to *Contractor* for the period of work on Site.

Facilities provided by the *Contractor*

a) The Contractor makes provision for accommodation, vehicles, kitchen - and office space (mobile container) and Equipment etc.

b) The *Contractor* removes all this Equipment and waste which was generated during the installation and commissioning within 24 hours after Completion.

c) The *Employer* is not able to offer office space to *Contractor*s for the period of work on Site.

d) An area will be allocated in the machine hall for the *Contractor* to utilise for temporary office space.

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

a) None

Survey control and setting out of the w*orks*

a) The Employer evaluates the Contractor's civil work changes required to the existing floorplan with regards to type of concrete used, core spacing, paint and weight distribution.

b) The *Contractor* is responsible to survey the w*orks* to ensure that the equipment and cabling allow for sufficient space to allow for installation.

Excavations and associated water control

a) None

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

a) The Contractor minimises interference of any nature with regards to existing services, cable and pipe trench covers.

b) In the event that the *Contractor* damages one of the above, the penalty would be for the *Contractor*.

Control of noise, dust, water and waste

a) Signage will indicate if any noise, dust, water and waste.

Sequences of construction or installation

a) All activities are performed according to the Accepted Programme.

Giving notice of work to be covered up

a) All notices and warnings follows the ECC3 requirements.

Hook ups to existing w*orks*

b) To be performed as per Eskom requirements.

Completion, testing, commissioning and correction of Defects

Work to be done by the Completion Date

On or before the Completion Date the *Contractor* has done everything required to Provide the w*orks* 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 w*orks* and Others from doing their work.

Item of work	**To be completed by**
As built drawings	Within 30 days after Completion
Maintenance and operating manuals	Within 30 days after completion
Recommended spares list	Within 30 days after completion

Use of the w*orks* before Completion has been certified

a) Not applicable

Materials facilities and samples for tests and inspections

a) The Contractor is responsible for and provides all necessary apparatus, equipment, materials and labour to carry out the tests to the Employer's satisfaction.

b) The *Contractor* provides but not limited the following equipment for the onsite testing:

   i. Phase rotation tester

   ii. Insulation resistance tester

   iii. Multimeter

   iv. Tools

c) Should the *Contractor* make use of a component that is not listed in the approved list of components, the component may be subjected to testing which may include destructive testing. The *Contractor* provides the component at his cost.

d) All components are in line with approved list of components as supplied by the *Employer*. Samples of components may be requested by the *Employer* for pre-approval where deemed necessary.

Commissioning

a) Commissioning and testing proceeds only after:

   i. As-Built documentation is updated and correct

   ii. All defects have been cleared

b) The *Employer* provides the *Contractor* with a safety clearance certificate based on completed and signed off cold commissioning documentation prior to power up of the equipment. The *Contractor* signs the safety clearance certificate.

c) The *Contractor* provides at least one capable commissioning engineer onsite for the duration of the testing and commissioning of the equipment. The commissioning engineer is officially certified by the *Contractor* as being qualified and experienced to commission the equipment and be able to make the necessary software updates as may be required onsite.

d) The *Contractor* performs the verification, testing and commissioning of the equipment, which is witnessed by the *Employer* and conducted in accordance with the *Employer's* requirements.

e) The *Contractor* provides training during the testing and commissioning of the equipment installed.

f) Settings and configurations as applied to the devices within the IED's are verified individually per device.

g) The *Contractor* ensures all correct protection, control, measurement and operating settings for the different commissioning testing scenarios.

h) The *Contractor* performs loop checks, functional tests and secondary injections to verify feedbacks and correct operation of the equipment installed.

i) The *Contractor* allows 48 hours in his program for inspection and testing of the equipment by the *Employer* prior to commissioning.

j) The *Contractor* provides the *Employer* with testing requirements that may require network planning.

k) The *Employer* brings to the attention of the *Contractor* the prevailing system requirements at the time which stipulates the type of tests, duration of the tests and time during which the tests can be carried out.

l) The *Contractor* makes provisions for additional commissioning tests of equipment that the *Employer* and others require.

m) The *Contractor* performs Site Acceptance Testing as detailed in the standards, specifications and guidelines listed:

   i. OEM testing requirements

   ii. IEC 60255

n) The *Contractor's* responsibility includes the erection of the panels, equipment supplied in the panels and schemes, the inter-panel / scheme cabling and any equipment or instruments necessary for commissioning.

o) The following are provided as part of the scheme documentation:

   i. commissioning test procedures

   ii. commissioning test sheets

   iii. maintenance test procedures

   iv. maintenance test sheets

Start-up procedures required to put the w*orks* into operation

The *Contractor* is onsite for power-up and thereafter to commence with verification, testing, commissioning and optimisation activities to obtain a fully functional system.

Take over procedures

Take-over is when all testing, inspections and commissioning as specified in sections 0 to 0 are completed successfully.

Access given by the *Employer* for correction of Defects

Access is granted to the *Contractor* for defects correction as per core clause 43.4 in ECC3.

Performance tests after Completion

Commissioning results is captured a commissioning report that will include all commissioning and pre-commissioning tests and results which will be shared with the system operator.

Training and technology transfer

Refer to section of this document.

Operational maintenance after Completion

None

Plant and Materials standards and workmanship

Investigation, survey and Site clearance

The *Contractor* is responsible to survey the current protection scheme, layout and positioning of the panels and need to clearly specify any additional requirements.

Building works

Not applicable

Civil engineering and structural works

a) The design and construction of civil structures is in accordance with the standardized specification for civil engineering design and construction. Structural design and construction conforms to the Eskom Structural Design and Engineering Standard 240-56364545.

b) Design and construction is in accordance with SANS design codes and SANS 1200 series specifications for civil construction.

c) The design of civil engineering *Works* meets the requirements of the permissible floor loading criteria and O&M Manuals.

d) Where holes are required through concrete, in the case of reinforced concrete the indicated positions where core drilling will be carried out must be done without obstructing the rebar. Holes are drilled through concrete only where it is acceptable and does not compromise the structural integrity. The *Contractor* takes adequate measures to locate rebar ensuring that it is safe to core. The reinforcement and concrete drawings are analysed when selecting core positions. If it is required that reinforcement be maintained, a scan (Concrete Ground Penetrating Radar System) is performed to determine the position of the rebar, embedded objects and features. Holes through concrete are sleeved with PVC sleeve.

e) Floor repairs and preparation is in accordance with SANS 10400-J. Appropriate grouting is used for levelling, cavities and gaps. Proprietary grout to be cement-based and must match the existing.

f) Anchor bolts can be made of Grade 4.8 or Grade 8.8 which are designed to resist tension and shear. Anchor bolt systems are in accordance with the manufacturer's recommendations.

g) The *Contractor* is required to provide a detailed Quality Control Plan and Construction Method Statement for related civil *Works*.

h) The *Contractor* provides the preliminary design of all civil engineering work for review and acceptance by the *Employer*.

Electrical & mechanical engineering works

a) No additional requirements other than listed throughout the document.

