NEC3 Engineering & Construction Contract

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

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

for **MV SWITCHGEAR UPGRADE PROTECTION FOR A PERIOD OF 36 MONTHS AT ARNOT POWER STATION**

Contents:		**No of pages**
Part C1	**Agreements & Contract Data**	**[•]**
Part C2	**Pricing Data**	**[•]**
Part C3	**Scope of Work**	**[•]**
Part C4	**Site Information**	**[•]**

CONTRACT No. **[Insert at award stage]**

Part C1: Agreements & Contract Data

Contents:		No of pages
C1.1	**Form of Offer and Acceptance**	**[●]**
	[to be inserted from Returnable Documents at award stage]	
C1.2a	**Contract Data provided by the *Employer***	**[●]**
C1.2b	**Contract Data provided by the *Contractor***	**[●]**
	[to be inserted from Returnable Documents at award stage]	
C1.3	**Proforma Guarantees**	**[●]**

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:

MV Switchgear Upgrade Protection for a Period of 36 Months at Arnot Power Station

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 B, C or D	The offered total of the Prices exclusive of VAT is	**R [●]**
Option E or F	The first forecast of the total Defined Cost plus the Fee 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*

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
		X7: Delay damages
		X16: Retention
		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)	**[•]**
	Address	**[•]**
	Tel	**[•]**
	Fax	**[•]**
	e-mail	**[•]**
10.1	The *Supervisor* is: (Name)	**[•]**

	Address	**[●]**
	Tel No.	**[●]**
	Fax No.	**[●]**
	e-mail	**[●]**
11.2(13)	The *works* are	**MV Switchgear Protection**
11.2(14)	The following matters will be included in the Risk Register	**Site Access** **Permits** **Lead times for material delivery** **Outage Readiness**
11.2(15)	The *boundaries of the site* are	**Arnot Power Station Units 1-6**
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	**5 days**
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	**[●].**
11.2(9)	The *key date*s and the *condition*s to be met are:	***Condition* to be met** — ***key date*** **1 Detail Design Approval — TBA**
30.1	The *access dates* are:	**Part of the Site** — **Date** **1 Units 1 - 6 — TBA**
31.1	The *Contractor* is to submit a first programme for acceptance within	**2 weeks of the Contract Date.**
31.2	The *starting date* is	**TBA**
32.2	The *Contractor* submits revised programmes at intervals no longer than	**2 weeks.**
35.1	The *Employer* is not willing to take over the *works* before the Completion Date.	[No data needed if this statement is included]
4	**Testing and Defects**	
42.2	The *defects date* is	**52 weeks after Completion of the whole of the *works*.**

43.2	The *defect correction period* is	**2 weeks**
	except that the *defect correction period* for	**[●] is [●] weeks**
	and the *defect correction period* for	**[●] is [●] weeks**
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	**South African Rand.**
51.2	The period within which payments are made is	Thirty (30) Calendar days after the signed assessment by both Parties and a valid Tax Invoice**.** **ATTENTION:** Eskom's standard policy on payment term for all contracts valued above R50 000 0000 (Fifty Million Rand), including VAT, is 60 days**.** Bidders are requested to bear this payment term in mind when submitting bids and concluding contracts.
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**
6	**Compensation events**	**All Compensation Events are to be managed as per Core clause 6 of the NEC3 ECC**
60.1(13)	The place where weather is to be recorded is:	**Witbank**
	The *weather measurements* to be recorded for each calendar month are,	**the cumulative rainfall (mm)** **the number of days with rainfall more than 10 mm** **the number of days with minimum air temperature less than 0 degrees Celsius** **the number of days with snow lying at 09:00 hours South African Time** **and these measurements:**
	The *weather measurements* are supplied by	**A third-party agency on behalf of the *Employer***
	The *weather data* are the records of past *weather measurements* for each calendar month which were recorded at:	**Witbank Weather Station**
	and which are available from:	**the South African Weather Bureau and included in Annexure A to this Contract Data provided by the *Employer***

60.1(13)	Assumed values for the ten-year return *weather data* for each *weather measurement* for each calendar month are:	**As stated in Annexure A to this Contract Data provided by the *Employer*.** **Note: If this arrangement is used, delete the rows above for 60.1(13) and delete this note.**	
7	**Title**	**To be managed as per Core clause 7 of the NEC3 ECC**	
8	**Risks and insurance**		
80.1	These are additional *Employer*'s risks	**as stated for "Format A" available on** http://www.eskom.co.za/live/content.php?Item_ID=9248 **(See Annexure B for basic guidance)**	
9	**Termination**	**To be managed as per core clause 9 of the NEC3 ECC**	
10	**Data for main Option clause**		
A	**Priced contract with activity schedule**	**There is no reference to Contract Data in this Option and terms in italics are identified elsewhere in this Contract Data.**	
		from [•]% to [•]%	**[•]%**
		greater than [•]%	**[•]%**
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).**	
	Address	**[•]**	
	Tel No.	**[•]**	
	Fax No.	**[•]**	
	e-mail	**[•]**	
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 latest edition of Rules for the Conduct of Arbitrations published by The Association of Arbitrators (Southern Africa) or its successor body.**	
	The place where arbitration is to be held is	**[•] South Africa**	

	The person or organisation who will choose an arbitrator - 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	**One month before ITT/RFQ closing.**		
X1.1(c)	The proportions used to calculate the Price Adjustment Factor are:	**proportion**	**linked to index for**	**Index prepared by**
		15%	**Fixed**	**Fixed Portion**
		30%	**Labour**	**SEIFSA Table C3 (All hourly paid)**
		5%	**Preliminary & General**	**SEIFSA Table D4**
		20%	**Material: Steel**	**SEIFSA Table E4**
		25%	**Material: Electrical**	**SEIFSA Table G1**
		5%	**Material: Copper**	**SEIFSA Table F**
	Total	**100%**		
X2	**Changes in the law**	**Becomes a Compensation Event only if the changes in the Law of the Republic of South Africa took place after the Contract Date elsewhere in this Contract Data.**		
X7	**Delay damages (but not if Option X5 is also used)**			
X7.1	Delay damages for Completion of the whole of the *works* are	**R[●] per day up to a limit of R[●]**		
		R [●]	**for [●]**	
X16	**Retention (not used with Option F)**			
X16.1	The *retention free amount* is	**NIL**		
	The *retention percentage* is	**5%**		

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**
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) 2 years 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 insuranc 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 at 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 law
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 applicable 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 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	181	5	0	0	
February	124	4	0	0	
March	52	2	0	0	
April	0	0	0	0	
May	14	0	0	0	
June	35	1	1	0	
July	0	0	4	0	
August	14	1	0	0	
September	1.4	0	0	0	
October	140	6	0	0	
November	159	6	0	0	
December	191	5	0	0	

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)[1] 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: Qualifications: Experience:	

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

		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)	The *activity schedule* is in		
11.2(30)	The tendered total of the Prices is	**(in figures)**	
		(in words), excluding VAT	
B	**Priced contract with bill of quantities**		
11.2(21)	The *bill of quantities* is in		
11.2(31)	The tendered total of the Prices is	**(in figures)**	
		(in words), excluding VAT	
C	**Target contract with activity schedule**		
11.2(20)	The *activity schedule* is in		
11.2(30)	The tendered total of the Prices is	**(in figures)**	
		(in words), excluding VAT	
D	**Target contract with bill of quantities**		
11.2(21)	The *bill of quantities* is in		
11.2(31)	The tendered total of the Prices is	**(in figures)**	
		(in words), excluding VAT	
F	**Management contract**		
20.2	Work which the *Contractor's* will do himself is	**Activity**	***price*** **(lump sum or rate)**
	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**		
B	**Priced contract with bill of quantities**	**Data for the Shorter Schedule of Cost Components**		
41 in SSCC	The percentage for people overheads is:	**%**		
21 in SSCC	The published list of Equipment is the last edition of the list published by The percentage for adjustment for Equipment in the published list is	**Minus %**		
22 in SSCC	The rates of other Equipment are:	**Equipment**	**Size or capacity**	**Rate**
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:			
	If Option C, D or E is used	**Data for Schedule of Cost Components**		
23 in SCC	The listed items of Equipment purchased for work on this contract, with an on cost charge, are:	**Equipment**	**Time related charge**	**Per (time period)**
24 in SCC	The rates of special Equipment are:	**Equipment**	**Size or capacity**	**Rate**

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** **Please insert another schedule if foreign resources may also be used**	**Category of employee**	**Hourly rate**
52 in SCC	The percentage for manufacture and fabrication overheads is	**%**	
	If Option C, D, or E is used	**Data for both schedules of cost components**	
61 in SCC & 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 SCC & SSCC	The percentage for design overheads is	**%**	
63 in SCC & SSCC	The categories of design employees whose travelling expenses to and from the Working Areas are included as a cost of design of the *works* and Equipment done outside the Working Areas are:		
	If Option C, D or E is used	**Data for the Shorter Schedule of Cost Components**	
41 in SSCC	The percentage for people overheads is:	**%**	
21 in SSCC	The published list of Equipment is the last edition of the list published by The percentage for adjustment for Equipment in the published list is	**%**	

22 in SSCC	The rates of other Equipment are:	**Equipment**	**Size or capacity**	**Rate**

PART 2: PRICING DATA
ECC3 Option A

Document reference	Title	No of pages
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.

An activity schedule could have the following format:

Item No.	**Programme Reference**	**Activity description**	**Price**

C2.2 the *activity schedule*

Use this page as a cover page to the *Contractor*'s *activity schedule*.

Item	Description	Unit	Quantity	Rate	Amount (R)
1	**Preliminaries and General**				
1.1.1	Safety file -First year	No	1		
1.1.2	Safety file -year 2 & 3	Annually	2		
1.1.3	Medicals (annually)	Annually	3		
1.1.4	Police clearance (annually)	Annually	3		
1.1.5	Kitchen Converted Container Fitted with Single Bowl Sink with a Work Top, Fitted with Undercounter Cupboard. L-6m; W-3m (Inclusive of Transportation, Handling and monthly running costs)	Monthly	36		
1.1.6	Storage Container, Enclosed with No Windows L-12m; W-2.5m (Inclusive of Transportation, Handling and monthly running costs)	Monthly	36		
1.1.7	Split Male and Female Ablution L-6m; W-3m (Inclusive of Transportation, Handling and monthly running costs)	Monthly	36		
1.1.8	Connecting water, electrical, ablution services, and drainage	Monthly	1		

1.1.9	PPE (SANS Standard Flame Retard PPE (2 pairs per year),SANS Hard Hat (1 pair per year);SANS Standard Eye googles (2 pair per year); SANS Standard Safety Boots (Steel toe) (1 pair per year); SANS Standard Ear muffs (1 pair per year); SANS Micro Flex Hand Gloves (1 pair every 3 months)	Annually	3		
1.1.10	Travelling	km	129600		
1.1.11	Site de-establishment	Sum	1		
	Total Preliminaries & General				
2	**MV AND LV SWITCHGEAR PROTECTION**				
2.1	**UNIT 3 - SUPPLY OF PROTECTION EQUIPMENT**				
2.1.1	**11kV UNIT BOARD 3**				
2.1.1.1	4PA0100-Motor Interconnector Protection Scheme	Item	5		
2.1.1.2	4PA0700 - Transformer Protection Scheme (Transformer >= 10MVA)	Item	2		
2.1.1.3	4PA0800 - MV Interconnector Protection Scheme	Item	1		
2.1.1.4	4PA1000 - Transformer and Feeder Protection (Transformer < 10MVA)	Item	5		
2.1.1.5	4PA1200 - MV Incomer Protection Scheme	Item	1		
2.1.1.6	Arc Protection Scheme (14 Circuits Tripping - Single Zone)	Item	1		
2.1.1.7	High-Impedence Busbar Protection and Control Panel (Double Zone -28 Circuits)	Item	1		
2.1.1.8	LV Protection - 11/0.4kV Turbine TRFR Incomer	Item	1		
	Total Price				
2.1.2	**3.3kV Boiler Board 3A & 3B**				
2.1.2.1	4PA0100 - Motor Protection Scheme (Motor >=1MW)	Item	2		
2.1.2.2	4PA0400 - Motor Protection Scheme (Motor < 1MV)	Item	18		
2.1.2.3	4PA1200 - MV Incomer Protection Scheme	Item	2		
2.1.2.4	4PA1400 - Bus Section Protection Scheme	Item	1		

2.1.2.5	Arc Protection Scheme (23 Circuits Tripping) - Double Zone	Item	1		
2.1.2.6	High-Impedence Busbar Protection and Control Panel (Double Zone -28 Circuits)	Item	1		
2.1.2.7	LV Protection - 11/0.4kV B/B 3A & 3B Incomer & Unit Air Compressor Feeder	No	3		
	Total Price				
2.2	**UNIT 4 - SUPPLY OF PROTECTION EQUIPMENT**				
2.2.1	**11kV UNIT BOARD 4**				
2.2.1.1	4PA0100-Motor Interconnector Protection Scheme	Item	5		
2.2.1.2	4PA0700 - Transformer Protection Scheme (Transformer >= 10MVA)	Item	2		
2.2.1.3	4PA0800 - MV Interconnector Protection Scheme	Item	1		
2.2.1.4	4PA1000 - Transformer and Feeder Protection (Transformer < 10MVA)	Item	5		
2.2.1.5	4PA1200 - MV Incomer Protection Scheme	Item	1		
2.2.1.6	Arc Protection Scheme (14 Circuits Tripping - Single Zone)	Item	1		
2.2.1.7	High-Impedence Busbar Protection and Control Panel (Double Zone -28 Circuits)		1		
2.2.1.8	LV Protection - 11/0.4kV Turbine TRFR Incomer	Item	1		
	Total Price				
2.2.2	**3.3kV Boiler Board 3A & 3B**				
2.2.2.1	4PA0100 - Motor Protection Scheme (Motor >=1MW)	Item	2		
2.2.2.2	4PA0400 - Motor Protection Scheme (Motor < 1MV)	Item	18		
2.2.2.3	4PA1200 - MV Incomer Protection Scheme	Item	2		
2.2.2.4	4PA1400 - Bus Section Protection Scheme	Item	1		
2.2.2.5	Arc Protection Scheme (23 Circuits Tripping) - Double Zone	Item	1		
2.2.2.6	High-Impedence Busbar Protection and Control Panel (Double Zone -28 Circuits)	Item	1		

2.2.2.7	LV Protection - 11/0.4kV B/B 3A & 3B Incomer & Unit Air Compressor Feeder	Item	3		
	Total Price				
3	**ENGINEERING OF PROTECTION MV AND LV SWITCHGEAR PROTECTION**				
3.1	Engineering of 4PA and LV (Typicals) Scheme Design	Item	1		
3.2	Engineering of BusZone Scheme Design	Item	1		
	Total Price				
4	**TESTING OF PROTECTION MV AND LV SWITCHGEAR PROTECTION**				
4.1	Factory Acceptance Testing (FAT) - High Impedence Busbar Protection and Control Panel Panels	Item	1		
	Total Price				
5	**COMMISSION OF PROTECTION MV AND LV SWITCHGEAR PROTECTION**				
5.1	4PA Schemes and LV Schemes SAT and Commissioning	Item	1		
5.2	High-Impedance Busbar Protection and Control Panel Schemes	Item	1		
	Total Price				
6	**ENGINEERING WORK STATION (EWS) SUPPLY OF EWS**				
6.1	11kV Unit Board 3 - Communication and SCADA/RTU Hardware	Item	1		
6.2	11kV Unit Board 4 - Communication and SCADA/RTU Hardware	Item	1		
	Total Price				
7	**Installation and Commissioning of EWS**				