Process control and IT works

None

Other [as required]

Notes to tender:

A preliminary design is submitted with the tender documentation for evaluation and approval.

List of drawings

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. The *Contractor* may request additional plant interface drawings if so required from the *Employer.*

Drawing number	Revision	Title
0.39/995 sht. 1 of 2	**11**	**Generators 1 & 2 AC Key Diagram**
0.39/995 sht. 2 of 2	**11**	**Generators 1 & 2 AC Key Diagram**
0.39/996 sht. 1 of 5		**Generators 1 & 2 DC Key Diagram**
0.39/996 sht. 1A of 5		**Generators 1 & 2 DC Key Diagram**
0.39/996 sht. 2 of 5		**Generators 1 & 2 DC Key Diagram**
0.39/996 sht. 3 of 5		**Generators 1 & 2 DC Key Diagram**
0.39/996 sht. 4 of 5		**Generators 1 & 2 DC Key Diagram**
0.39/996 sht. 5 of 5		**Generators 1 & 2 DC Key Diagram**
0.39/1281 sht. 1		**Unit 1 & 2 Cable Block Diagram**
0.39/1281 sht. 2		**Unit 1 & 2 Cable Block Diagram (Roodekuil)**
18.48/5695 Sheet 1	**1**	**Circuit function letters and wire numbers**
18.48/5695 Sheet 2	**1**	**Power and control wiring terminations**
18.48/5695 Sheet 3	**1**	**Ferrules, wiring and KKS labelling**
18.48/5695 Sheet 4	**1**	**Power and control wiring terminations**
0.39/205	**8**	**Vanderkloof Single Line Diagram**
0.39/1061		**Generators 1 & 2 Relay Panel Equipment Layout**
0.39/1063		**Cable Diagram Generators 1 & 2 Relay Panel 1**
0.39/1064		**Cable Diagram Generators 1 & 2 Relay Panel 2**
0.39/1065		**Cable Diagram Generators 1 & 2 Relay Panel 3**
0.39/1292		**VDK Control block &Surface Building Panel Layout**
0.37/3059		**RDK Control Room Layout**
0.52/30655	**0**	Vanderkloof - Roodekuil Transmission-Generation Protection Drawing

- **Table 21: Drawings**

ANNEXURES

Appendix A: DEVIATION LIST
Appendix B: VANDERKLOOF SINGLE LINE DIAGRAM FOR METERING
Appendix C: Vanderkloof Hydro Station proposed single line diagram
Appendix D: Existing panel layout
Appendix E: CONCEPTUAL METERING AND EMDAS LAYOUT
Appendix F: METERING RECORDS
Appendix G: EXAMPLE OF GENERATION HOURLY ENERGY REPORT FORMAT

NUMBER	DESCRIPTION
160A/1373	VDK Protection Replacement Investigation report
160A/1373-A	VDK Protection Replacement ROC
160A/1373-G	VDK Protection Replacement Stakeholder Requirements Definition
160A/1373-G1	VDK Protection Replacement EMAP
160A/1373-G2	VDK Protection Replacement SRD End-of-Phase Design Review Report
160A/1373-H	VDK Protection Replacement Concept Design Report
160A_1373_H1	VDK Protection Replacement Concept Design EOP Review Report
160A_1373_H2	53. VDK Protection Replacement Concept Executive Summary SCCC
160A_1373_H3	VDK Protection Replacement Concept Executive Summary CCCC
160A_1373_P	VDK Protection Basic Design Report
240-170000983	Roodekuil – Vanderkloof Transmission-Generation Interface Protection

- **Table 22 : List of Normative References**

Other applicable standards

Item No	Standard	Title	Tick if publicly available
[1]	ISO 9001	Quality Management Systems	
[2]	240-53114002	Engineering Change Management Procedure	
[3]	240-53114026	Project Engineering Change Management Procedure	
[4]	240-109607332	Eskom Plant Labelling Abbreviation Standard	
[5]	240-109607736	Eskom KKS Key Part Standard	
[6]	240-93576498	Eskom KKS Coding Standard	
[7]	240-55410927	Cyber Security Standard for Operational Technology	
[8]	240-56364545	Eskom Structural Design and Engineering Standard	
	240-62629353	Specification for Panel Labelling Standard	
	240-56179121	Spares Management Policy Standard	
	240-56356396	Earthing and Lightning Protection Standard	

Item No	Standard	Title	Tick if publicly available
	240-56227443	Requirements for Control and Power Cables for Power Stations Standard	
	240-51999977	Standard for Digital Transducer-Based Measurement System for Electrical Quantities	
	General	Interface Specification: Phoenix Interface for Power Stations EMDAS	
	240-62581162	Generation Energy Management and Data Acquisition System (EMDAS) Standard	
	474-10721	Phoenix FTP File Format: Additional Record Requirements	
	240-65292589	Standard for Substation Meter Panels: HV/MV Indoor	
	240-149521909	List of Acceptable Single and Three Phase Meters	
	D-DT-5804	Standard Substation Metering Panel	
	240-0975231	Specification for current and voltage transformer test blocks.	
	DST32-326	Terminology Relating to the Direction of Power Flow	
	240-55197966	Standard for the Commissioning of Metering Installations (HV and	
	240-56359083	Metering and Measurement Systems for Power Stations in Generation	
	240-56364444	Minimum Requirements for the Metering of Electrical Energy and Demand	
	D-DT-5804	Substation Metering Panel Drawings	
	BS 4579	Specification for performance of mechanical and compression joints in electric cable and wire connectors	
	240-56227589	List of Approved Electronic Devices to be used on Eskom Power Stations Standard	
	240-64100247	Standard for Earthing secondary plant equipment in Sub-Stations	
	240-56356630	Generator Protection Settings Management Standard	
	240-64685228	Generic Specification for Protective Intelligent Electronic Devices. (IEDS)	
	240-56356548	Generating Unit Electrical Protection Standard for Hydro PS	
	240-86973501	Engineering Drawing Standard – Common Requirements	
	240-54179170	Technical Documentation Classification and Designation Standard	
	240-56227426	Management of Power Station MV and LV Protection and Settings Standard	
	240-53114186	Documents and Record Management Procedure	
	240-55410927	Cyber Security Standard for Operational Technology	
	IEEE Std 242-2001	IEEE Buff Book–IEEE Recommended Practice for Protection devices Coordination of Industrial and Commercial Power Systems	
	IEEE Std C37.91-2008	IEEE Guide for Protective Relay Applications to Power	

Item No	Standard	Title	Tick if publicly available
		Transformers	
	IEEE Std C37.96-2012	IEEE Guide for AC Motor Protection	
	IEEE Std C37.102-2006	IEEE Guide for Generator Ground Protection	
	IEEE Std C37.102-2006	IEEE Guide for AC Generator Protection	
	IEEE Std C37.106-2003	IEEE Guide for Abnormal Frequency Protection for Power Generating Plants	
	IEEE Std C37.108-2002 (R2007)	IEEE Guide for the Protection of Network Transformers	
	IEEE Std C37.110-2007	IEEE Guide for the Application of Current Transformers Used for Protective Relaying Purposes	
	IEEE Std C37.111-1999	IEEE Standard IEEE Standard Common Format for Transient Data Exchange (COMRADE) for Power Systems	
	IEEE Std C37.112-1996 (R2007)	IEEE Standard Inverse-Time Characteristic Equations for Overcurrent Relays	
	IEEE Std C37.119-2005	IEEE Guide for Breaker Failure Protection of Power Circuit Breaker	
	IEEE Std C37.234-2009	IEEE Guide for Protective Relay Applications to Power System Buses	
	IEEE Std C37.2-2008	IEEE Standard for Electrical Power System Device Function Numbers, Acronyms, and Contact Designations	
	IEC 61355	Classification and designation of documents for plant, systems and equipment.	
	240-75655504	Corrosion protection standard for new indoor and outdoor Eskom equipment, components, materials and structures manufactured from steel standard	

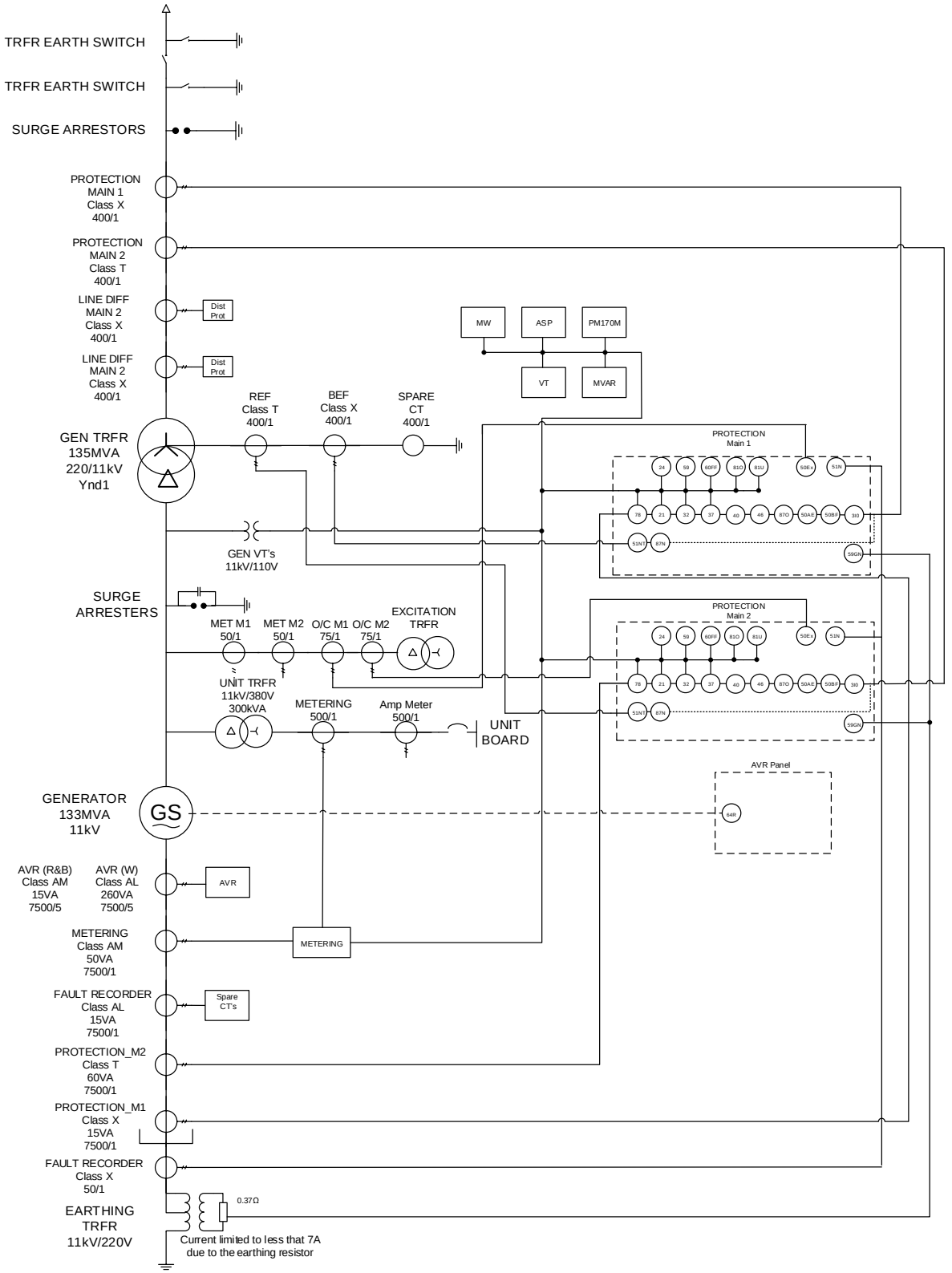
- **Table 23: List of other applicable standards**

1. : DEVIATION LIST

List of deviations from Schedule A&B			
Item no.	**Item Description**	***Employers* Specification**	**Deviation**