7.1	Installation and Commissioning of Communication and SCADA/RTU Hardware	Item	1		
	Total Price				
8	**CONTROL AND INSTRUMENTATION (C&I) INTERFACE**				
8.1	SUPPLY OF SERVER AND SOFTWARE (MICROSCADA)				
8.1.1	Substation Automation software Engineering and Functional Tests.	Item	1		
	Total Price				
	Suppliers offered total Excluding VAT				

PART 3: SCOPE OF WORK

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

C3.1: EMPLOYER'S WORKS INFORMATION

Contents

Part 3: Scope of Work **1**
C3.1: Employer's works Information **2**
1. Description of the *works* **6**
1.1 Executive overview 6
1.2 *Employer*'s objectives and purpose of the *works* 6
1.3 Scope of the Works 7
1.3.1 MV and LV switchgear protection schemes 7
1.3.2 Engineering Work Station 7
1.3.3 Control & Instrumentation 9
1.3.4 Heating, Ventilation and Air Conditioning (HVAC) 9
1.4 Interpretation and terminology 9
2. Management and start up **11**
2.1 Management meetings 11
2.2 Documentation control 20
2.3 Health and safety risk management 21
2.4 Environmental constraints and management 29
2.5 Quality assurance requirements 29
2.6 Programming constraints 32
2.7 *Contractor*'s management, supervision and key people 33
2.8 Invoicing and payment 34
2.9 Insurance provided by the *Employer* 35
2.10 Contract change management 35
2.11 Provision of bonds and guarantees 35
2.12 Records of Defined Cost, payments & assessments of compensation events to be kept by the *Contractor* 35
2.13 Training workshops and technology transfer 36
3. Engineering and the *Contractor*'s design **36**
3.1 *Employer*'s design 36
3.1.1 Electrical Designs 36
3.1.2 Control and Instrumentation (C&I) Designs 36
3.1.3 Low Pressure Services (LPS) Designs- HVAC 36
3.1.4 Civil and Structural Design 38
3.2 Parts of the *works* which the *Contractor* is to design 38
3.2.1 Switchgear Protection and control schemes 38

3.2.2 Engineering Work Station (EWS) 57
3.2.3 C&I interface 70
3.2.4 HVAC systems 71
3.2.5 Civil and Structural 73
3.3 Procedure for submission and acceptance of *Contractor*'s design 74
3.3.1 Design Review Procedure 75
3.3.2 Engineering Change Procedure 75
3.3.3 Process for Submission of Documents 75
3.3.4 Time Required for Acceptance of Designs 76
3.4 Other requirements of the *Contractor*'s design 76
3.5 Use of *Contractor*'s design 77
3.5.1 System Interface 77
3.5.2 Equipment Layout 77
3.5.3 Current and Voltage Transformers 77
3.6 Design of Equipment 77
3.7 Equipment required to be included in the *works* 77
3.8 As-built drawings, operating manuals and maintenance schedules 77
3.8.1 Drawing Requirements 78
3.8.2 Operating and Maintenance Manual 80
3.8.3 Maintenance Schedule 80
4. Procurement 81
4.1 People 81
4.1.1 Minimum requirements of people employed on the Site 81
4.1.2 BBBEE and preferencing scheme 81
4.1.3 Accelerated Shared Growth Initiative – South Africa (ASGI-SA) 81
4.2 Subcontracting 81
4.2.1 Preferred sub*Contractor*s 81
4.2.2 Subcontract documentation, and assessment of subcontract tenders 81
4.2.3 Limitations on subcontracting 82
4.2.4 Attendance on sub*Contractor*s 82
4.3 Plant and Materials 82
4.3.1 Quality 82
4.3.2 Plant & Materials provided "free issue" by the *Employer* 83
4.3.3 *Contractor*'s procurement of Plant and Materials 83
4.3.4 Spares and consumables 83
4.4 Tests and inspections before delivery 84
4.4.1 Factory Acceptance and Testing (FAT) 84
4.5 Marking Plant and Materials outside the Working Areas 85
4.6 *Contractor*'s Equipment (including temporary works) 85
4.7 Cataloguing requirements by the *Contractor* 85

5. Construction 86

5.1 Temporary works, Site services & construction constraints 86

5.1.1 *Employer*'s Site entry and security control, permits, and Site regulations **Error! Bookmark not defined.**

5.1.2 Restrictions to access on Site, roads, walkways and barricades ..... **Error! Bookmark not defined.**

5.1.3 People restrictions on Site; hours of work, conduct and records ..... **Error! Bookmark not defined.**

5.1.4 Health and safety facilities on Site ..... **Error! Bookmark not defined.**

5.1.5 Environmental controls, fauna & flora, dealing with objects of historical interest **Error! Bookmark not defined.**

5.1.6 Title to materials from demolition and excavation ..... **Error! Bookmark not defined.**

5.1.7 Cooperating with and obtaining acceptance of Others ..... **Error! Bookmark not defined.**

5.1.8 Publicity and progress photographs ..... **Error! Bookmark not defined.**

5.1.9 *Contractor*'s Equipment ..... **Error! Bookmark not defined.**

5.1.10 Equipment provided by the *Employer* ..... **Error! Bookmark not defined.**

5.1.11 Site services and facilities ..... **Error! Bookmark not defined.**

5.1.12 Facilities provided by the *Contractor* ..... **Error! Bookmark not defined.**

5.1.13 Existing premises, inspection of adjoining properties and checking work of Others ..... **Error! Bookmark not defined.**

5.1.14 Survey control and setting out of the *works* ..... **Error! Bookmark not defined.**

5.1.15 Excavations and associated water control ..... **Error! Bookmark not defined.**

5.1.16 Underground services, other existing services, cable and pipe trenches and covers ..... **Error! Bookmark not defined.**

5.1.17 Control of noise, dust, water and waste ..... **Error! Bookmark not defined.**

5.1.18 Sequences of construction or installation ..... **Error! Bookmark not defined.**

5.1.19 Giving notice of work to be covered up ..... **Error! Bookmark not defined.**

5.1.20 Hook ups to existing works ..... **Error! Bookmark not defined.**

5.2 Completion, testing, commissioning and correction of Defects 88

5.2.1 Work to be done by the Completion Date 88

5.2.2 Use of the *works* before Completion has been certified ..... **Error! Bookmark not defined.**

5.2.3 Materials facilities and samples for tests and inspections ..... **Error! Bookmark not defined.**

5.2.4 Commissioning ..... **Error! Bookmark not defined.**

5.2.5 Start-up procedures required to put the *works* into operation ..... **Error! Bookmark not defined.**

5.2.6 Take over procedures ..... **Error! Bookmark not defined.**

5.2.7 Access given by the *Employer* for correction of Defects ..... **Error! Bookmark not defined.**

5.2.8 Performance tests after Completion ..... **Error! Bookmark not defined.**

5.2.9 Training and technology transfer ..... **Error! Bookmark not defined.**

5.2.10 Operational maintenance after Completion ..... **Error! Bookmark not defined.**

6. Plant and Materials standards and workmanship 94

6.1 Investigation, survey and Site clearance 94

6.2 Building works 94

6.3 Civil engineering and structural works 94

6.4 Electrical & mechanical engineering works....94
6.5 Process control and IT works....95
6.6 Other [as required]....95
7. List of drawings....96
7.1 Drawings issued by the *Employer* .... **Error! Bookmark not defined.**
C3.2 *Contractor*'s Works Information....99

1. Description of the *works*

1.1 Executive overview

Arnot Power Station has Siemens 8FB Medium Voltage (MV) Switchgear, which was upgraded in 2003, including its protection. The phase 3 numerical and Arc protection (REA Series) relays were installed. The MV&LV protection has now approached its end-of-life span. The station also confirmed that over the years from the year of installation, these relays have encountered numerous failures on power supply cards and the memory cards, over and above that the relays have become obsolete, and this has posed a huge risk to the station. The spares for the relays are no longer manufactured making it difficult to replace relays that have failed. These failures also have a negative impact on UCLF.

The project scope highlighted in this works information describes the Employer's requirements for new medium voltage switchgear protection schemes that also includes Engineering Workstation, Control & Instrumentation interface and heating, ventilation and air conditioning (HVAC) at the Power Station.

Within this works information the requirements for the different protection schemes and the quantities required are defined. It also covers the signals that need to be catered for on medium voltage switchgear that will be sent to the Distributed Control System (DCS). The scope of work to be executed by the *Contractor* is also highlighted

It also covers the requirements for the Engineering Workstation (EWS). This system is required to interface with a number of existing electrical systems at the Power Station for monitoring purposes. This system will be used mainly for the monitoring and fault finding of the electrical reticulation failures on the protection schemes at the Power Station. The *Contractor*'s Intelligent Electronic Devices (IEDs) will also be configured via this system.

The requirements for Control & Instrumentation (C&I) interface are covered. This part is inclusive of the control system interface to the Low Voltage and Medium Voltage switchgear and new Engineering Workstation.

This works information also sets out the requirements for Heating, Ventilation and Air Conditioning (HVAC) system for all the affected substations. The works includes the installation and provision for new air conditioning system at the substations.

The core drilling requirements and any related civil work for Low Voltage and Medium Voltage Switchgear rooms is also the scope of this project.

1.2 *Employer*'s objectives and purpose of the *works*

One of the Employer's objectives and purpose of the works is to replace selected protection schemes on MV and LV switchgear at Arnot Power Station. The list of the boards which the protection schemes will be replaced can be found on Appendix 4

The following is a record of the replacement/equipment/systems that are required:

a) Replacement of the existing protection schemes with protection schemes of the latest technology and that have more functionalities

b) The latest intelligent electronic devices (IED's) protection equipment with designed life of a minimum of 15 years.
c) Provision of Engineering Workstation for monitoring of electrical reticulation, enhance and speed up diagnosis of plant errors.
d) Heating, ventilation and air conditioning (HVAC) in all the Switchgear rooms addressed by the project.
e) Maintain the Control & Instrumentation (C&I) interface on the MV&LV Switchgear.

1.3 Scope of the Works

The project scope in this Technical Specification covers the requirements for new medium voltage switchgear protection schemes, EWS, cabling, LV power supplies, C&I interface, HVAC and the Civil work

1.3.1 MV and LV switchgear protection schemes

The Scope of the Works includes the design, manufacture, factory testing, supply, delivery, off-loading, erection, installation, site testing and commissioning of new MV and LV switchgear protection schemes

The *Contractor* performs the mounting of protection equipment, the wiring of the relays and control circuits on the MV switchgear as specified in section 3.2.1. The *Employer* provides the typical functional protection and interface block diagrams as presented in Appendix 2.

The *Contractor* performs the detailed design of the protection and control circuits as well as interfacing. The *Contractor*'s designs are submitted to the *Employer* for review and Acceptance.

The *Contractor* supplies all IEDs in accordance with Appendix 3 of section 3.2.1 of the Works information. LV switchgear IEDs are configured and programmed in accordance to the LV switchgear philosophies issued to the *Contractor* by Others. Over and above MV switchgear protection schemes, the *Contractor* is also responsible for testing and commissioning of the LV switchgear IEDs after installation.

The *Contractor* designs protection schemes that comply with section 2.2.1 of this Works Information. The *Contractor* completes Technical Schedule A and B in Appendix 11 to provide guarantees on the offered Plant.

The re-connection of the power and control cables once the medium voltage switchgear is in position is performed by others.

1.3.2 Engineering Workstation

The scope of the Works includes the design, procurement, manufacture, factory acceptance testing, supply, delivery, off-loading, storage, erection, installation, site testing and commissioning of all equipment forming part of an Engineering Workstation (EWS).

The *Contractor* provides in his tender a conceptual design for the EWS architecture with the description of each component and their specifications. The design for the main offer for the EWS shall be in accordance with the proposed architecture overview provided in this section of the Works information and appendix 7. The *Contractor* also submits an alternative offer for the EWS that provides a more reliable and optimised solution, in line with the offered devices.

The *Contractor* provides in his tender preliminary system descriptions that describe the working of the system.

The *Contractor* performs detailed Reliability, Availability and Maintainability (RAM) studies of the complete EWS system and submits with his tender, RAM study reports for both the main and alternative offer. The *Contractor* provides reliability and availability calculations using established methodologies and 240-49230030 (Reliability Engineering Analysis Guideline) to demonstrate the adequacy of the designs. The reliability and availability calculations should be based on reliability block diagrams and indicating any redundant equipment that may be required. In addition to the EWS system, the tender submission includes life cycle costs of both the main and the alternative offer.

The VisualSPAR latest version reliability simulation software package shall be used in performing the RAM analysis.

During detailed design, the *Contractor* provides a detailed philosophy (system description) document and technical operation manual for the EWS offered. The documents describe in detail, the operation of the automation system and include elements such as the philosophy of the automation system, interlocking and controls provided on each protection scheme, the operation of the HMI etc. The documents are such that engineers and technicians can easily understand the relevant portions of the philosophy of operation of the complete system once he/she has read the document.

During detailed design, the *Contractor* provides a detailed document describing how to configure the system and its components. The document is such that an engineer can easily understand how to configure the complete system once he/she has read the document. The *Contractor* provides a RAM study report of the final system configuration and individual system components.

The *Contractor* provides a detailed specification of the logical nodes with associated data sets supported by each IED offered. The *Contractor* indicates which data sets in their offer are mandatory and which are optional.

No annual license renewal is required for software or operating systems. All licenses that are required are a once-off purchase. The fact that a bug is only found after the warranty has expired does not make it acceptable and therefore all bug fixes are free.

The *Contractor* and the associated supplier/s have at least 5 years of experience in development, design, engineering and implementation of the EWS or Substation Automation Systems (SAS). All equipment used in the system will form part of the *Contractor's* current marketed range of equipment and will not be experimental nor prototype in nature. The *Contractor* provides information regarding reference sites/projects of similar nature where the offered equipment has been installed. If equipment has been launched as a commercial product on the international market but has never been installed at a previously commissioned similar reference site, such equipment will have been tested rigorously and to the satisfaction of the *Employer.*
The *Contractor* provides a diEWSter recovery process for each communication device (i.e. network equipment, IEDs and the EWSs). This process must be auditable, and a recovery test must be performed during the Factory Acceptance Testing (FAT) to gather recovery times.

The *Contractor* provides for an OPC link to the Station Historian. The *Contractor* provides for receiving a time stamping signal from the Station GPS. The *Contractor* also engineers the EWS to receive information from electrical equipment at the Power Station as per this Works Information.

The *Contractor* designs Engineering Work Station that complies with section 3.2.2 of this Works Information. The *Contractor* completes Technical Schedule A and B in Appendix 11 to provide guarantees on the offered Plant.

1.3.3 Control & Instrumentation

a) The *Contractor* interfaces signals from the new protection schemes to the ABB Microscada SOR and ABB P13/14 DCS.
b) The *Contractor* performs software engineering, cold commissioning and functional tests.

c) The *Contractor* provides connectivity server together with accompanying software that will be required to achieve interface to the Station Historian.

d) The NTP time server has a spare port (Lan 1) which will be used to interface with the Ethernet switch (Station level Ethernet Switch 2) for the purpose of distributing the time signal to all the MV switchgear IEDs (refer to appendix 7). The Meinberg Lantime M300 supports SNTP (Simple Network Time Protocol) and will need to be configured to provide the time packaged information in SNTP format by the *Contractor*.

1.3.4 Heating, Ventilation and Air Conditioning (HVAC)

The HVAC scope of works, as detailed in these specifications' documents; comprise of the engineering, the provision of all labour including materials and *Contractor*'s equipment, manufacturing, supply, delivery, off-loading, hoisting, erection, testing, balancing and commissioning to serve, guarantee and maintenance after final completion of the air conditioning and ventilation installation. HVAC scope is as follows:
Installation of Direct Expansion (DX) units, fresh air system, which is equal or similar to dust collection units, Exn rated fans for smoke extraction.

The HVAC works is to comply with 240-102547991 General Technical Specification for HVAC Systems Standard and 240-70164623 Design Guideline for HVAC in the Eskom Coal Fired Power Stations.

1.4 Interpretation and terminology

The following abbreviations are used in this Works Information:

Abbreviation	**Meaning given to the abbreviation**
AFC	Approved for construction
OBL	Outside battery limits
Abbreviation	Meaning given to the abbreviation
%	Percentage
AC	Alternating Current
AI	Analogue Inputs
AO	Analogue Outputs
BI	Binary Inputs
C&I	Control & Instrumentation
COC	Certificate of Competence
COMTRADE	Common Format for Transient Data Exchange

CT	Current Transformer
DC	Direct Current
DCF	Direct Current Failure
DCS	Distributed Control System
EMI	Electromagnetic Interference
EOD	Electrical Operating Desk
EWS	Engineering Work Station
FAT	Factory Acceptance Testing
HMI	Human Machine Interface
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
IDMTL	Inverse Definite Minimum Time Lag
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
IP	Internet Protocol
IPC	Interposing Close
IPO	Interposing Open
ISO	International Organisation for Standardisation
kA	kilo Ampere
KKS	Kraftwerk Kennzeichen System
kV	kilo Volt
LAN	Local Area Network
LCD	Liquid Crystal Display
LV	Low Voltage
m	Meter
ms	Milli seconds
mm	Milli meters
MV	Medium Voltage
NTP	Network Time Protocol
OEM	Original Equipment Manufacturer
OHS Act	Occupational Health and Safety Act
PC	Personal Computer
QC	Quality Control
QoS	Quality of Supply

RAM	Reliability, Availability, Maintainability
RTU	Remote Terminal Unit
SCL	Substation Configuration Language
SNTP	Simple Network Time Protocol
SOR	Switch Operating Room
TCS	Trip Circuit Supervision
UPS	Uninterruptable Power Supply
V	Voltage
VDSS	Vendor Document Submittal Schedule
VT	Voltage Transformer
WBS	Work Breakdown Structure
VLAN	Virtual Local Area Network

2. Management and start up.

2.1 Management meetings

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

2.1.1 Project kick-off meeting

The *Project Manager arranges* a kick-off meeting after contract award. Normally, the *Project Manager* and the *Contractor* (and any other co-opted members) attend the meeting. The meeting is chaired by the *Project Manager* who is also responsible for drafting and circulation of the minutes.

Typically, the following items are discussed
:

- Scope/Commercial
- Scope review clarification
- Permits for hot work
- QCPs
- Safety induction training arrangements for team

Organizational structures

- *Employer* organization
- *Contractor* organization
- Management of Sub*Contractor*/s (quality and material supply)
- Parent company involvement (define the roles and responsibilities)
- Focal points of contact: *Employer* (*Project Manager*) – *Contractor* (Person to be named)
- *Contractor* Organogram with emphasis on site bound personal

Communication

- Communication plan
- Letter writing requirements (Communication procedure as per the contract for all formal communication)
- Standard numbering
- Contact details (e.g. telephone numbers, etc.)
- Communication registers
- Early warning and Compensation event registers
- Registers compared during progress meetings

Schedule/Progress review

- Planning meetings to interface with Others
- Program dates of all items are provided by the *Employer*

Engineering

- Technical issues requiring immediate clarification
- Documentation requirements

Logistics

- Arrangements for training of the *Contractor's* Responsible Persons and/or Authorised Supervisors.
- Requirements for the marking of equipment/tools brought onto site.
- Free issue items – Delivery and storage.

Security

- Access arrangements.
- Access permit (personnel, laptops, etc.)
- Cameras and cellphones with cameras

HR & IR

- Working hours
- Accommodation and meals

Safety, Health and Environment

- Health and Safety Plan
- Site procedures (e.g. emergency preparedness, etc.)
- *Employer* Safety Officer/s
- *Contractor* Safety Officer/s
- PPE
- Emergency telephone numbers

Quality Management

- Quality Management Plan

Risk Management

- Risk meetings

Accepted Programme and Activity Schedule.

2.1.2 Project review meetings

The *Project Manager* and the *Contractor* (and any other co-opted members) meet to discuss the overall project status. The meeting is chaired by the *Project Manager* who is also responsible for drafting and circulation of the minutes.

Typically, the following items are discussed:

- *Contractor's* program comparing it to the *Employer's program* highlighting problematic differences.
- Commercial or any other technical issues.
- Correspondence logs for any outstanding correspondence; etc.

2.1.3 Construction and commissioning management on Site

2.1.3.1 Construction progress committee

Constitution
The following persons are members of the Construction Progress Committee:

- *Project Manager* or delegate. (Chairperson)
- *Contractor's Project manager*.
- The *Supervisor.*
- *Employer's* project engineer.
- *Contractor's* project lead engineer.
- *Employer's* operating department representative.
- *Employer's* maintenance department representative.
- *Employer's* production representative.

Functions

To meet at the discretion of the Project Manager to report on overall progress of programmed activities this includes:

- *Contractor's* current activities progress and planned finish dates local and foreign.
- *Contractor's* planned start and finish dates for work planned in the next week, 2 weeks and one month.
- Accepted Programme and *Employer's* program agenda compared for problematic differences.

The progress of any other relevant activities.

- Critical path items progress
- Long lead times items update.

A project progress and related aspects report as described in section 2.6 "Programming Constraints".

Note: The *Project Manager* takes the minutes of these meetings. The minutes of these meetings do not serve as early warnings.

2.1.3.1.1 Construction scheduling committee

The *Project Manager or delegate only* grants permission for construction to commence and gives access of the *working areas* to the *Contractor* upon his acceptance of:

A final detail construction activity WBS, down to 4th level.
A final detail construction programme as part of the Accepted Programme, with a supporting resource schedule.
Final construction procedures describing in detail all the activities contained in the WBS.
A final quality control plan, quality assurance procedures and quality control procedures and check sheets.
A construction documentation procedure detailing the transmittal control and storage of check lists and certificates.
Completion of all other requirements of the Works Information with regard to activities up to and including the procurement, fabrication and delivery phase.

Once permission for construction to commence is obtained, the scheduling of construction activities is controlled by the Construction scheduling committee which convenes each day with minutes of meeting prepared by the *Contractor* for each meeting held.

Constitution

The following persons are members of the Construction Scheduling Committee:

- *Project Manager* or delegate. (Chairperson)
- *Contractor's Project Manager*.
- The *Supervisor.*
- *Employer's* project engineer.
- *Contractor's* project lead engineer.
- *Contractor's* Sub*Contractor*(s) for construction activities.
- *Employer's* operating department representative.
- *Employer's* maintenance department representative.
- *Employer's* production representative.
- *Employer's* works management representative.
- *Employer's* safety representative.

Functions
The Construction Scheduling Committee's daily meeting is the forum for scheduling of:

- Issue permit to work documentation, for construction activities both for those that require and do not requiring plant outages.
- Erection inspections and receive completed installation check list.
- Allocation of *Employer's* resources required for inspection and test activities.
- Progress reporting of the construction programme forming part of the Accepted Programme.

This is done in accordance with the operational constraints of the *Employer's* plant.

Note: The minutes of these meetings do not serve as early warnings.

2.1.3.2 Commissioning management

2.1.3.2.1 Pre-commissioning progress committee

This committee is applicable for the following phases/stages, namely: Investigation, Clarification, System Engineering and Design, Design freeze and FAT.

Constitution

The following persons are members of the Pre-Commissioning Committee:

- *Project Manager* or delegate. (Chairperson)
- *Contractor's Project Manager*.
- The *Supervisor.*
- *Employer's* project engineer.
- *Contractor's* project lead engineer.
- *Employer's* operating department representative.
- *Employer's* maintenance department representative.
- *Employer's* production representative.

Functions

To meet once a day or at the discretion of the *Project Manager or delegate to* report overall progress of programmed activities as shown in the Accepted Programme and listed on the *Employer's* agenda, which includes:

- *Contractor's* current activities' progress and planned finish dates local and foreign.
- *Contractor's* planned start and finish dates for work planned in the next week, 2 weeks and one month.
- Accepted Programme and *Employer's* program agenda compared to identify problematic differences.
- The progress of any other relevant activities.
- Critical path items progress.
- Long lead times items update.
- A weekly project progress and related aspects reports as per section 2.6 "Programming Constraints".

Note: The *Project Manager* takes the minutes of these meetings, and the minutes of these meetings do not serve as early warnings.

2.1.3.2.2 Commissioning progress committee

This committee is applicable for the following phases, namely: Commissioning, SAT and Operational Testing.

Constitution

The following persons are members of the Construction Progress Committee:

- *Project Manager* or delegate. (Chairperson)
- *Contractor's Project Manager*
- The *Supervisor.*
- *Employer's* project engineer.
- *Contractor's* project lead engineer
- *Employer's* operating department representative.
- *Employer's* maintenance department representative.
- *Employer's* production representative
- *Employer's* works management representative.
- *Employer's* safety representative.

Functions

To meet every day of the week or at the discretion of the *Project Manager or delegate to* report overall progress of programmed activities as shown in the Accepted Programme and listed on the *Employer's* agenda, which includes

- To establish project-commissioning policies which cover:
- Acceptance of commissioning programmes and procedures.
- The co-ordination of the *Contractor's* commissioning interfaces.
- The scheduling and progressing of commissioning activities.
- The availability of equipment and resources.
- Safety assurance and statutory requirements.
- The Completion of contractual obligations.
- Any other relevant commissioning activities.

Note: The *Contractor* takes the minutes of these meetings, and the minutes of these meetings do not serve as early warnings.

2.1.3.2.3 Commissioning scheduling committee

The *Project Manager or delegate only* grants permission for commissioning to commence upon acceptance of:

- A final detailed commissioning activity WBS 4th level
- A final detailed commissioning programme as part of the Accepted Programme, with supporting resource schedule
- Final commissioning procedures describing in detail all the activities contained in the WBS
- Identification procedure whereby plant & equipment status (decommissioned, safety cleared / live, isolated) is identified.
- A commissioning documentation procedure detailing the transmittal, control and storage of check lists and certificates
- A final quality control plan and QA procedures
- Completion of training of *Employer's* personnel
- Any other activities required by the Works Information for Completion before commissioning commences.

Once permission for commissioning to commence is obtained, the scheduling of commissioning activities is controlled by the Commissioning Scheduling Committee which convenes on a daily basis with minutes of meeting prepared by the *Contractor* for each meeting held.

The following persons are members of the Commissioning Scheduling Committee:

Constitution

- *Project Manager* or delegate. (Chairperson)
- *Contractor's Project Manager*
- The *Supervisor*
- *Employer's* project engineer.
- *Contractor's* project lead engineer.
- *Contractor's* Sub*Contractor*(s) for construction activities.
- *Employer's* operating department representative.
- *Employer's* maintenance department representative.

- *Employer's* production representative.

Functions

The Commissioning Scheduling Committee's daily meeting is the forum for scheduling of:

- Cold commissioning activities for construction activities not requiring plant outages.
- Cold commissioning activities for construction activities requiring plant outages.
- Issue of safety clearances of equipment.
- Issue of permits to work documentation for construction activities requiring plant outages for de-commissioning and commissioning activities.
- Optimisation.
- Acceptance tests.
- Allocation of *Employer's* resources required for commissioning activities.
- Arrange for Completion Certificate application.
- Progress reporting against commissioning programme, forming part of the Accepted Programme.
- It is done in accordance with the operational constraints of the *Employer's* plant.

Note: The minutes of these meetings do not serve as early warnings.

2.1.4 Special meetings

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 are submitted to the *Project Manager* by the person convening the meeting within five days of the meeting.

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

2.2 Programme and Planning

The *Contractor* provides, from the Contract Date to the Completion of the whole of the *works*, full-time skilled staff to perform all time, cost and resource planning activities required to enable the timely Provision of the Works and supply of information by the *Contractor* to the *Project Manager* as described in the Works Information.

The *Contractor* uses a computerised planning system recognised by the *Employer* and for which written acceptance is obtained from the *Project Manager*.

2.2.1 Planning

a) The *Contractor* assesses the available data and knowledge explicitly. Any technical detail, policies, imposed organisational conditions, contract conditions, specifications, overall programme constraints, resource availability, long delivery items or any other factor of significance to Provide the Works, are considered by the *Contractor* in his planning.

b) The *Contractor* employs decision network techniques, accepted by the *Project Manager* at the Contract Date, to determine project strategy.

c) The *Contractor* provides work planning bar charts and resource schedules as agreed with the *Project Manager.*

2.2.2 Project breakdown

The *Contractor* produces a work breakdown structure as employed for his internal planning purposes of which the first level is systems oriented and the remaining levels functionally oriented.

First level:
This level is in accordance with the project phases.

Second level:
This level is in accordance with the project stages.

Third level:
This level indicates high-level activities under each project stage.

2.2.3 Work packages

a) The *Contractor* develops the work breakdown structure to the third level or further, as required to establish a practicable Accepted Programme for the effective Provision of the Works.

b) Work package development for the various disciplines follows from the third (or lower) level of the work breakdown structure.

2.2.4 Project organisation structure

From the work breakdown structure, the *Contractor* determines the resource requirements (skill and quantity) and develops a detailed project organisation structure.

2.2.5 Accepted Programme / project network

a) Using the work breakdown structure, the *Contractor* develops a network structure / programme. This is in the form of a Gantt chart, based on precedence network principles, in which all the activities present in the work breakdown structure (to minimum third level) is shown together with network logic. This network is constructed to reflect the sequence(s) of activities, using subsequent resource scheduling to stagger the activities into the most probable sequence. The *Contractor* gives a single time estimate for the duration of each activity.

b) All contractual dates are integrated into the *Contractor*'s programme. The programme includes the activities performed by Sub*Contractor*(s), the interface points between different Sub*Contractor*'s work, the Employer's operations, the work of Others as well as the interface points between the *Contractor*'s work and the individual Sub*Contractor*'s work.

c) In addition, a summary programme to the second level of the work breakdown structure is submitted. This summary programme shows all key events. The *Contractor* gives a single time estimate for the duration of each activity.

d) The calendar used is based on normal working hours per day, normal working days per week and does not include any holidays. Daily time units are used with graphical representation showing weeks for a three-month window print and months for the total Contract duration.

e) The following reports are required as supporting documentation to the Accepted Programme:

- Time analysis print-out
- Critical activities report
- Key event report
- Resource schedules and histograms

f) All programmes, networks and reports are computer generated.

g) The first Accepted Programme (at the Contract Date) serves as a baseline for the Provision of the Works until the defects date. This baseline is shown on all subsequent graphical presentations of revised programmes.

h) The *Contractor* submits 3 copies of revised programmes to the Project Manager. A synopsis of all changes to the Accepted Programme is submitted, by the *Contractor*, with each revision. Each revision is uniquely identified by a revision number which is agreed with the *Project Manager* prior to submission of the first revised programme.

i) Changes to contractual dates contained in the Accepted Programme can only be made if so, required by compensation events. The revised programme submission comprises a detailed as well as a summary programme.

j) Graphical representation of the updated programme consists of a total overview print with a monthly time basis and summary activities as well as a three-month window detail print with a weekly time basis.

k) The Accepted Programme shows the scheduled test dates and durations for the FAT, SIT, SAT, Commissioning, switch-over and operational tests.

l) During the latter stages of the production engineering phase (in particular to include the FAT) until the end of the commissioning phase one (1) week, two (2) weeks and/or one month “look-ahead” windows are provided in the Accepted Programme by the *Contractor*. The duration of the “look-ahead” window is agreed with the *Project Manager* one (1) month prior to the start of FAT.