- **Table 24: List of deviations from Schedule A&B**

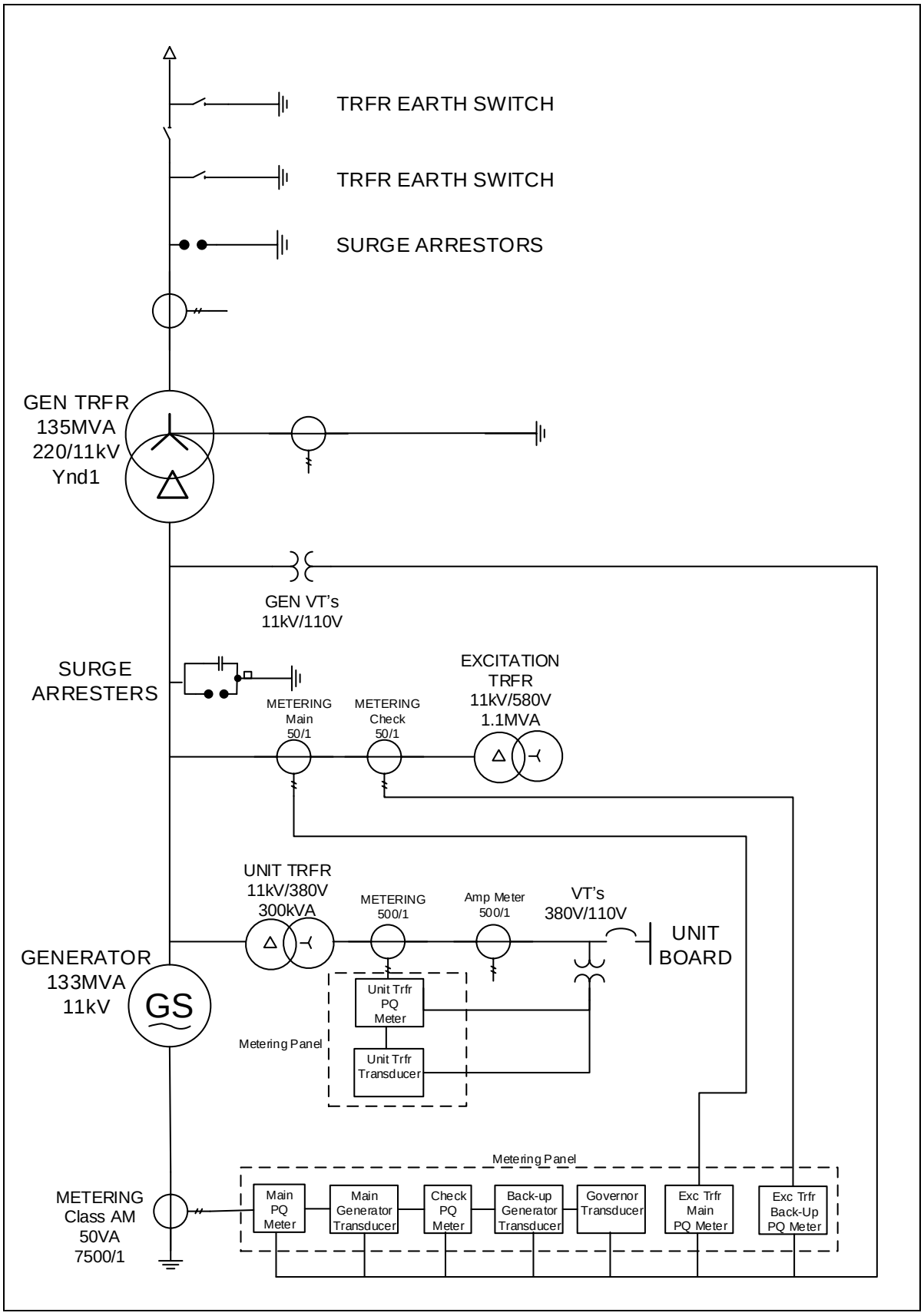
2. : VANDERKLOOF SINGLE LINE DIAGRAM FOR METERING



21G	B/U IMPEDANCE	50BF	HV BREAKER FAIL	81U	UNDER FREQUENCY
24G	OVER FLUXING	51NT	GEN TRFR HV B/U E/F	87O	OVERALL DIFF
32	UNDERPOWER	59G	OVER VOLTAGE	87N	HV RESTRICTED E/F
37	REVERSE POWER	59GN	95% STATOR E/F	3Io	RESIDUAL E/F
40G	LOSS OF FIELD	60FF	FUSE FAIL		
46G	NEGATIVE PHASE SEQ	64R	ROTOR E/F		
50AE	S.O.S	78G	POLE SLIP		
50Ex	EXCITATION O/C	81O	OVER FREQUENCY		

- **Figure 10: VANDERKLOOF METERING SINGLE LINE**

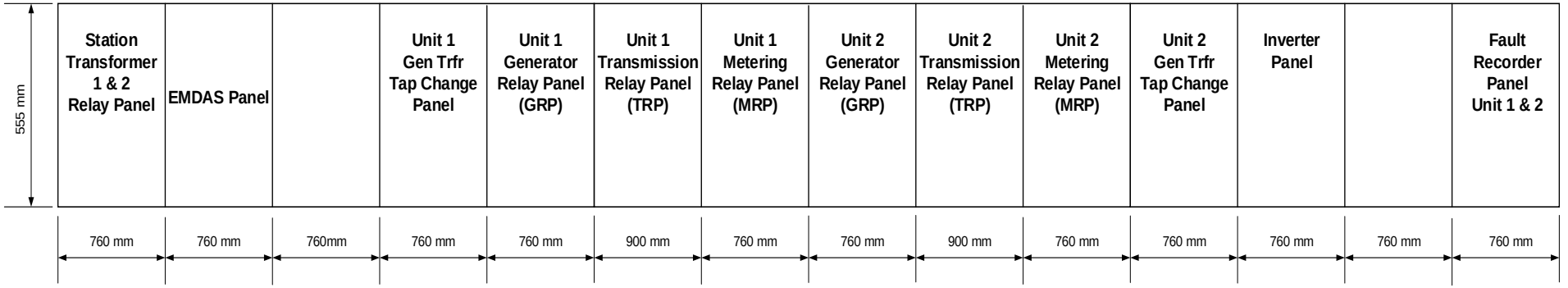
3. : VANDERKLOOF HYDRO STATION PROPOSED SINGLE LINE DIAGRAM



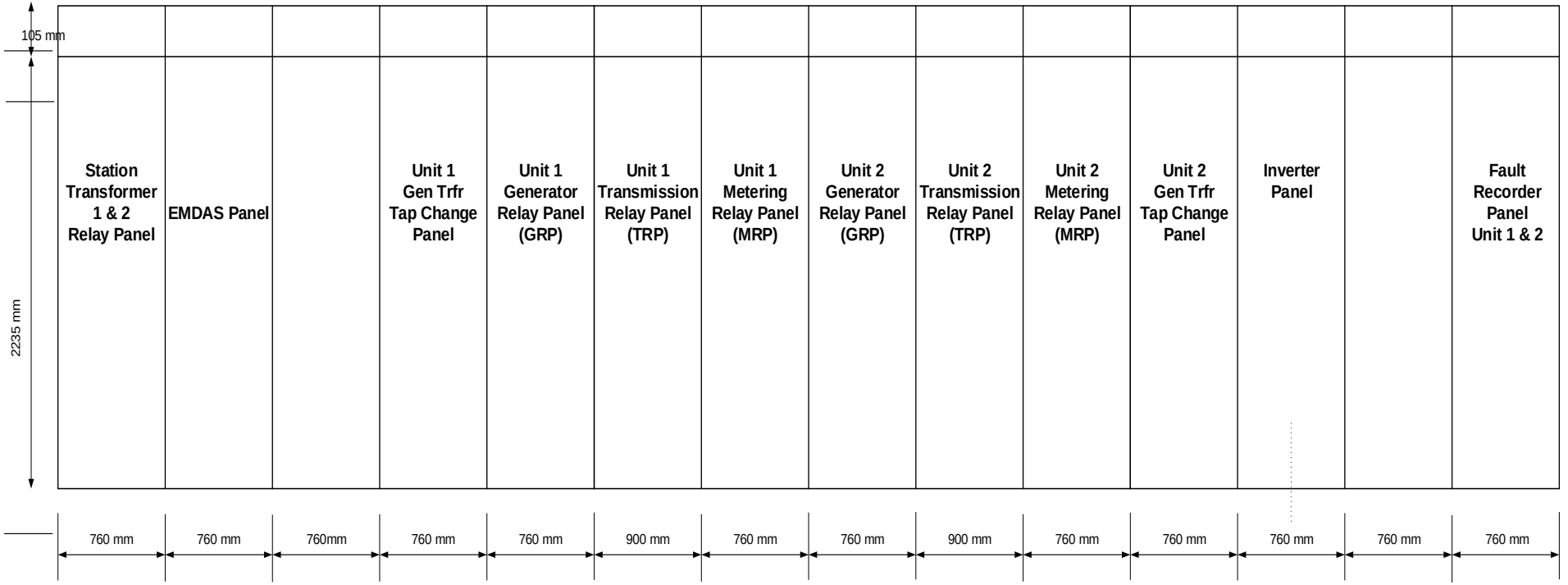
- **Figure 11: Metering System Single Line Diagram**

4. : EXISTING PANEL LAYOUT

Control Room Relay Panels Layout (Top View)

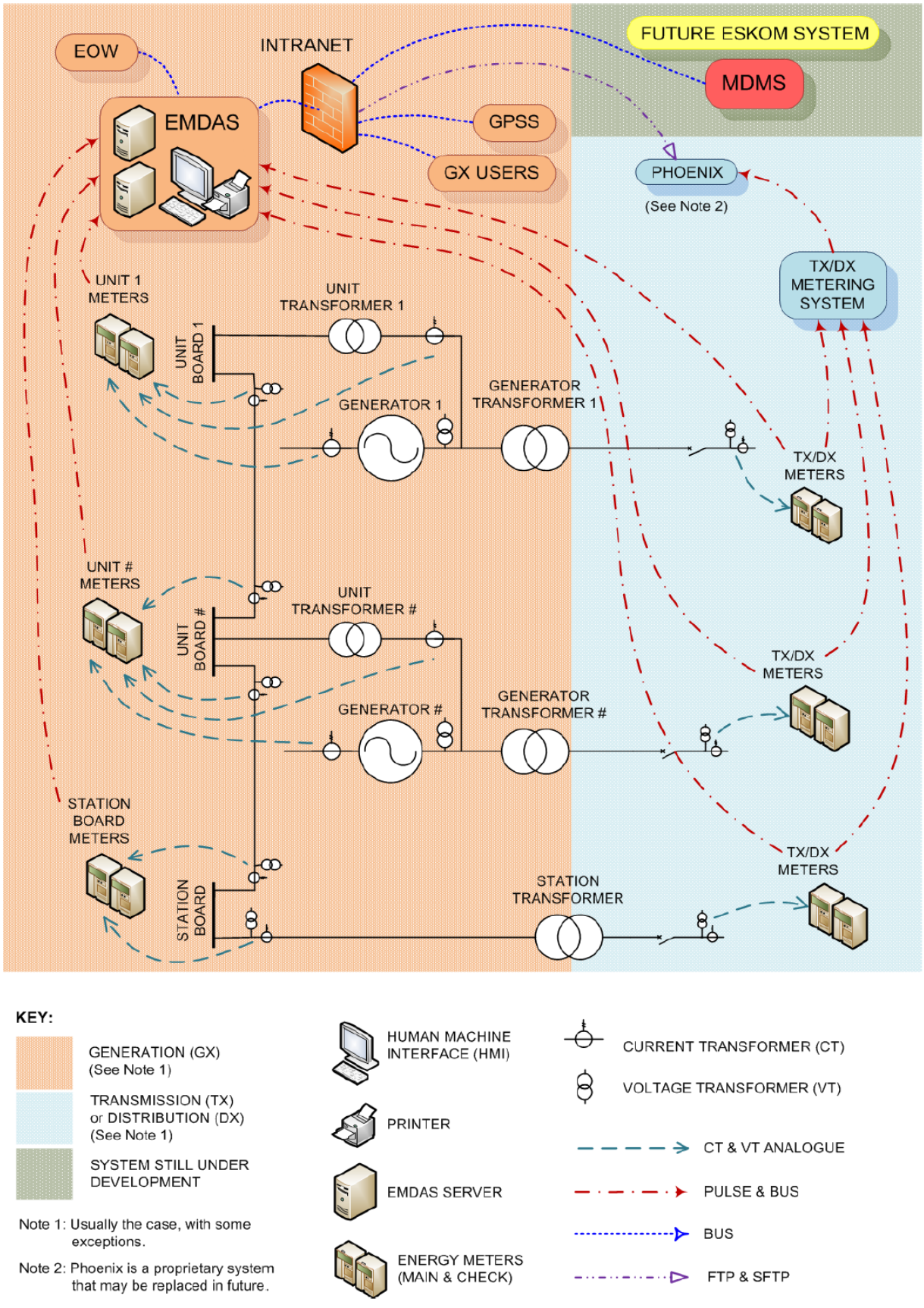


Control Room Relay Panels Layout (Front View)



- **Figure 12: Panel layout**

5. : CONCEPTUAL METERING AND EMDAS LAYOUT



- **Figure 13: Existing panel configuration:**

6. : METERING RECORDS

The Supplier of EMDAS must ensure that the output text file, sent via FTP/SFTP on an hourly basis, is capable of reporting on the quantities listed in Table 25 and Table 26, with the capability to include additional user-defined comma-delimited fields to the text file as required.

This must be done in accordance with 474-10721 Phoenix FTP File Format: Additional Record Requirements and PHOENIX EMDAS Interface for Power Stations Specification ([14] and [16]).

Field	Field Name	Type	Mandatory	Description
1	Record	A(3)	Yes	S58: Generating Unit Metering Period.
2	Hour	N(2)	Yes	Hour of the day for which the data is recorded, from 0 to 23.
3	Unit Pumping Load (MWh)	N(10.3)	No	Stored in dedicated register in EMDAS, based on operating mode.
4	Unit Pumping Load (MWh) Quality Flag	N(1)	No	Same as Gross Gen Quality Flag.
5	Unit SCO Load (MWh)	N(10.3)	No	Stored in dedicated register in EMDAS, based on operating mode.
6	Unit SCO Load (MWh) Quality Flag	N(1)	No	Same as Gross Gen Quality Flag.
7	Unit Sentout Load (MWh)	N(10.3)	No	Sent Out HV Calc WP+ minus absolute value of Sent Out HV Calc WP-.
8	Unit Sentout Load (MWh) Quality Flag	N(1)	No	Healthy if all meters used for Sent Out HV Calc value are healthy.
9	Unit Back-energized Stand-still (MWh)	N(10.3)	No	Stored in dedicated register in EMDAS, based on operating mode.
10	Unit Back-energized Stand-still (MWh) Quality Flag	N(1)	No	Healthy if all meters used for Sent Out MV Calc value are healthy.
11	Unit Generated Load (MWh)	N(10.3)	No	By default, use Gross Gen WP+ M. If not available, use Gross Gen WP+ C.
12	Unit Generated Load (MWh) Quality Flag	N(1)	No	Same as Gross Gen Quality Flag.
13	Unit Imported (Mvarh)	N(10.3)	No	Sum of Sent Out MV Calc WQ3 and Sent Out MV Calc WQ4 .
14	Unit Imported (Mvarh) Quality Flag	N(1)	No	Healthy if all meters used for Sent Out MV Calc value are healthy.
15	Unit Exported (Mvarh)	N(10.3)	No	Sum of Sent Out MV Calc WQ1 and Sent Out MV Calc WQ2 .
16	Unit Exported (Mvarh) Quality Flag	N(1)	No	Healthy if all meters used for Sent Out MV Calc value are healthy.
17	Mvarh Quadrant 1	N(10.3)	No	Sent Out MV Calc WQ1 .
18	Mvarh Quadrant 1 Quality Flag	N(1)	No	Healthy if all meters used for Sent Out MV Calc value are healthy.
19	Mvarh Quadrant 2	N(10.3)	No	Sent Out HV Calc WQ2 .
20	Mvarh Quadrant 2 Quality Flag	N(1)	No	Healthy if all meters used for Sent Out MV Calc value are healthy.
21	Mvarh Quadrant 3	N(10.3)	No	Sent Out HV Calc WQ3 .
22	Mvarh Quadrant 3 Quality Flag	N(1)	No	Healthy if all meters used for Sent Out MV Calc value are healthy.
23	Mvarh Quadrant 4	N(10.3)	No	Sent Out HV Calc WQ4 .
24	Mvarh Quadrant 4 Quality Flag	N(1)	No	Healthy if all meters used for Sent Out MV Calc value are healthy.
25	Gross Gen WP+ M	N(10.3)	No	Active energy exported (Main).
26	Gross Gen WP+ C	N(10.3)	No	Active energy exported (Check).
27	Gross Gen WP- M	N(10.3)	No	Active energy imported (Main).
28	Gross Gen WP- C	N(10.3)	No	Active energy imported (Check).