2.2.6 Forecast rate of invoice (FRI)

As per NEC conditions

2.2.7 Progress reports

The *Contractor* submits progress reports every two weeks. Once possession of any Site has occurred, progress reports may be required more frequently and are submitted as decided by the construction progress committee.

The progress report includes as a minimum the following:

a) Statement and report on those activities comprising the *works* where delay against the last Accepted Programme has occurred together with the reasons why the delay has occurred and the plan detailing the action to be taken and the period of time required to recover such delays.

b) Statement and report on activities comprising the *works* currently ahead of the Accepted Programme.

c) Near critical activities.

d) The impact of any programme changes to resource schedules, arising from implemented compensation events

2.2.8 Project meetings

From the starting date until the first construction progress committee meeting the *Project Manager* convenes a progress meeting on a weekly basis or at such frequency as is deemed appropriate and mutually agreed with the *Contractor*.

The *Project Manager* schedules meetings to discuss and resolve any technical or commercial matters on an as required basis. These may include changes in production environment and / or requirements.

2.3 Documentation control

All contractual communications and decisions are in the form of properly compiled letters or forms attached to e-mails and not as a message in the e-mail itself. All correspondence, in the form of letters, reports and e-mails is stored in a project communication file. The sequence of which will be in dates.

All correspondence between the *Contractor,* the *Project Manager* and the *Supervisor* follow the following rules:

1. All letters bear the sender's signature.
2. Letters follow the numbering scheme described in point 9.
3. Correspondence sent via E-mail:

Sender

The letter is saved in PDF format and sent as an attachment to the receiver.
The email Subject field contains only the doc reference number as described in point 9.
The e-mail body may contain informal text, which is not contractually binding, provided it’s recorded on the meeting minutes and signed by the *Project Manager* and the *Contractor.*

Receiver

The receiver replies to the e-mail received, ensuring that the complete message from the sender is included in the message as an attachment. This attachment includes the letter in PDF format.

In his reply the receiver includes the following text on the first line of the Message Body: "Acknowledgement of receipt”. This acknowledgement of receipt is contractually binding and serves as proof that the letter was delivered to the receiver’s address (Core Clause 13.2).

When a reply to a letter is required, e.g. “Acceptance of documentation” the receiver now becomes the sender and the procedure under for 3 a. and b. is followed with the receiver writing a new letter with a new reference number as described under point 9.

Correspondence delivered by hand:

Sender - The sender prepares the letter with a space for the receiver to sign and date acknowledgement of acceptance. The sender signs the letter and prepares two copies of the letter for delivery.

Receiver - The receiver signs both copies of the letter upon receipt and returns a signed and dated copy to the sender.

Correspondence by fax:

Sender – The sender prepares the letter with a space for the receiver to sign and date acknowledgement of acceptance. The sender signs the letter and sends it to the receiver by fax.

Receiver - Upon receipt, the receiver signs and dates the letter and returns it to the sender by fax, acknowledging receipt.

Drawings and other technical document transmittals:

Transmittals are numbered as described in point 9.
The same procedure as for letters described under point 4 is followed for transmittals

No other forms of correspondence are acceptable, nor will it be deemed contractually binding.

All correspondence not transmitted with one of the methods described above will be deemed as informal communication and not contractually binding. Only when a correspondence is acknowledged for receipt by the receiver by way of points 3 b, 4 b or 5 b will it be deemed contractually binding.

Correspondence numbering scheme:

To be agreed on contract award

2.4 Health and safety risk management

2.4.1 Introduction

The purpose of this document is to provide clear and unambiguous Health & Safety specifications to enable the Tenderer / Principal *Contractor* to make provision for and comply with the required Health & Safety requirements - both in terms of relevant legislation and Eskom requirements, as well as any additional or site-specific H&S requirements required by the *Client*. In response to this document, tenderers are required to prepare Health & Safety plans providing details on how they will manage Health & Safety during the prospective project(s). This document forms an integral part of the Contract and Principal *Contractor*s are required to make it an integral part of their contracts with sub-Principal *Contractor*s and suppliers.

This document is a GSA generic document. Before inclusion on any tender enquiry document(s) during the tender stage of a project, the end-user is required to amend the document to ensure that is project specific. The document promotes legal compliance as well as a health and safety culture amongst those working in Eskom Generation Division projects.

2.4.2 References

- Construction Safety Health & Environmental Management procedure (32-136)
- Guideline for developing a Safety Health & Environmental Specification (32-524)
- Occupational Health & Safety Act 85 of 1993
- Eskom SHE Policy (32-94)
- Eskom Cardinal Rules (32-421)
- Eskom Incident Management procedure (32-95)
- Vehicle and Driver Safety Management procedure (32-93)

- Work at Heights procedure (32-418)
- Eskom Vehicle Safety Specifications (32-345)
- Medical Surveillance Procedure (32-282)
- Plant Safety Regulations (GGR 0992)
- Operating Regulations for High Voltage Systems (ESKPVAEY6)
- Compensation for Occupational Injuries & Diseases Act

It is important that the above procedures/ documents are made available to the potential service provider in preparation of his/her health and safety management compliance to Eskom requirements. Parties using this specification shall apply the most recent edition of the documents listed above.

2.4.3 Abbreviations

H&S – Health & Safety
DOL – Department of Labour
OHSA – Occupational Health & Safety Act 85 of 1993
HIRA – Hazard Identification and Risk Assessment
GAR – General Administrative Regulations
CR – Construction Regulations
GS&A – Generation Safety & Assurance
GST&A – Generation Safety Strategy & Assurance

2.4.4 Health and Safety requirements

Health and Safety requirements that the *Contractor* shall comply with include:

2.4.4.1 Detailed costing for Health and Safety

- Based on the overall scope of work/ service to be performed – compulsory.
- Demonstration of an adequate health and safety management system that the Service Provider has:
  - Does the service provider have a documented health and safety management system?
  - provide proof
- Examples of the above include (but are not limited to), where applicable:
  - Notification to Commence Construction Work

The Principal *Contractor* shall, on receipt of the letter of appointment from the *Client*, before commencement of on-site activities, notify the Provincial Director of the Department of Labour of commencement of construction work as defined in Construction Regulations of the Occupational Health & Safety Act.85 of 1993

A copy of the notification letter acknowledged by the DOL shall be forwarded to the Agent and *Client* and a copy also kept on the H&S file on site.

Compensation for Occupational Injuries and Diseases

The Principal *Contractor* shall submit a letter of good standing with the Compensation Commissioner or Insurer at tender stage. The letter of good standing shall be valid throughout the project period. The *Client* shall at regular intervals of time carry out inspections to ensure that the letter of good standing remains valid throughout the project period.

Appointments

The Principal *Contractor* shall after consideration of the risks involved in the work, make relevant Occupational Health and Safety appointments as stipulated in the OHSA, before commencement of site operations and submit to the *Client* as part of the H&S Plan.

Competency for Principal *Contractor*'s responsible persons

The Principal *Contractor* shall compile and maintain a current register/inventory of all supervisory and management personnel appointed to the construction Site. The inventory shall include H&S and professional competencies for each person appointed. The inventory shall be submitted to the *Client* for approval at tender stage as part of the H&S plan.
Organogram

A site organogram clearly defining the reporting structure and legal appointment structure shall be drawn up and submitted by the Principal *Contractor* to the *Client* as part of the H&S plan at tender stage.

Hazard Identification and Risk Assessment (HIRA)

Using the scope of works provided as part of the tender enquiry documents, the *Contractor* shall compile and submit a HIRA at tender stage with proposed control measures. The HIRA shall indicate in general the type of H&S hazards and risks anticipated in the project and shall in broad terms indicate the proposed control measures to eliminate or minimise the identified risks.

The *Contractor* shall ensure that a detailed HIRA is performed by a competent person before commencement of construction work and it shall form part of the H&S plan to be submitted to the *Client* for approval.

The HIRA is an on-going process, and a review shall be submitted whenever there are changes in the scope and/or process. The Health and Safety Representative(s), the Health and Safety Committee members and *Contractor's* Representative shall be members of the HIRA team and shall ensure that all the identified hazards and risks are appropriately controlled and reviewed.

The *Contractor* shall be responsible for making sure that all employees under his control are conversant with the content of the HIRA, as well as putting in place appropriate measures to either eliminate or reduce the risks.

The HIRA must take into consideration the baseline risk assessment that will have provided by the *Client*.

Health and Safety (H&S) Plan

The Principal *Contractor* shall develop, compile and submit, at tender stage for approval by the *Client*, a composite H&S Plan as per the *Client*'s specifications.

Health and Safety Training

The Principal *Contractor* shall conduct a training needs analysis on receipt of the letter of appointment from the *Client*. The training needs analysis shall be updated before every major work change and every six months for the duration of the contract. The training conducted on each project shall be three-fold, namely:

Induction – the Principal *Contractor* shall ensure that all his employees undergo H&S induction based on the legislative requirements, *Client*'s specification and his H&S Plan before starting work on site.

Awareness – the Principal *Contractor* shall continuously conduct on site toolbox talks, display posters and contract statistics regularly and before any hazardous work takes place.

Competency – the Principal *Contractor* shall, based on his HIRA and training needs analysis nominate relevant persons to be sent on appropriate courses. The Principal *Contractor* shall make available at the *Client*'s request copies of certificates of training.

All records of training attendance, contents of training and training certificates shall be kept in the site H&S file.

Documentation

The Principal *Contractor* shall keep and maintain H&S records to demonstrate compliance to legal requirements, the H&S specification, as well as any other Eskom requirements. All documents shall be available for inspection by the *Client*, Agent and the DOL.

Monitoring and Evaluation

Inspections - The Principal *Contractor* shall carry out inspections as prescribed by legislation, the H&S Plan and the *Client* H&S specification. The Principal *Contractor* shall keep records of all inspections.

Internal Audits - the Principal *Contractor* shall conduct regular H&S audits at least once a month to ensure compliance to OHSA and H&S specification. Records of audits shall be kept on site and non-conformances reported.

External Audits - the Principal *Contractor* shall ensure that regular external H&S audits are conducted to ensure compliance to H&S legislation. External audits shall be carried out by competent persons or company. All documentation held by the Principal *Contractor* shall be available for inspection by the *Client*.

Reporting, Recording and Investigation of Accidents and Incidents

All accidents and incidents must be reported, recorded and investigated in accordance with the OHSA and Eskom procedure 32-95. The Principal *Contractor* shall report all accidents and incidents to the *Client* within 24 hours. The Principal *Contractor* shall allow the *Client* to participate in any investigation linked to any activity within the scope of the construction project. The Principal *Contractor* shall keep an on-site record of all incidents reported in the form of OHSA GAR Annexure 1. In the case of accidents/incidents, Eskom may conduct an independent investigation. The *Client* will provide the Principal *Contractor* with 32-95 procedure

Emergency Preparedness

The Principal *Contractor* shall, in consultation with the *Client*, develop and submit to the *Client* an emergency response plan from a review of potential emergency scenarios before commencement on site which will include, but not be limited to:

- Escape procedures and routes
- Employee accounting systems after emergency
- Rescue and medical duties
- Means and procedures for reporting emergencies
- Persons to be contacted for information
- Emergency alert systems
- Contact list of emergency service providers

The emergency plan shall include training of employees to deal with such emergencies and shall form part of the H&S plan. The Principal *Contractor* shall advise the *Client* or his agent within 24 hours of any site emergency occurring together with the action taken.

2.4.5 *Client's* Considerations and Management Requirements

2.4.5.1 Injury Statistics

The Principal *Contractor* shall report monthly injury statistics to SRM on the first of every month and in the case where the first is on the weekend then it must be reported on the first working day of the month

2.4.5.2 *Client's* audits

The *Client* will from time-to-time conduct audits of the Principal *Contractor*'s activities to ensure compliance with *Client*'s requirements and specification.

2.4.5.3 Permits and Authorizations

The Principal *Contractor* shall ensure that a written work permit and/or authorisation are obtained from the *Client* prior to commencement of any work to be done on the plant. When completing the application for a permit to work, the responsible person shall ensure that any special requirements, such as hot work, or working in a confined space, is stated in the application.

All work permit requests must be accompanied by a method statement stating:

- The scope of work to be undertaken
- Identification of hazards and risk assessment of the proposed work
- Mitigation strategies to control, reduce or eliminate the identified hazards
- Safe Working procedure
- Training strategies for employees
- Equipment to be used
- Process for evaluation of employees' physical and psychological fitness
- Other information deemed necessary, as stipulated in the Plant Safety Regulations and Operating Regulations for High Voltage Systems.

2.4.5.4 Public Health and Safety Information

The Principal *Contractor* shall ensure that each person visiting a site shall be made aware of the dangers likely to arise from on-site activities and the precautions to be taken to avoid or minimise those dangers. Appropriate health and safety signage shall be posted at all times.

2.4.5.5 Facilities

Principal *Contractor*s shall comply with the requirements of CR 28 (We need to re look at the phrasing of this statement depending on whether the y supply or we supply).

2.4.5.6 Medical Surveillance Program

Where Principal *Contractor* employees are exposed to occupational health hazards and risks that may have adverse effects to their health and/or lead to occupational diseases e.g. inhalation of dusts, exposure to noise, etc, the Principal *Contractor* shall establish a medical surveillance program. The program shall include all high-risk occupations as specified in the Construction regulations i.e. crane operators, construction vehicles, mobile plant operators,

Medical screening shall be conducted by an Occupational Health Practitioner with either the SA Health Profession's Council or SA Nursing council. Medical screening shall be conducted as per the following frequencies:

- Pre-employment
- Periodic medical screening
- Post-employment and
- When the scope of work or individual's medical condition (which has the potential to affect their ability to perform their duties) changes.

2.4.5.7 Non-compliance and Penalties

Eskom will view the following at-risk behaviour in a very serious light:

- Disregarding any requirements contained in OHSA, this document, site specific health and safety requirements and plan.
- Performing an unsafe act or creating an unsafe condition that could pose a danger to themselves or to others.
- A Principal *Contractor* allowing any of their employees or sub*Contractor*'s employees (including casual labourers, or labour broker employees) to work on any site without ensuring that each employee has received proper training.
- If any of the above (inclusive but not limited to) are noted, it may result in cancellation of the contract.

2.4.6 Safety notification Arnot Power Station GMR 2.1

The following serves as a compliance and notification instruction with reference to the OSHACT, Act 85 of 1993 and any amendments thereto; BCEA and LRA of South Africa.

- All safety related incidents (Category A, B&C; Fire Incidents; Usage of Fire Extinguishers and Near misses) shall be immediately notified to the ARNOT Power Station Safety Risk Management Personnel.
- All Category C incidents shall be immediately notified to the Project Manager, either telephonically or in person.
- All personnel are allowed to wear Safety Harnesses whilst walking through plant only if they are secured properly onto the person and no loose sections of the harness drags onto floors, gratings, etc. where it can get caught and restrict a person's movement.
- During working on elevated positions all personnel, including scaffolders to use Safety Harness, which they shall attach onto Lifelines or secure as per the *Contractor*s Fall Protection Plan, which each *Contractor* shall have written and available on site for perusal, as and when required.

- All Safety Harnesses shall comply with:

  - SABS EN 362:1992; 363:1992; 362:1992; 365:1992, 364:1992 Codes of Practice.

1. In terms of Section 16.1 of the OSHACT, "Every chief executive officer shall as far as be reasonably practicable ensure that the duties of his *Employer* as contemplated in this Act, are properly discharged." Basically, every employee, permanent/temporary/part-time/sub-contracted onto the ARNOT Site shall be treated as an "employee" in terms of the Act whilst under your "direct supervision and care".

2. All employees as stated in 5 above have a right to "free issue" safety equipment, which shall be supplied to them prior to commencement of work. The equipment shall comply to the relevant SABS standards and shall be in proper working condition, clean and undamaged whilst working on the ARNOT Site.

3. In terms of the BCEA and LRA all employees shall be afforded a fair minimum wage, including allowances for meals and transport, if not provided, which has been agreed and set by the relevant Bargaining Councils, which form part of the Acts.

4. All employees shall be granted 3 breaks during the course of a 12-hour shift (1x 15 minute break in the morning; 1 x 30-minute lunch break midday; and 1 x 15-minute break in the afternoon). Refreshments or meals shall be provided or be the responsibility of the *Contractor* (*Employer*). Employees cannot be allowed to work without having proper meals or refreshments.

5. All *Contractor* employees entering the ARNOT Power Station site shall be medically fit. A full medical examination shall have been carried out by a Registered Occupational Health Worker who shall issue a certificate confirming the medical fitness of the employee. The examination shall consist of an eye test, heart function, lung function, chest x-ray, blood pressure, hearing function, previous occupational injuries, epilepsy, allergies, asthma and verification of work in elevated/confined spaces. Basically, a full evaluation (a Red Ticket) shall be done and only those that pass these examinations shall be allowed to work on ARNOT Power Station.

6. In terms of Section 8.2 & 18.3 of the OSHACT, *Employer*s shall ensure that employees working at ARNOT Power Station are trained in the hazards associated with the tasks and the precautionary measures are taken in the interest of health and safety. The responsibility of shall include compliance and adherence to the Eskom Plant Safety Regulations, Permit to Work System and Emergency Care.

7. All *Contractor* s to ensure that the ARNOT Emergency Alarm is activated for serious injuries and the injured shall not be ‘moved’ by the *Contractors* staff unless in a condition which threatens the injured or other parties’ life. Movement of injured persons (employees) shall be done by a trained First Aider, who shall be at the site at all times during the work phase.

8. All *Contractor*s shall send a Safety Officer/Representative to all Safety Meetings arranged by the Power Station.

9. Safety Officers shall be at site or as reasonably practical to ensure that all hazards’ risks are identified and corrective action is taken.

10. All *Employer*s shall ensure that any employee disregarding a safety instruction is not allowed to be a risk to the *Contractor*, ARNOT Power Station or other parties whilst on this site. The appropriate disciplinary action shall be taken against these employees.

11. The *Contractor* shall have daily Toolbox talks, periodic site inspections, job observations, risk assessments, safety equipment checks and safety talks with all employees.

12. Safety Induction will be done by the Power Station on prior arrangements but is not the minimum requirement. Induction and hazards training shall be done by the *Contractor*.

13. In term of Section 37.2 of the OSHACT, you the *Contractor* will ensure compliance with all requirements of the OSHACT and any instruction/notification that enhances those requirements.

14. All *Contractor*s to ensure that a Safety Manual is completed prior to working on site and the relevant appointees are fully conversant with their responsibilities are trained and competent in those requirements, training proof is available and appropriate re-training is done.

15. *Contractor*s to ensure that all staff, whether permanent/non-permanent/supplied by Labour Broker are competent in their relevant disciplines that they are employed/contracted in and all proof of training, experience, etc. is available and is current. Appropriate re-training shall have been done.

16. Due to all staff being under the “direct supervision and control” of yourself, they shall and will be treated as an ‘employee’, as defined in the OSHACT, Act 85 of 1993.

17. All equipment, welding panels, compressors, pneumatic tools, electrical equipment shall comply with a relevant SABS Code of Practice and all documentation related to this shall be made available as and when required, except for welding panels which shall only be connected by ARNOT Electrical Department with a Certificate of Compliance submitted prior to request. All pneumatic tools shall have had an inspection covering condition of pressure components, including piping, bolting, spring loaded bolts, safety devices and controls. A certificate must be issued by the hire company to the Main/Sub-*Contractor* confirming the tool is in a good and acceptable working condition. Proof of inspections must be issued by Hire Company to lessor prior to bringing onto ARNOT Power Station Site.

CLARIFICATION:

All staff whether permanent, non-permanent, part-time, sub-contracted, and labour only supply is your responsibility in terms of “direct supervision and control” and as the Main *Contractor*.

All *Contractor*s to ensure compliance to the above requirements and any non-compliance or contravention shall be considered in breach of the contractual and legal requirements and serious action shall be taken by the Project Manager with or without consultation with the Department of Labour.

Contractor Site Manager *Site* Supervisor ----------	----------	----------
Print Name	Signature	Date

Contractor Director / CEO ----------	----------	----------
Print Name	Signature	Date

2.5 Environmental constraints and management

The management and staff at Arnot Power Station are committed to generate low-cost power without compromising its responsibility towards the natural environment. Arnot Power Station management has decided to implement and align its environmental management system in compliance with SABS ISO 14001:1996 as a means of managing impacts to and ensuring continual improvement of the environment in which it operates.

The *Contractor* needs to comply with ISO 14001 on environmental management.

The environmental policy for Arnot Power Station is set out below:

We are committed to sustainable development and will actively work to reduce the impact on the natural environment resulting from the power generation process.

We commit to continual improvement in our performance and aspire to minimum harm to people and the environment

Whenever we conduct our business, we will:

- Develop, implement and maintain an environmental management system that is consistent with internationally recognised standards.
- Effectively and efficiently manage the natural resources required to generate electrical power
- Comply with the requirements of environmental legislation and adhere to Eskom's corporate policies and procedures on environmental management.
- Set and achieve targets, that include preventing pollution, to address our environmental aspects and impacts
- Develop our people and provide resources to meet our targets
- Communicate and engage with our employees, clients, regulatory authorities and suppliers to build relationships based on integrity, honesty, openness and involvement to meet the requirements of this policy
- Increase environmental sensitivity and awareness among station management, employees and the community and achieve active involvement of all parties, with respect to environmental matters

And promote Arnot Power Station and Eskom as environmentally responsible organisations to outside parties

We will review and report our progress regularly and ensure this policy remains relevant to the needs of our stakeholders. We will be satisfied when we achieve our targets toward minimum harm to people and the environment and are valued by our clients and the communities in which we work.

2.6 Quality assurance requirements

2.6.1 Quality management system

The *Contractor* provides the complete QA&QC documentation including that of his Subcontractor(s), for all Plant, Material and Equipment, in compliance with SANS 9001:2008 Edition 4, "Quality Management Systems - Requirements", and the *Employer's* standard GGS 0462 Rev 1 "Quality Requirements for Engineering and Construction Works in Generation"

The *Contractor* further ensures that the Subcontractor(s) programmes comply with the requirements of the Works Information

The *Contractor* notifies the *Project Manager* of any changes to the Quality System and obtains agreement prior to implementation on existing orders and contracts, or sub orders and subcontracts.

2.6.2 Quality documents submitted with the tender

The *Contractor* submits a copy of his quality policy and quality system procedures relevant to the *Works*.

The *Contractor* also submits a typical quality control plan.

The *Project Manager* evaluates the *Contractor*'s capabilities with regards to quality assurance and quality control based on these submissions and the performance history of the *Contractor*. The *Project Manager* performs pre-award assessments where necessary, giving further information to aid the selection process.

2.6.3 Quality documents submitted after the contract date

The *Contractor* submits a fully detailed Quality Assurance Programme (QAP) for acceptance by the *Project Manager* within four weeks of the *Contract Date*.

The documents submitted by the *Contractor* shall include the following:

- Copy of the Quality Manual
- Copy of the Quality System Procedure
- Copy of the Contract Quality Management Plan
- Copy of Quality Control Plans
- Copy of the proposed index of the QA/QC, inspection and test records

The *Contractor* will further submit the following documents during the course of the contract:

- Non-conformance reports (NCR's) raised by the *Contractor*
- Notification of any planned changes to the *Contractor's* quality manual, quality system procedures, contract quality management plan or quality plan for acceptance by the *Project Manager* prior to implementation
- Concession/production permit applications and supporting documentation
- Data books and/or data packages

2.6.4 Contract quality management plan requirement

The *Contractor* prepares a contract quality management plan that, where appropriate, indicates the following:

- Indicates the interface with the *Contractors* quality system and applicable documents such as procedures and work instructions
- Establishes communication channels between the *Contractor* and the *Project Manager* in respect of quality and the integration of such with the prescribed contract communication channels
- Indicates how specific Sub*contractor*s will be monitored
- Identifies items or activities for which quality control plans will be prepared
- Identifies the specifications, drawings and acceptance criteria for material for which quality control plans are not required
- Identifies the areas or processes requiring special controls
- Identifies the *Contractor's* Management Representative and personnel responsible for the control of quality activities and their relationship to the *Contractor's* management structure
- Identifies the documents which are to be submitted to the Project Manager
- Indicates the *Contractor's* quality monitoring programme

The *Contractor* periodically updates the contract quality management plan to reflect changes in any of the above details. The frequency of such updates is determined by the Project Manager but will not be greater than one year.

2.6.5 Quality control plan

The *Contractor* quality control plans cover inspection and test proposals for items or activities to be supplied as part of the *works*.

The quality control plan indicates the following as appropriate:

- The identification of the item
- The material
- A list of the sequence of operations including inspections and tests
- The identification of the specification, drawings or procedures for each operation
- The acceptance criteria with reference to the appropriate technical specification, in-house, national or international standard and relevant clause number
- The inspections and tests the *Contractor* has nominated for hold and witness points and it is shown in the Accepted Programme.
- During contract execution no actions to provide the *Works* are implemented at any of the *working areas* before the relevant quality control plans and procedures are accepted by the *Project Manager.*
- Proof of the *Contractor's* personnel competence in terms of Reg 18 (5 and 6) of the OHS Act is submitted to the *Project Manager* for acceptance prior to the commencement of any work on Site and is shown in the Accepted Programme.

Quality control plans with hold and witness points are supplied to *the Project Manager* for his review and acceptance 15 days before the start of each of the following phases and or stages and it is shown in the Accepted Programme:

Investigation phase

i. Design and engineering phase

- Technical clarification stage.
- Design freeze stage

ii. Production engineering phase

- Procurement, fabrication and delivery stage.
- Factory acceptance test stage

iii. Construction and erection phase.

iv. Commissioning phase

- SIT stage
- Commissioning stage.
- SAT stage.

v. Operational test phase.

2.6.6 Access to the *Contractor's* and subcontractor(s) premises and facilities

The *Contractor* and/or its Sub*contractor* gives access to the *Supervisor* and/or the Authority/Agency and the Regulator where appropriate to their premises and facilities at reasonable times to conduct quality assessments, audits, surveillances and inspections to establish compliance with the contractual requirements.

2.6.7 Inspection and testing

The *Contractor* gives at least 72 hours advance notification to the *Supervisor* or the Authority for inspection/test and hold or witness points, which require their attendance. The *Contracto*r confirms readiness for inspection at least 24 hours prior to the test.

The *Contractor* ensures that all work has been fully inspected, accepted and documented prior to requesting any inspection by the *Supervisor*.

2.6.8 Quality records

The *Contractor* prepares and submits to the *Project Manager* an Index of QA/QC and inspection and test records prior to the commencement of work.

The *Project Manager* determines which documents are to be submitted during the performance of work and reviews the index and request changes if required. The *Contractor* conforms to the Index approved by the *Project Manager*

The *Contractor* ensures all records identify the items, equipment and/or activities to which they pertain and collates indexes and securely stores the records in such a manner that they are readily retrievable.

The *Contractor* implements appropriate administrative controls to limit access to prevent inadvertent loss of or damage to records.

The *Contractor* stores all quality records. The *Contractor* only destroys or discards quality records with the approval of the *Project Manager*.

The *Contractor* presents on completion of the works all quality records in the form of a data package. The package is indexed and shows the entire contents.

2.7 Programming constraints

2.7.1 Design and construction

2.7.1.1 Electrical switchgear rooms access

Safe access to electrical switchgear rooms will be dependent on the availability of unit outages and plant conditions.

It will not be possible for outages or complete isolation on certain electrical switchgear rooms i.e. DC Station Board, Battery Room etc., therefore it is of utmost importance to ensure compliance with necessary safety regulations and prescriptions for work to be carried out under these conditions.

This will have to be included acceptable programme with realistic time frames and in the *Contractor's* risk register.

The following to be noted and catered for:

- Permanent supervision, toolbox talks and proper risk assessments per area
- Compliance to PPE category 2A under certain conditions
- Inconvenience due to outage plan changes and short notices

2.8 *Contractor*'s management, supervision and key people

A detailed project organisational structure and resource plan, accompanied by CVs of key personnel, is provided in Appendix. Further detail, as required in the next paragraph, is supplied to the *Project Manager* for acceptance within 1 week after the Contract Date.

The organogram distinguishes between the various types of labour (i.e. skilled, unskilled etc.) and the position level as well as indicate the structure and responsibilities during the different phases. As a minimum it addresses the following:

- Project management
- Documentation management
- Configuration management
- Planning and programming
- Site management
- QA / QC
- Safety
- Technical Clarification
- Design / Engineering
- Procurement
- Manufacturing
- Erection and Installation
- Commissioning
- Acceptance Tests

2.8.1 Design Office

For the proper co-ordination and execution of the *works* from the *starting date* to the *defects date,* the staff of the design and administration office is properly qualified and competent in fossil fired power station operations.

2.8.2 Key technical, training and management personnel

The *Contractor* provides the following personnel resources to provide the Works:

2.8.2.1 The *Contractor's* Project Manager

The Project Manager has previous experience in handling a project of this size and complexity under the NEC 3. His responsibilities include the overall co-ordination of the project, technical and commercial aspects. He is assigned to the project on a full-time basis from the Contract Date until Completion of the whole of the *works*.

2.8.2.2 Project planning personnel

An experienced full-time individual for the purposes of project planning under the NEC 3 to meet the requirements of the Contract from the Contract Date until the Completion of the whole of the *works*.