Field	Field Name	Type	Mandatory	Description
29	Gross Gen WQ1 M	N(10.3)	No	Reactive energy exported, lagging (Main).
30	Gross Gen WQ1 C	N(10.3)	No	Reactive energy exported, lagging (Check).
31	Gross Gen WQ2 M	N(10.3)	No	Reactive energy exported, leading (Main).
32	Gross Gen WQ2 C	N(10.3)	No	Reactive energy exported, leading (Check).
33	Gross Gen WQ3 M	N(10.3)	No	Reactive energy imported, lagging (Main).
34	Gross Gen WQ3 C	N(10.3)	No	Reactive energy imported, lagging (Check).
35	Gross Gen WQ4 M	N(10.3)	No	Reactive energy imported, leading (Main).
36	Gross Gen WQ4 C	N(10.3)	No	Reactive energy imported, leading (Check).
37	Gross Gen Quality Flag	N(1)	No	Healthy if Main and/or Check Gross Gen meters are healthy.
38	Excitation WP+	N(10.3)	No	Active energy exported.
39	Excitation WP-	N(10.3)	No	Active energy imported.
40	Excitation WQ1	N(10.3)	No	Reactive energy exported, lagging.
41	Excitation WQ2	N(10.3)	No	Reactive energy exported, leading.
42	Excitation WQ3	N(10.3)	No	Reactive energy imported, lagging.
43	Excitation WQ4	N(10.3)	No	Reactive energy imported, leading.
44	Excitation Quality Flag	N(1)	No	Healthy if Excitation meter is healthy.
45	Gross Out WP+	N(10.3)	No	Active energy exported.
46	Gross Out WP-	N(10.3)	No	Active energy imported.
47	Gross Out WQ1	N(10.3)	No	Reactive energy exported, lagging.
48	Gross Out WQ2	N(10.3)	No	Reactive energy exported, leading.
49	Gross Out WQ3	N(10.3)	No	Reactive energy imported, lagging.
50	Gross Out WQ4	N(10.3)	No	Reactive energy imported, leading.
51	Gross Out Quality Flag	N(1)	No	Healthy if all meters used for Gross Out value are healthy.
52	Unit Auxiliaries WP+	N(10.3)	No	Active energy exported.
53	Unit Auxiliaries WP-	N(10.3)	No	Active energy imported.
54	Unit Auxiliaries WQ1	N(10.3)	No	Reactive energy exported, lagging.
55	Unit Auxiliaries WQ2	N(10.3)	No	Reactive energy exported, leading.
56	Unit Auxiliaries WQ3	N(10.3)	No	Reactive energy imported, lagging.
57	Unit Auxiliaries WQ4	N(10.3)	No	Reactive energy imported, leading.
58	Unit Auxiliaries Quality Flag	N(1)	No	Healthy if all Unit Auxiliaries meters are healthy.
59	Sent Out MV Calc WP+	N(10.3)	No	Active energy exported.
60	Sent Out MV Calc WP-	N(10.3)	No	Active energy imported.
61	Sent Out MV Calc WQ1	N(10.3)	No	Reactive energy exported, lagging.
62	Sent Out MV Calc WQ2	N(10.3)	No	Reactive energy exported, leading.
63	Sent Out MV Calc WQ3	N(10.3)	No	Reactive energy imported, lagging.
64	Sent Out MV Calc WQ4	N(10.3)	No	Reactive energy imported, leading.
65	Sent Out MV Calc Quality Flag	N(1)	No	Healthy if all meters used for Sent Out MV Calc value are healthy.
66	Sent Out HV Calc WP+	N(10.3)	No	Active energy exported.
67	Sent Out HV Calc WP-	N(10.3)	No	Active energy imported.
68	Sent Out HV Calc WQ1	N(10.3)	No	Reactive energy exported, lagging.
69	Sent Out HV Calc WQ2	N(10.3)	No	Reactive energy exported, leading.
70	Sent Out HV Calc WQ3	N(10.3)	No	Reactive energy imported, lagging.
71	Sent Out HV Calc WQ4	N(10.3)	No	Reactive energy imported, leading.
72	Sent Out HV Calc Quality Flag	N(1)	No	Healthy if all meters used for Sent Out HV Calc value are healthy.
73	Sent Out WP+	N(10.3)	No	Active energy exported.
74	Sent Out WP-	N(10.3)	No	Active energy imported.
75	Sent Out WQ1	N(10.3)	No	Reactive energy exported, lagging.

Field	Field Name	Type	Mandatory	Description
76	Sent Out WQ2	N(10.3)	No	Reactive energy exported, leading.
77	Sent Out WQ3	N(10.3)	No	Reactive energy imported, lagging.
78	Sent Out WQ4	N(10.3)	No	Reactive energy imported, leading.
79	Sent Out Quality Flag	N(1)	No	Healthy if Sent Out meters are healthy.
80	Station Boards WP+	N(10.3)	No	Active energy exported.
81	Station Boards WP-	N(10.3)	No	Active energy imported.
82	Station Boards WQ1	N(10.3)	No	Reactive energy exported, lagging.
83	Station Boards WQ2	N(10.3)	No	Reactive energy exported, leading.
84	Station Boards WQ3	N(10.3)	No	Reactive energy imported, lagging.
85	Station Boards WQ4	N(10.3)	No	Reactive energy imported, leading.
86	Station Boards Quality Flag	N(1)	No	Healthy if Station Boards Main and/or Check meters are healthy.
87	Onsite Photovoltaic WP+	N(10.3)	No	Active energy exported.
88	Onsite Photovoltaic WP-	N(10.3)	No	Active energy imported.
89	Onsite Photovoltaic WQ1	N(10.3)	No	Reactive energy exported, lagging.
90	Onsite Photovoltaic WQ2	N(10.3)	No	Reactive energy exported, leading.
91	Onsite Photovoltaic WQ3	N(10.3)	No	Reactive energy imported, lagging.
92	Onsite Photovoltaic WQ4	N(10.3)	No	Reactive energy imported, leading.
93	Onsite Photovoltaic Quality Flag	N(1)	No	Healthy if PV Plant meters are healthy.