2.8.2.3 Specialist engineers

The specialist engineers are responsible for the design review, verification, formulation, engineering, FAT, installation, commissioning, SIT, SAT, development and formulation training manuals as required for the Works from the Contract Date until Completion of the whole of the *works*
Specialist engineers in the following fields are also employed by the *Contractor*:

Control and indicating equipment

- Design and installation
- Software and Hardware interfacing
- Programming
- Management and monitoring
- Alarming
- Mass notifications
- Control and communication network
- Graphics and layout

Power supply requirements
Management server and client's setup and configuration

Civil Engineers

- Demolition
- Design and construction
- Structural design and reviews
- HVAC
- Ergonomics

Responsibilities also include the solving of technical problems and technical liaison with all major parties involved in the project for the whole duration of the contract for the purpose of providing the Works.

2.8.2.4 QA &QC staff

The *Contractor* provides staff with proven experience in developing QCP and maintaining QA & QC measures in accordance with section 2.6 of the Works Information, from the Contract Date until Completion of the whole of the *works*.

2.8.2.5 Training personnel

The *Contractor* supplies qualified and experienced staff for the purposes of formal training, in all aspects of the *works*.

2.9 Invoicing and payment

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 showing the amount due for payment equal to that stated in the *Project Manager's* payment certificate.

The *Contractor* shall address the tax invoice to Eskom Holdings SOC Ltd and include on each invoice the following information:

- Name and address of the *Contractor* and the *Project Manager.*
- The contract number and title.

- *Contractor*'s VAT registration number.
- The *Employer*'s VAT registration number 4740101508.
- Description of service provided for each item invoiced based on the Price List.
- Total amount invoiced excluding VAT, the VAT and the invoiced amount including VAT.
- (add other as required)

Add procedures for invoice submission and payment (e.g. electronic payment instructions)

2.10 Insurance provided by the *Employer*

The *Employer's* Insurance Policies is reviewed and may be revised annually on the annual insurance policy maturity date at the end of March each year when the *Contractor* is advised to inform himself of such updates on the above website. Claims procedures and claim forms are also available from this website. If Marine insurance is applicable, the procedure for initiation of this insurance cover is also available from this website.

2.11 Contract change management

To ensure a standard implementation methodology and that continuous improvements from subsequent units are back fitted to units already commissioned, the *Contractor* is responsible for the management of change of software and hardware until Completion of the whole of the *works*.

The *Contractor* develops implements and maintains a DCR (design change request) procedure. The DCR process is submitted to the *Project Manager* for acceptance, prior to the *Contractor* implementing it.

2.12 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.

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

The *Contractor* provides training for the *Employer's* personnel on systems directly applicable to the *works*. Training for Operating, Maintenance and Engineering staff takes place on site or at the *Contractor's* premises. If it places at *Contractor's* premises, the *Employer* is responsible for traveling and accommodation costs.

No training shall be allowed off site during construction and erection phase. The Employer's local training facilities are suitably sized air-conditioned rooms, as well as a trainer desk, an overhead projector and a white board.

At Conceptual design freeze (i.e. after clarification), the *Contractor* submits a training schedule for acceptance by the *Project Manager*, including a list of all courses and documentation for each course.

Practical hands-on training during the whole contract implementation forms an integral part of the training process.

Training in all categories a, b and c detailed in section 5.2.6.2 below is completed before the start of commissioning phase of the control and indicating equipment.

The *Contractor* shall develop a training schedule with the consideration of staff constraints and shows these dates in the Accepted Programme.

2.14 Training workshops and technology transfer

3. Engineering and the *Contractor*'s design

3.1 *Employer*'s design

The *Employer* will provide the following documentation/drawings for this Works Information:

3.1.1 Electrical Designs

a) Arnot Single Line Diagram with Protection Schemes numbers
b) Quantity of Protection Schemes Required
c) Eskom MV and LV Protection Philosophy
d) Electrical Heat Loads
e) Site Layout Information
f) LV Incomer and Main Feeder Standard Schematics
g) Existing MV Boards Schematic Drawings (with Switchgear Schedule and GA's)
h) Existing Substation Layouts with New Buszone Panels
i) Conceptual Engineering Work Station Drawing
j) Low Voltage Compartment
k) List of MV and LV Boards

3.1.2 Control and Instrumentation (C&I) Designs

C&I Scope to be performed by the *Contractor* include:

a) Planning, co-ordinating and executing all cold commissioning activities
b) Performing all functional tests
c) Providing connectivity server together with accompanying software that will be required to achieve interface to the Station Historian
d) Providing all interfacing for time synchronization for the protection equipment to the GPS based master station

3.1.3 Low Pressure Services (LPS) Designs- HVAC

The new protection and EWS equipment is designed for a working lifespan of at least 15 years in a controlled environment which is in accordance with 240-56355731 Environmental Conditions for Process Control Electronic Equipment used at Power Stations, whereby temperature is controlled at 22 ^{o}C (± 2 ^{o}C).

3.1.3.1 Design Inputs

The design parameters are as follows:

Outdoor Conditions

a) Summer: Ambient Temperature = 35°C DB ; 22° WB

b) Winter: Ambient Temperature = 2°C
c) Site elevation: 1720 m above sea level

Indoor Conditions

Table 1: Required Room Temperatures and Humidity

Item	Area/Building	Indoor Temperatures	Relative Humidity
1	Switchgear rooms, and Unit Board rooms	22°C±2°C	75%max, no condensation

3.1.3.2 HVAC Design

The heat load and airflow analysis were used to determine the size of the HVAC plant required for the respective areas as detailed by the HVAC floor layout drawings. The supplier technical data sheets have been used to provide a high level selection of units required to service the heat loads.

3.1.3.3 System Description- Direct Expansion (DX) Package Units

The affected substations are to be serviced by cooling package units or similar units. The package unit is to be supplied complete evaporator and condenser sections which are connected via a refrigerant circuit.

The unit is to be equipped with evaporator belt driven fan which enables air volume and static pressure to be adjusted as required. The condenser section is to be equipped with primary washable filters for dusty environment, and direct driven condenser fans. The refrigerant circuit is to be equipped with compressors, high and pressure switch, access valves, 4-way valves, filter drier, electronic expansion valve, strainer, accumulator, solenoid valve, bypass capillary tube, evaporator and condenser coils, check valves, compensator and capillary tube. The HVAC system in each room will be equipped with running and standby units.

The HVAC package units will be placed at a suitable location outside the switchgear rooms, on the operating floor.

The equipment is to be capable to interfacing with a DCS

3.1.3.4 Air Distribution System

Filtered and conditioned air is to be supplied from the package units to the different spaces via externally insulated ducting and matching air terminals. The air is to be returned to the unit via return air ductwork during normal operating conditions and exhausted to the outside by means of wall mounted or ducted axial flow fans during free cooling or full ventilation conditions.

Fresh air is to be provided to various rooms via the fresh air intake of the package unit, supplying 20% fresh air to the return air side. The package unit fresh air intake side is to be equipped unit and be fitted with washable primary air filters and disposable secondary (bag type) air filters (to 85% Dust Spot Efficiency - EU7). Smoke extraction capability will be required in the event of a fire.

3.1.3.5 Operating Design and Control Philosophy

The HVAC equipment will be configured to operate on running and standby mode for redundancy, including automatic change over between the units in case of failure of any one unit and at pre-set intervals to allow equal running time between the units. In case of common controller failure (which controls the redundancy and change over between redundant controllers) each unit must be able to run and control the set points on its own. For example, controls should be able to switch over operation of the pumps at specified intervals, for instance

once every week, to ensure equal operating time of both pumps. Manual override switch will also be installed to have any HVAC equipment switched on by maintenance when required.
The control system will be able to generate alarms that will be routed to DCS for monitoring & control purposes.

3.1.3.6 Equipment Selection and Power Requirements

Typical data sheets were used for equipment specifications. The details for each room

Power requirements for the HVAC equipment are found in appendix 18. The power supply that will used for HVAC will be 380V, 3 phase, 50Hz.

Dedicated HVAC boards are to be provided for each room.

3.1.3.7 Equipment details

The equipment details that will used in all the affected Switchgear rooms for the HVAC system are defined in appendix 18

In addition to air conditioning units and fresh air units, economy fans shall be provided to be utilized during low ambient conditions as well as for smoke extraction

3.1.4 Civil and Structural Design

No Civil and Structural Designs

3.2 Parts of the *works* which the *Contractor* is to design

The *Contractor* is responsible for the design of the following as a minimum:

a) Protection and control schemes in accordance with section 3.2.1
b) Engineering Work Station in accordance with section 3.2.2
c) C&I interface in accordance with section 3.2.3
d) HVAC systems in accordance with section 3.2.4
e) Civil and Structural in accordance with section 3.2.5

3.2.1 Switchgear Protection and control schemes

The scope of the switchgear protection and control scheme includes the provision for the engineering, design, procurement, manufacture, factory acceptance testing, supply, delivery, off-loading, storage, erection, installation, site testing and commissioning of all equipment forming part of the switchgear protection and control scheme.

The works for the MV and LV switchgear protection and control schemes includes:

a) Decommissioning and removal of the existing protection schemes (MV and LV switchgear),including the removal of the existing LV compartment door
b) Provision for new protection schemes (MV and LV switchgear), with new LV compartment door
c) Decommissioning and removal of the existing buszone protection scheme, including the panel
d) Provision for new buszone protection schemes (one standalone panel per board)
e) Equipping the existing unequipped LV feeders for the supply of the air conditioning units
f) Provision for all the required power (HVAC units) and protection cabling

3.2.1.1 Reference Documents

The *Contractor* provides the switchgear protection and control schemes in strict accordance with the requirement stated in this technical specification. In addition to the requirements of this Works Information,

the Works conform to the documents and drawings listed in section 3.1.1 of this Works Information as well as other documents forming part of the references.

The applicable revisions and amendments of the reference documents are the latest versions in force at the time of the contract award.

Unless specifically stated in this technical specification, the *Contractor* proposes the specifications required for the detail engineering, fabrication, installation and commissioning. Such specifications are supported by International specifications, standards; codes, practices and their use are accepted by the *Project Manager*.

3.2.1.2 Drawing Convention

Where reference is made in this Works Information to the normal position of auxiliary contacts, the convention is such that the contacts are in the normal condition when:

a) Circuit breaker truck is in the service position
b) Circuit breaker shown in open position
c) Power and control supplies are "off"
d) Spring not charged

Circuit diagrams produced by the *Contractor* comply with this convention.

3.2.1.3 General Requirements

The *Contractor provides the protection schemes, which includes buszone and arc protection, for all the MV and LV switchboards listed in Appendix 4*

The *Contractor* provides all the protection devices and auxiliary equipment required to perform the functions defined for the different protection schemes. The main protection functions are implemented by the use of IEDs.

Other protection functions required, such as internal arc and bus zone protection are performed by separate IEDs. The *Contractor* designs a comprehensive protection scheme that defines the interfaces between all relays as well as the other related systems.

The *Contractor* makes provision for the supervision and indication of the status of wiring and signals from all the tripping relays to the external trip coils.

The design of the protection schemes are presented in the form of Protection Control Functional & Interface Diagrams and detailed design drawings together with the related documentation describing the functions of the different devices used.

Protection Control Functional & Interface Block Diagrams for typical circuits defined in section 3 are submitted with the tender documentation for evaluation. All indicated optional functionalities are catered for and tendered for separately on an individual basis. Preliminary designs for the 4PA0100, 4PA0700, 4PA0800 and Buszone protection schemes are submitted with the tender documentation for evaluation.

Although the *Contractor* is permitted to alter the designs of the circuits to suit their products, no functionality may be omitted after Design Freeze without the written consent of the *Project Manager*.

All IEDs are pre-programmed with the respective logics that enable the protection scheme to comply with the specification as provided during the engineering phase. The programmable logics are also aligned with the relevant design drawings that define the functionality of the scheme. No logic programming is required after delivery of the equipment, but the application of conventional functional settings is necessary.

The *Contractor* also provides protection scheme for the LV switchgear reticulation circuits listed in Appendix 4 of this technical specification.

The *Contractor* supplies at least two licences for the software as a minimum for application of settings and for IED logics.

All IEDs and auxiliary relays provided by the *Contractor* are type tested by an independent laboratory and these results are made available to the *Project Manager* for evaluation and acceptance. In addition to independent laboratory tests, the protection and associated equipment offered are evaluated, tested and approved by the *Project Manager* as per 240-56227589: List of Approved Electronic Devices to be used on Eskom Power Stations and 32-333 prior to offer.

All IEDs, auxiliary relays and their modules have a proven service record of at least five years and a combined effective service life of one hundred years. An international and national relay reference sales list is provided by the *Contractor* with tender submission.

Tendered equipment is designed for a working life-span of at least 15 years in a controlled environment which is in accordance with 240-56355731 Environmental Conditions for Process Control Electronic Equipment used at Power Stations, whereby temperature is controlled at 22 ^{o}C ± 2 ^{o}C. All common plant substations are pressurised and their ambient temperature can be taken to range between 5 ^{o}C to 40^{o}C. Written guarantees to this effect are provided. The *Contractor* also states the maximum allowable operating temperature to achieve a 15 year life span of the devices.

The *Contractor* provides the information regarding re-calibration of the electronic devices necessary to keep them in perfect working order or any other required intervention by the OEM, subsequent to the sale of equipment that has a financial impact on the *Employer*.

All future upgrades and modifications of the electronic devices are communicated timeously to the *Employer.* Any malfunction of the same device experienced by other users or known to the *Contractor* is communicated to the *Employer.*

3.2.1.4 Power Supplies

Auxiliary power for the protection systems will be provided from an external DC power supply system provided by the *Employer.* The nominal rating of the voltage supply will be 220V DC.
IEDs, auxiliary relays and other DC equipment are capable of operating continuously at extreme tolerances of the DC supply voltage, which is 220V DC ± 20%. The equipment is therefore capable of operating at either 176V or 264V continuously without detriment to the protection system.

All indications are non-volatile i.e. if the DC supply fails, then on restoration of the DC supply the indication resumes the status that it had before the supply failed.

3.2.1.5 Protection Devices

The *Contractor* supplies protection devices that conform to the requirement stated below in the following subsections.

3.2.1.5.1 *Intelligent Electronic Devices*

a. Design and Construction

The *Contractor* designs and provide Protection schemes for all the power circuits (i.e. incomers, feeders and others) consisting of IEDs constructed as a 19 inch rack mountable unit or according to *Contractor's*

standard arrangement. No terminals are provided on the 19 inch rack. Where required, the tails are suitably ferruled with a minimum length of two meters.

All IEDs are equipped with screen or display facility to allow for human interface. The contents are clearly visible from a distance of 2 m and at an angle of 30° from either side. This display is of the Liquid Crystal Display (LCD) with anti-glare and non-blinking properties. The IEDs display makes it possible for the mimic of the circuit protected by the device to be illustrated on the display. The mimic shows as a minimum the status of circuit breakers (ON or OFF), status of earth switches, position of circuit breaker (connected or disconnected) and electrical parameters (voltage, current, power, etc.) for a particular circuit. The mimic should also display (indication only) an interlock on a device if present. No interlocking is performed via the IED, the existing Station philosophy utilising the mechanical interlocks will be maintained.

Provision is made for the local control of the breakers to be performed from the associated IED using an integrated control pad for local test purposes during maintenance only.

LEDs are required for indication of the operation of the alarm and protection functions within the IED and are an integral part of the device. The allocation of the LEDs to the different functionality is configurable to allow for flexibility during the engineering phase.

Split face IEDs, whereby the digital display is mounted on the door of the LV compartment and connected to the main processing unit by means of fibre optic cable, are preferred.

The devices are equipped with ports to allow for access to information via a communication link. These ports have the capacity that matches the data transfer requirements for the associated communication bus.

A label stating the firmware version is fixed to all IEDs. Information regarding the estimated data retention time of the storage medium used in the IEDs is provided to the *Employer*.

b. Functions

The protection, control, indication and data capturing functionalities are provided by the IEDs. All functions, settings and internal logic are programmable through the IED software and a personal computer (PC), except where otherwise stated.

The *Contractor* specifies and gives written details of protection functionalities that are inherently part of their IEDs but are not required by the performance specification.

A single IED is able to provide all the required main and back-up protection functions for the scheme in question as a minimum. The control and indication functions are also incorporated in the IEDs.

IEDs have measurement functions with analogue outputs as described under section 3.2.1 of this Works Information for each protection scheme. These analogue outputs are configurable by the user for ranges between 4 and 20mA. Response time for signals is 500msec for a step input of 80%.

The integration of the auxiliary functions such as the DC Fail and Trip Circuit Supervision (TCS) functions within the device is preferred. The IEDs have a self-monitoring function of both integral hardware and software that is done on a continuous basis. Any fault or irregularity is immediately alarmed to an output contact.

The random switching of the DC auxiliary supplies at high rate does not affect the functionality of the IED. Where required, the internal battery requirements for numerical IEDs (i.e. battery lifetime, type of battery etc.) are stated on a label attached to the front of the numerical device.

Unless otherwise specified, all IED are provided with manual-reset operation indicators for each function of the IED. These do not operate until the IEDs have operated. Resetting is accomplished without opening the case.

The IEDs have disturbance or event recording and data logging capability with the integral storage media. The information stored in the IED is accessible via the communication port. Information regarding the estimated data retention time of storage medium of the IEDs is provided to the *Employer*.

All IEDs have the capability to perform control, indication or monitoring, interlocking and data transfer functions via a communication bus. The IED's communication capability complies with IEC 61850 standard.

c. Software

Software installed on the IEDs for event or disturbance recordings, data logging, settings and marshalling or configuration is accessible via a dedicated communication link using engineering tools. This software allows information to be downloaded in COMTRADE format in accordance with IEEE C37.111-1991. All software required to perform the marshalling and settings of the IEDs is contained in one package.

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 at no additional cost. The specification is based on a requirement document and comprehensive risk analysis. The software is formally verified to ensure that it matches its specification.

All software purchased on this contract and subsequent software upgrades supports the latest Microsoft Windows operating system. The *Contractor* informs the *Employer* of any and all new releases. The latest software version is always compatible with the installed base of IEDs, which originally were compatible with the previous version of software that was compatible with the previous Microsoft Windows operating system. For example, if the existing software is only compatible with Windows 95, it is upgraded to Windows 7 (the latest Microsoft supported operating system).

All software and firmware are backward and forward compatible (i.e. the software on this contract is such that all future versions of software will be compatible with the installed base of IEDs).

d. Analogue Voltage and Current Inputs

The current inputs of the devices are rated at 1A. Where required, the voltage inputs are rated at 110V AC. The technical information (ratings, classes) of the instrument transformers can be found in the switchgear schedules and existing protection schematic diagrams in Appendix 5.

The IED is also provided with the digital inputs for the control and indication functions as determined by the schemes described in section 3.2.1

The configuration of the inputs is programmable. The minimum number of inputs required is provided in the C&I Interface Signals for MV Switchgear found in Appendix 16.

e. Output Contacts

The *Contractor* designs all protection schemes such that all output contacts of the IEDs have self-resetting capabilities, except for those linked to master trip and lockout functions, which have manual-reset capabilities.

Each protection scheme has at least two output contacts for tripping. The IED is also provided with the digital outputs for the control and indication functions as determined by the schemes described in section 3.2.1.

The configuration of the device's outputs is programmable. The minimum number of outputs required is provided in the C&I Interface Signals for MV Switchgear found in Appendix 16 and existing detailed MV and LV schematics in Appendix 5. Where required, some of the trip, alarm and indication outputs are channelled via the communication ports.

DC Fail and under voltage protection functions are facilitated by normally closed contacts. All other relays have normally open contacts.

f. Testing of Devices

The *Contractor* submits certificates and report stating that protection devices offered have been subjected to routine and type tests which cover at least the tests recommended in standard 32-333. The program of routine and type tests is submitted to the *Project Manager* for acceptance.

Unless otherwise specified, all IEDs are provided with suitable test facilities for VT and CT circuits to enable tests carried out on the IEDs while in position inside the panel without disconnecting any wiring or links. Test facilities are provided in accordance with standard 32-333.

Two copies of all test certificates are submitted to the *Project Manager* for acceptance once the tests have been completed.

3.2.1.5.2 Buszone Protection Relay

Buszone protection is implemented by utilising a numerical differential relay. These devices comply with the requirements of the 32-333 standard as a minimum.
Only a high impedance scheme is acceptable. This is so that the impact of cabling changes on the existing installation is avoided or minimised. The *Contractor* refers to the switchgear schedules and existing scheme drawings (both board and buszone panel) provided for details of the CT installed. The *Contractor* confirms the specification adequacy (i.e. ratios, burden, and classes) of the currently installed CTs for use in his/her scheme. The confirmation of the existing CTs specification adequacy is submitted with the tender documentation for evaluation. The *Contractor* verifies the status and performance of the existing CTs through inspections and routine testing and submits the outcome of the verification to the *Project Manager* for acceptance, during execution phase.

All devices are fitted with contacts which are self-resetting with exception of the tripping function.

The devices are provided with hand-reset operation indicators for each of the functions. The indicators do not operate until the relays have closed their contacts. Re-setting is accomplished without opening the case.

The protection schemes are provided with suitable test facilities to enable tests to be carried out on the device while in position on the panel without disconnecting any wiring.

The bus zone protection equipment is housed in separate panels designed to accommodate 482.6 mm (19 inch) type racks or the *Contractor*'s standard arrangement. The panels are constructed in accordance with Eskom Standard number 32-333.

Auxiliary power for the bus zone protection device will be provided at 220V DC nominal voltage rating from an external DC power supply system provided by the Employer. The AC power supply for the cubicle lighting will also be provided by the *Employer.*

DC line filters are installed in the bus zone system such that it protects the electronic components against voltage spikes.

3.2.1.5.3 Arc Detection System

The *Contractor* designs and supplies arc protection schemes that are integral part of the switchgear.

The arc detection system conforms to the requirement stated below in the following subsections.

a. Protection Relays

The arc protection function is provided by a device that accepts both light and current signals as input. These signals are detected simultaneously to initiate a trip and alarm.

The arc protection relay performs the high-speed tripping of the supply circuit breaker in the event of an arc fault when the current exceeds a pre-set reference value. The device have a maximum sensor detection function pulse delay time of less than 5 ms and subsequently issues a breaker trip pulse in a time of less than 10 ms from fault inception. The total (including breaker and arcing time) fault clearance time required is less than 100 ms from fault inception.

All devices are fitted with contacts which are self-resetting with exception of the tripping function.

DC line filters are installed in the arc detection system such that they protect the electronic components against voltage spikes.

b. Light Sensors

Arc detection is performed with light sensitive type elements located in the respective switchgear chambers (including segregated busbars between panels). The *Contractor* installs the new elements in exactly the same position as the existing elements to be decommissioned such that they completely cover the space to be protected.
The light sensors are not triggered by external light sources such as camera flashes or welding arcs.
The sensor has the degree of protection to operate within the boards' internal environmental conditions.
The *Contractor* verifies through insulation test the status of the existing wiring from the sensors to the LV compartment prior to use.

c. Monitoring

The internal arc protection system has a self-diagnostic (self-monitoring) function that prevents the relays from operating if a system (i.e. devices and sensors) fault is detected. It clearly indicates by means of an alarm indicator the fault and the location thereof.

The system gives an indication of the fault location (i.e. which compartment faulted) locally at the switchgear panel through an IED and remotely on the dedicated engineering station.
The power supply modules are continuously monitored and should provide an alarm in the event of failure.

d. Auxiliary Relays

Where required, the auxiliary relays are provided with the desired trip or indication function with the operation time of less than 50 ms. The auxiliary relays must comply with the requirements of 32-333.

Unless otherwise specified, all the relays are provided with manual-reset operation indicator/s for the dedicated function. The indicator/s does not operate until the relay has operated. Resetting is accomplished without opening the case.

Each relay has at least two output contacts for tripping and two output contacts for external alarms.

3.2.1.6 MV Switchgear Protection Schemes

Description of circuit protection schemes to be supplied by the *Contractor* for MV switchgear.

The *Contractor* reuses the existing interfacing primary equipment such as the CTs, VTs, Earth switches and Circuit breakers. The *Contractor* performs an inspection and testing of the interfacing primary equipment (CT, VT, Earth switches and circuit breakers), the secondary wiring from the primary equipment to the LV compartment backplate, and the inside LV compartment backplate wiring and terminals for the purpose of reuse if they pass all the prescribed tests.

The *Contractor* is responsible for providing all the secondary circuit wiring from the CTs, VT, earth switches and Circuit breakers, in the case of the existing wiring not passing the prescribed tests (i.e. Insulation test). The *Contractor* decommissions and removes the existing protection and control equipment, including the LV compartment door, with an exception of the wiring and terminals installed on the backplate which are to be reused by the *Contractor* if passed the prescribed inspections and tests. The *Contractor* submits the inspection and test results to the *Project Manager* for acceptance.

The *Contractor* reviews all the existing 2PA protection scheme drawings, then performs the physical inspection to verify the accuracy and alignment of the provided designs to the physical wiring in the panels and designs the new 4PA protection schemes reusing the existing wiring and terminals as much as it is possible. The *Contractor* develops a detailed protection scheme upgrade procedure per panel, clearly indicating each activity to be performed in order migrate the existing 2PA schemes to 4PA schemes. The procedure to be written such that even junior wiring personnel can use to wire the panel as required.

3.2.1.6.1 Numbering System

The “PA” numbering is a numbering system dating back to the 1980's. The first numerical represents the protection technology, 4 signifying phase 4 (an Eskom description meaning an IED). “PA” stands for Protection Auxiliary. The last four numbers signify the type of circuit being protected.

3.2.1.6.2 Motor Protection Scheme – 4PA0100 (Motors ≥ 1 MW)

Protection scheme is provided for all feeders to the MV motors with power rating larger or equal to 1MW. Each scheme includes the following functions:

a) motor differential protection,
b) three-phase thermal overload protection,
c) three-phase definite time overcurrent protection,
d) three-phase IDMTL overcurrent protection,
e) definite time earth fault element,
f) IDMTL earth fault protection.
g) negative phase sequence protection,
h) three phase undervoltage protection,
i) motor stall protection element.

In addition, the schemes have binary Input/output (I/O) facilities as well as analogue outputs. These input facilities are for external trip and close signals and to enable thermistors to decrease the tripping time of the overload elements. The trip outputs are latched.

The protection elements have setting ranges as detailed in Schedule A in Appendix 11. The characteristic curves of IDMTL overcurrent and earth fault protection elements conform to IEC standards.

Thermal overload protection monitors the current flowing into the motor. Based on these currents, it models the temperature inside the motor.

Negative phase sequence protection function is made available in the motor protection scheme. This function protects the motor against overheating caused by induced double frequency currents. The negative phase protection has an inverse and a definite time characteristic.

Motor stall protection function is available in the motor protection scheme. This function is preferably an overcurrent protection element set below the locked rotor current and a time delay set to the stall capability time of the motor. The time delay is adjustable over the range specified in Schedule A in Appendix 11.

Three-phase definite time undervoltage protection function is made available in the motor protection scheme. This function does not operate for the loss of a single-phase VT supply but only operates for the loss of all three phases after a predetermined period. The undervoltage protection function trips the motors for a sustained under voltage condition. The protection elements are energized from voltage transformers with secondary of 110 V phase-to-phase and 63.5 V phase-to-neutral. The elements are adjustable to operate in the voltage ranges specified in Schedule A and have drop-off/pick-up ratios greater than 95%. Setting adjustment is preferably continuously variable, but if adjusted in steps, these do not exceed 10%. The time delay is adjustable over the range specified in Schedule A in Appendix 11.

Other functions required in the motor protection scheme such as current interlock, long starting time, etc. are indicated in Schedule A in Appendix 11.

Provision is made for output analogue signals (i.e. current and power) from the IEDs. The *Contractor* provides separate measurement modules (i.e. transducers) for both current and power. Alternatively, the measurement modules are provided as an integral part of the protection IED. The *Contractor* also provides in the Rates Price Schedule both the takeout price for having separate measurement modules, as well as the price for transducers provided as an integral part of the IED.

3.2.1.6.3 Motor Protection Scheme - 4PA0400 (Motors < 1 MW)

Protection scheme is provided for all feeders to the MV motors with power rating smaller than 1MW. Each scheme includes the following:

a) three-phase thermal overload protection,
b) three-phase definite time overcurrent protection,
c) three-phase IDMTL overcurrent protection,
d) definite time earth fault element,
e) IDMTL earth fault protection.
f) negative phase sequence protection,
g) three-phase undervoltage protection,
h) Motor stall protection element.

In addition, the schemes have binary I/O facilities as well as analogue outputs. These input facilities are for external trip and close signals and to enable thermistors to decrease the tripping time of the overload elements. The trip outputs are latched.

The protection elements have setting ranges as detailed in Technical Schedule A in Appendix 11. The characteristic curves of IDMTL overcurrent and earth fault protection elements conform to IEC standards.

Thermal overload protection monitors the current flowing into the motor. Based on these currents, it models the temperature inside the motor.
Negative phase sequence protection function is made available in the motor protection scheme. This function protects the motor against overheating caused by induced double frequency currents. The negative phase protection has an inverse and a definite time characteristic.

Motor stall protection function is made available in the motor protection scheme. This function is preferably an overcurrent protection element set below the locked rotor current and a time delay set to the stall capability time of the motor. The time delay is adjustable over the range specified in Schedule A in Appendix 11.

Three-phase definite time under voltage protection function is made available in the motor protection scheme. This function trips the motors for a sustained under voltage condition and is provided for protection of MV motors. They are energised from voltage transformers with secondary of 110-volt phase-to-phase and 63.5-volt phase-to-neutral. The measuring elements are adjustable to operate in the voltage ranges specified in Schedule A and have drop-off/pick-up ratios greater than 95%. Setting adjustment are preferably continuously variable, but if adjusted in steps, these do not exceed 10%. The time delay is adjustable over the range specified in Schedule A in Appendix 11.

Directional earth fault is required if the option of a zero-sequence current balancing transformer is considered across the motor feeder cables since the MV system is resistive earthed with the MV motor neutral unearthed.

Other functions required in the motor protection scheme such as current interlock, long starting time, etc. are indicated in Schedule A in Appendix 11.

Provision is made for output analogue signals (i.e. current and power) from the IEDs. The *Contractor* provides separate measurement modules (i.e. transducers) for both current and power. Alternatively, the measurement modules are provided as an integral part of the protection. The *Contractor* also provides in the Rates Price Schedule both the takeout price for having separate measurement modules, as well as the price for transducers provided as an integral part of the IED.