- **Table 25: Generating Unit Metering Record (S58)**

Field	Field Name	Type	Mandatory	Description
1	Record	A(3)	Yes	S59: Generating Station Metering Period.
2	Hour	N(2)	Yes	Hour of the day for which the data is recorded, from 0 to 23.
3	Station Pumping load (MWh)	N(15.3)	No	Sum of Unit Pumping Load (MWh) for all units.
4	Station SCO Load (MWh)	N(15.3)	No	Sum of Unit SCO Load (MWh) for all units.
5	Station Sentout Load (MWh)	N(15.3)	No	Sum of Unit Sentout Load (MWh) for all units.
6	Station Sentout Flag		No	Healthy if all meters used for Sent Out HV Calc value on all units are healthy.
7	Station Generated Load (MWh)	N(15.3)	No	Sum of Unit Generated Load (MWh) for all units.
8	Station Mvarh Imported	N(15.3)	No	Sum of Unit Imported (Mvarh) for all units.
9	Station Mvarh Exported	N(15.3)	No	Sum of Unit Exported (Mvarh) for all units.
10	Station Transformers WP+	N(10.3)	No	Sum of all active energy exported via Station Transformers.
11	Station Transformers WP-	N(10.3)	No	Sum of all active energy imported via Station Transformers.
12	Station Transformers W_{Q1}	N(10.3)	No	Sum of all reactive energy exported (lagging) by Station Transformers.

Field	Field Name	Type	Mandatory	Description
13	Station Transformers W_{Q2}	N(10.3)	No	Sum of all reactive energy exported (leading) by Station Transformers.
14	Station Transformers W_{Q3}	N(10.3)	No	Sum of all reactive energy imported (lagging) by Station Transformers.
15	Station Transformers W_{Q4}	N(10.3)	No	Sum of all reactive energy imported (leading) by Station Transformers.
16	Station Transformers Quality Flag	N(1)	No	Healthy if Station Transformers meters are healthy.
17	Extraneous Supplies WP+	N(10.3)	No	Sum of all active energy exported by Extraneous Supplies.
18	Extraneous Supplies WP-	N(10.3)	No	Sum of all active energy imported by Extraneous Supplies.
19	Extraneous Supplies WQ1	N(10.3)	No	Sum of all reactive energy exported (lagging) by Extraneous Supplies.
20	Extraneous Supplies WQ2	N(10.3)	No	Sum of all reactive energy exported (leading) by Extraneous Supplies.
21	Extraneous Supplies WQ3	N(10.3)	No	Sum of all reactive energy imported (lagging) by Extraneous Supplies.
22	Extraneous Supplies WQ4	N(10.3)	No	Sum of all reactive energy imported (leading) by Extraneous Supplies.
23	Extraneous Supplies Quality Flag	N(1)	No	Healthy if all Extraneous Supplies meters are healthy.

- **Table 26: Generating Station Metering Record (S59)**

7. : EXAMPLE OF GENERATION HOURLY ENERGY REPORT FORMAT

Report format is user-configurable, to cater for site requirements.

Abbreviation	Description
*	Unit number
C/B	Check/Backup
n	Variable index
M	Main
WP +	Active energy exported
WP -	Active energy imported
WQ1	Reactive energy exported (lagging)
WQ2	Reactive energy exported (leading)
WQ3	Reactive energy imported (lagging)
WQ4	Reactive energy imported (leading)

- **Table 27: Table Key for Report Abbreviations**

SITE: POWER STATION NAME
HOURLY ENERGY REPORT
DATE:
TIME:

GENERATORS (Gx)	Unit 1	Unit *
Gross Gen W_P+ M	xxx.xxx	xxx.xxx
Gross Gen W_P+ C/B	xxx.xxx	xxx.xxx
Gross Gen W_P- M	xxx.xxx	xxx.xxx
Gross Gen W_P- C/B	xxx.xxx	xxx.xxx
Gross Gen W_{Q1} M	xxx.xxx	xxx.xxx
Gross Gen W_{Q1} C/B	xxx.xxx	xxx.xxx
Gross Gen W_{Q2} M	xxx.xxx	xxx.xxx
Gross Gen W_{Q2} C/B	xxx.xxx	xxx.xxx
Gross Gen W_{Q3} M	xxx.xxx	xxx.xxx
Gross Gen W_{Q3} C/B	xxx.xxx	xxx.xxx
Gross Gen W_{Q4} M	xxx.xxx	xxx.xxx
Gross Gen W_{Q4} C/B	xxx.xxx	xxx.xxx

GENERATOR TRANSFORMERS (HV Side, metered by Tx/Dx)	Unit 1	Unit *
Gen Sent Out W_P+ M	xxx.xxx	xxx.xxx
Gen Sent Out W_P+ C/B	xxx.xxx	xxx.xxx
Gen Sent Out W_P- M	xxx.xxx	xxx.xxx
Gen Sent Out W_P- C/B	xxx.xxx	xxx.xxx
Gen Sent Out W_{Q1} M	xxx.xxx	xxx.xxx
Gen Sent Out W_{Q1} C/B	xxx.xxx	xxx.xxx
Gen Sent Out W_{Q2} M	xxx.xxx	xxx.xxx
Gen Sent Out W_{Q2} C/B	xxx.xxx	xxx.xxx
Gen Sent Out W_{Q3} M	xxx.xxx	xxx.xxx
Gen Sent Out W_{Q3} C/B	xxx.xxx	xxx.xxx
Gen Sent Out W_{Q4} M	xxx.xxx	xxx.xxx
Gen Sent Out W_{Q4} C/B	xxx.xxx	xxx.xxx

GENERATOR TRANSFORMERS (Calculated by Gx)	Trfr 1	Trfr *
Gen Trfr Losses W_P-	xx.xxx	xx.xxx
Gen Trfr Losses W_{Q2}	xx.xxx	xx.xxx
Gen Trfr Losses W_{Q3}	xx.xxx	xx.xxx

UNIT TRANSFORMER 1 (Gx)	Unit 1	Unit *
Unit Trfr W_P- M	xxx.xxx	xxx.xxx
Unit Trfr W_P- C/B	xxx.xxx	xxx.xxx
Unit Trfr W_{Q2} M	xxx.xxx	xxx.xxx
Unit Trfr W_{Q2} C/B	xxx.xxx	xxx.xxx
Unit Trfr W_{Q3} M	xxx.xxx	xxx.xxx
Unit Trfr W_{Q3} C/B	xxx.xxx	xxx.xxx

UNIT TRANSFORMER * (Gx)	Unit 1	Unit *
Unit Trfr W_P- M	xxx.xxx	xxx.xxx
Unit Trfr W_P- CH/B	xxx.xxx	xxx.xxx
Unit Trfr W_{Q2} M	xxx.xxx	xxx.xxx
Unit Trfr W_{Q2} C/B	xxx.xxx	xxx.xxx
Unit Trfr W_{Q3} M	xxx.xxx	xxx.xxx
Unit Trfr W_{Q3} C/B	xxx.xxx	xxx.xxx

STATION TRANSFORMERS (HV Side)	Trfr 1	Trfr *
Stn Trfr W_P+ M	xxx.xxx	xxx.xxx
Stn Trfr W_P+ C/B	xxx.xxx	xxx.xxx
Stn Trfr W_P- M	xxx.xxx	xxx.xxx
Stn Trfr W_P- C/B	xxx.xxx	xxx.xxx
Stn Trfr W_{Q1} M	xxx.xxx	xxx.xxx
Stn Trfr W_{Q1} C/B	xxx.xxx	xxx.xxx
Stn Trfr W_{Q2} M	xxx.xxx	xxx.xxx
Stn Trfr W_{Q2} C/B	xxx.xxx	xxx.xxx
Stn Trfr W_{Q3} M	xxx.xxx	xxx.xxx
Stn Trfr W_{Q3} C/B	xxx.xxx	xxx.xxx
Stn Trfr W_{Q4} M	xxx.xxx	xxx.xxx
Stn Trfr W_{Q4} C/B	xxx.xxx	xxx.xxx

LOOP SUPPLIES (Gx)	Loop 1	Loop *
Unit *n* to Loop W_P+	xx.xxx	xx.xxx
Unit *n* to Loop W_P-	xx.xxx	xx.xxx
Unit *n* to Loop W_{Q1}	xx.xxx	xx.xxx
Unit *n* to Loop W_{Q2}	xx.xxx	xx.xxx
Unit *n* to Loop W_{Q3}	xx.xxx	xx.xxx
Unit *n* to Loop W_{Q4}	xx.xxx	xx.xxx

STATION BOARD INCOMERS (Gx)	Trfr 1	Trfr *
Stn Brd *n* from Stn Trfr * W_P- M	xxx.xxx	xxx.xxx
Stn Brd *n* from Stn Trfr * W_P- C/B	xxx.xxx	xxx.xxx
Stn Brd *n* from Stn Trfr * W_{Q2} M	xxx.xxx	xxx.xxx
Stn Brd *n* from Stn Trfr * W_{Q2} C/B	xxx.xxx	xxx.xxx
Stn Brd *n* from Stn Trfr * W_{Q3} M	xxx.xxx	xxx.xxx
Stn Brd *n* from Stn Trfr * W_{Q3} C/B	xxx.xxx	xxx.xxx

STATION BOARD FEEDERS (Gx)	Unit 1	Unit *
Stn Brd *n* to Unit Brd * W_P+	xxx.xxx	xxx.xxx
Stn Brd *n* to Unit Brd * W_P-	xxx.xxx	xxx.xxx
Stn Brd *n* to Unit Brd * W_{Q1}	xxx.xxx	xxx.xxx
Stn Brd *n* to Unit Brd * W_{Q2}	xxx.xxx	xxx.xxx
Stn Brd *n* to Unit Brd * W_{Q3}	xxx.xxx	xxx.xxx
Stn Brd *n* to Unit Brd * W_{Q4}	xxx.xxx	xxx.xxx

GENERATOR EXCITATION TRANSFORMERS (Gx)	Unit 1	Unit *
Gen Exc Trfr W_P-	xxx.xxx	xxx.xxx
Gen Exc Trfr W_{Q3}	xxx.xxx	xxx.xxx

DIESEL GENERATORS (Gx)	Unit 1	Unit *
Diesel Gen W_P+	xx.xxx	xx.xxx
Diesel Gen W_{Q1}	xx.xxx	xx.xxx
Diesel Gen W_{Q4}	xx.xxx	xx.xxx

EXTRANEOUS SUPPLY SIGNALS (Gx)	Supply 1	Supply *
Ext Supply W_P+	xx.xxx	xx.xxx
Ext Supply W_{Q1}	xx.xxx	xx.xxx
Ext Supply W_{Q4}	xx.xxx	xx.xxx

TOTALS	Total
Total Stn Trfrs W_P-	xxx.xxx
Total Unit Trfr W_P-	xxxx.xxx
Total Unit Trfr W_{Q2}	xxxx.xxx
Total Unit Trfr W_{Q3}	xxxx.xxx
Total Stn Aux Consum W_P-	xxx.xxx
Total Stn Aux Consum W_{Q2}	xxx.xxx
Total Stn Aux Consum W_{Q3}	xxx.xxx
Total Gross Gen W_P+	xxxx.xxx
Total Gross Gen W_{Q1}	xxxx.xxx
Total Gross Gen W_{Q4}	xxxx.xxx
Total Gen Sent Out W_P+	xxxx.xxx
Total Gen Sent Out W_P-	xxxx.xxx
Total Gen Sent Out W_{Q1}	xxxx.xxx
Total Gen Sent Out W_{Q2}	xxxx.xxx
Total Gen Sent Out W_{Q3}	xxxx.xxx
Total Gen Sent Out W_{Q4}	xxxx.xxx

C3.2 *CONTRACTOR'S WORKS* INFORMATION

PART 4: SITE INFORMATION

Document reference	Title	No of pages
	This cover page	1
C4	Site Information	
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PART 4: SITE INFORMATION

Vanderkloof Hydro Power Station is part of the Peaking group of power stations and is located in the Upper Karoo Region in the Northern Cape. The station is powered with two 120MW units at an installed capacity of 240MW and encapsulated in an underground cavern on the left bank of the Orange River. The two units at Vanderkloof were put into commercial service in January and March 1977 respectively. The hydroelectric power station at the Vanderkloof Dam was the first power-generation station in South Africa situated entirely underground.
The Station has two vertical 'Francis' generators with a capacity of 120MW each and can be on load within 3 minutes.
Up to 220 000 litres (220 ton) of water per second flow through the penstock, which have an internal diameter of 7m

C4.1 Information about the site at time of tender which may affect the work in the contract

1. Access Limitations

Access to the Power Station is restricted to authorized personnel only. All *Contractor's* staff will be required to be cleared by security. *Contractor* gives 24hrs notice to the *Employer* of his intention to enter security-controlled areas.

All contractor personnel will be tested for the use of alcohol. Any person/s found to be above the legal limit will not be allowed on site.

2. Ground conditions in areas affected by work in this contract

N/A

3. Hidden and other services within the *site*

N/A