3.2.1.6.4 Transformer Feeder Protection Scheme - 4PA0700 (Transformer > 10 MVA)

Protection scheme for the feeders of the transformer with the power rating larger or equal to 10MVA includes the following functions:

a) transformer differential protection,
b) three-phase definite time overcurrent protection,
c) three-phase IDMTL overcurrent protection,
d) definite time earth fault protection,
e) IDMTL earth fault protection.

The IDMTL overcurrent and earth fault are set as back-up protection for the transformer differential protection as well as protection for downstream circuits.

In addition, the IEDs have binary input facilities. These input facilities cater for external alarm and trip signals such as Buchholz, winding temperature, oil temperature and pressure relief protection. A minimum of eight binary inputs is required.

The protection elements have setting ranges as detailed in Technical Schedule A found in Appendix 11. The characteristic curves of IDMTL overcurrent and earth fault protection elements conform to IEC standards.

3.2.1.6.5 MV Interconnector Protection Scheme - 4PA0800

Interconnector protection schemes include the following functions:

a) line differential protection,
b) three-phase definite time overcurrent protection,

c) three-phase IDMTL overcurrent protection,
d) definite time earth fault protection, and
e) IDMTL earth fault protection.

The overcurrent and earth fault elements (i.e. IDMTL or definite time) are set as main protection for the interconnector and back-up protection for downstream circuits.

The *Contractor* specifies and supplies the fibre optic or pilot wire cables, which are suitable for the cable differential protection, to be installed by Others. Fibre optic links are preferred for differential protection application.

A synchronism check facility is provided for the changing of power supplies on a MV board, which is feeding from different sources. The synchronism check facility measures the three phase voltage quantities from the cable and busbar VTs. Once the three voltages are the same, in phase, magnitude, phase rotation and frequency, a closing signal is issued to the breaker of the normal supply and an open to the alternative supply after a period not exceeding 100 ms. This is done to ensure the make-before-break operation. Different set parameters are required.

A typical switching or operating procedure for the power transfer is as follows: Close the unit supply breaker (with unit supply cable VT alive) to energize the busbar (busbar VT dead and station supply breaker opened with station supply breaker cable VT dead). Vice versa is also applicable. This is a ‘Live line’, dead bus charge.

The protection elements have setting ranges as detailed in Technical Schedule A found in Appendix 11. The characteristic curves of IDMTL overcurrent and earth fault protection elements conform to IEC standards.

The *Contractor* provides output analogue signals (i.e. current and voltage) from the IED’s. These measurement modules are an integral part of the protection IED. The *Contractor* also provides a takeout price for having separate measurement modules (i.e. transducers) in the Rates Price Schedule.

3.2.1.6.6 Transformer Feeder Protection Scheme – 4PA1000 (Transformer < 10 MVA)

Protection scheme for the feeders of the transformer with the power rating smaller than 10MVA includes the following functions:

a) three-phase definite time overcurrent protection,
b) three-phase IDMTL overcurrent protection,
c) definite time earth fault protection, and
d) IDMTL earth fault protection.

The IDMTL overcurrent and earth fault are set as main protection for the transformer / feeder and back-up protection for downstream circuits.

In addition, the IED’s have binary input facilities. These input facilities cater for external alarm and trip signals such as Buchholz, winding temperature, oil temperature and pressure relief protection. A minimum of eight binary inputs are required.

The protection elements have setting ranges as detailed in Technical Schedule A found in Appendix 11. The characteristic curves of IDMTL overcurrent and earth fault protection elements conform to IEC standards.
The *Contractor* provides output analogue signals (i.e. current) from the IED’s. These measurement modules are an integral part of the protection IED. The *Contractor* also provides a takeout price for having separate measurement modules (i.e. transducers) in the Rates Price Schedule.

3.2.1.6.7 MV Incomer Protection - 4PA1200

Incomer protection scheme have the following functions:

a) three-phase definite time undervoltage protection,
b) three-phase definite time overcurrent protection,
c) three-phase IDMTL overcurrent protection,
d) definite time earth fault protection,
e) IDMTL earth fault protection.

The overcurrent and earth fault protection is utilised to provide the required current input for the arc detection interlock and also act as back-up protection for downstream circuits.

A synchronism check facility is provided for the changing of power supplies on a MV board, which is feeding from different sources. The synchronism check facility measures the three phase voltage quantities from the cable and busbar VTs. Once the three voltages are the same in phase, magnitude, phase rotation and frequency, a closing signal is issued to the breaker of the normal supply and an open to the alternative supply after a period not exceeding 100 ms. This is done to ensure the make-before-break operation. Different set parameters are required.

A typical switching or operating procedure for the power transfer is as follows: Close the unit supply breaker (with unit supply cable VT alive) to energize the busbar (busbar VT dead and station supply breaker opened with station supply breaker cable VT dead). Vice versa is also applicable. This is a ‘Live line’, dead bus charge.

In addition, the IEDs have binary input and output facilities in accordance with the scheme requirements for external trip signals.

The protection elements have setting ranges as detailed in Technical Schedule A found in Appendix 11. The characteristic curves of IDMTL overcurrent and earth fault protection elements conform to IEC standards.

The *Contractor* provides output analogue signals (i.e. current and voltage) from the IEDs. These measurement modules are an integral part of the protection IED. The *Contractor* also provides a takeout price for having separate measurement modules (i.e. transducers) in the Rates Price Schedule.

3.2.1.6.8 Bus Section (4PA1400) and Maintenance Isolator (4PA1400A) Control Schemes

The bus section and maintenance isolator schemes are used as control and indication device only without protection functions.
The details on the requirements of the scheme are given in Technical Schedule A in Appendix 11.

3.2.1.7 LV Switchgear Protection and Control Schemes

3.2.1.7.1 LV switchgear incomers and board to board feeders

The *Contractor* provides new protection scheme for the affected LV switchgear incomers and feeders in accordance with the Standard LV schematics in Appendix 8 and the requirements of this Works Information.
The *Contractor* reuses the existing interfacing primary equipment such as the CTs, VTs and Circuit breakers.
The *Contractor* performs an inspection and testing of the interfacing primary equipment (CT, VT, circuit breakers), the secondary wiring from the primary equipment to the LV compartment back plate, and the inside LV compartment back plate wiring and terminals for the purpose of reusing if they pass all the prescribed tests.

3.2.1.7.2 LV switchgear power supply for the HVAC

The *Contractor* is responsible for providing all the secondary circuit wiring from the CTs, VT and Circuit breakers, in the case of the existing wiring not passing the prescribed tests (i.e. Insulation test). The *Contractor* decommissions and removes the existing protection and control equipment, including the LV compartment door, with an exception of the wiring and terminals installed on the backplate which are to be reused by the *Contractor* if passed the prescribed inspections and tests. Generic technical requirements of these IEDs are as per subsections of section 3.2.1 of this Works Information.

3.2.1.7.3 LV Feeders for Air Conditioning Units

The existing substation rooms for the affected boards do not have air conditioning system to maintain the room temperature at the required level. The protection equipment is designed for a working life-span of at least 15 years in a controlled environment whereby temperature is controlled at 22 ^{o}C ± 2 ^{o}C.

The proposed units require two redundant supplies for high availability. The *Contractor* provides two power supplies for each of the dual supplied HVAC unit to be installed in all affected substations as detailed in section 3.2.4.The *Contractor* is responsible for all the works required for the selected unequipped spares on LV switchgear board, which includes equipping of the spare in accordance with the standard LV feeder circuit found in Appendix 8, selection, installation and commissioning of the required cabling. Refer to Table 2 for the pre-selected unequipped LV circuits with load estimates.

Table 2: Pre-selected unequipped LV circuits with load estimates

Substation	Load	Voltage, Phase	LV Power Supply 1	LV Power Supply 2
Two Unit Board	28kW	380V, 3 Phase	400V Turbine Non Essential Board	400V Turbine Essential Board
Two Boiler Board	28kW	380V, 3 Phase	400V Boiler Board A	400V Boiler Board B

In order to meet this requirement, the units have one supply from board A's and another from board B's as shown in table above. The circuits wiring will be as per the similar Arnot LV schematics attached in Appendix 8.

The *Contractor* submits with the tender documentation, a load list of the actual HVAC units indicating all electrical power supply requirements, which includes the rated voltage, running current and power (kW), for evaluation.

3.2.1.8 Arc Protection Scheme

a. General

The system protects the segregated breaker, busbar and cable chamber respectively in the case of an internal arc fault for air insulated MV switchgear.

The main protection device is mounted on the board incomer panels with the auxiliary devices in different panels as required.

b. Current Detection Methods

A three-phase CT connection from the board incomer or upstream feeder overcurrent and/or earth fault function is provided together with an arc sensing device (two-out-of-two measuring criteria). The current rating of the input to the device is 1A.

An overcurrent or earth fault signal is activated once the current on any one phase exceeds the reference values. This function has the capability to capture and display the three phase currents that caused the protection operation. The system is able to provide arc protection with low fault currents as well (i.e. smaller than 4 kA fault current).

Detection of overcurrent conditions is implemented to increase the stability of the detection system under normal conditions. This feature ensures that the system does not act on incidents where light is emitted without the existence of excessive current in the circuit concerned.

c. Circuit Breaker Failure Protection

The circuit breaker failure protection facility is provided by the arc protection system to trip the upstream feeder circuit breaker in case of an incomer breaker failure. A time delay of 100 ms is allowed for the main circuit breaker to operate before the breaker fail protection operates the upstream circuit breaker. The total tripping time does not exceed the switchgear internal arc test time, T_t (as defined in IEC 62271-200).

d. Busbar Chamber Protection

The function of this application is to detect and clear internal arc faults in the busbar chamber on a particular board. When any of the light sensors on the board detect an arc together with an overcurrent or earth fault current on the incomer feeder, it trips the incomer feeder, bus section breaker and all the feeder circuit breakers of the relevant zone.

The internal arc detection devices are applied to overlap in the bus section chamber, thus tripping only the faulty zone for an internal arc fault in the bus section chamber.

e. Protection of Circuit Breaker Compartment

The function of this application is to detect and clear internal arc faults in the circuit breaker chamber. Where multiple tripping is required the arc sensing devices detect an arc together with an overcurrent or earth fault current from the incomer feeder, it trips the incomer feeder, bus section breaker and all the feeder circuit breakers of the relevant zone.

f. Protection of Cable Termination Compartments

Feeders

The function of this application is to detect and clear internal arc faults in the feeder cable chamber. Where multiple tripping is required the arc sensing devices detect an arc together with an over current or earth fault current from the incomer feeder it trips the incomer feeder, bus section breaker and all the feeder circuit breakers of the relevant zone.

Incomers

The function of this application is to detect and clear internal arc faults in the incomer cable chamber. Where multiple tripping is required the arc sensing devices detect an arc together with an over current from the upstream feeder it trips the upstream feeder circuit breaker.

3.2.1.9 Buszone Protection Scheme

The buszone protection scheme is designed to protect the breaker, busbar and cable chamber respectively in the case of a three-phase bolted fault for air insulated MV switchgear. The protection scheme is based on basic operation principles of high impedance differential current measuring system.
The function of the bus zone protection system is to perform fast clearance of phase to phase and phase to earth faults. The supply breaker and all feeder breakers are tripped in the event of a fault and current exceeding a pre-set reference value.

A testing system, consisting of current isolation and measuring facilities at the input from each current transformer, and facilities for short-circuiting the current transformer circuits, when they are isolated from the protection system, is included.

The detailed system description (i.e. specification, layouts and circuit diagrams) and test procedures for the bus-zone protection system is provided in the tender documents.

The *Project Manager* may request the *Contractor* to check whether the buszone protection is stable under external fault conditions.

The protection CT core is fed onto standard switchgear terminals and then to the CT test block and protection device measuring elements with overlapping of the bus section CT cores.
The boards requiring single or double zone tripping are indicated in the Appendix 3.

3.2.1.10 DC Fail Function

DC Fail function is provided to monitor the DC supplies of all the protection schemes at the last supply point. This functionality can either be incorporated in the IED, if a separate power supply is available, or a dedicated auxiliary relay.

The function allows for operating on loss of DC voltage. Alarm output signal is also transmitted to the DCS system and indicated on the IED, if separate suppliers are used.

3.2.1.11 Control Circuit Design Philosophy

The standard circuit design facilitates the integration of signals from the CTs and VTs and the interface with circuit breakers to perform various functions such as protection, control, alarm and monitoring. The IED that can perform at least control, indication and protection functionalities is used. The IED is also linked to the circuit breakers and earth switches for inter-tripping and interlocking functions where required.

The control circuit design for the different types of feeders is described by Typical Schematic Diagrams listed in section 3. The typical design includes functions for Supply Point, Control Trip, Control Close and Indication and DCF as shown in *Figure 1* below:

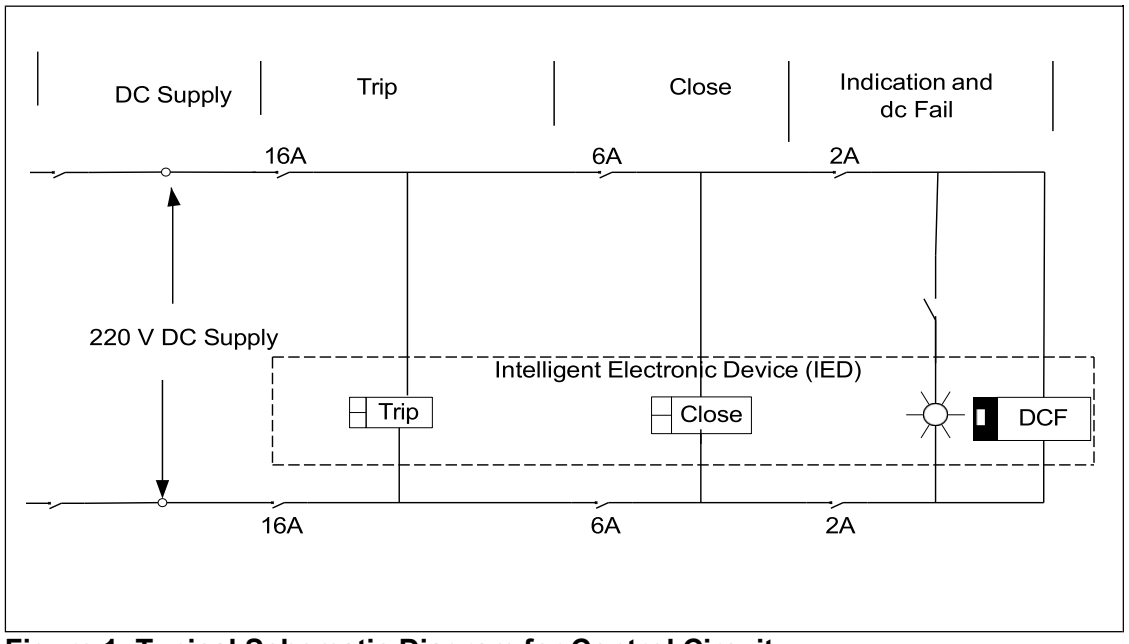


Figure 1: Typical Schematic Diagram for Control Circuit

The 220V DC control circuit design has the following functions as a minimum:

a) Control Trip - Trip signal to circuit breaker
b) Control Close - Close signal to circuit breaker
c) Indication and DC Fail - Circuit breaker indication and DC fail alarm.

The control circuit is protected as per proven Eskom practice. The *Contractor* ensures that there is adequate co-ordination grading between the MCB's in the control circuit and also the feeder from the DC supply. Example of the graded system of the MCB's used for the protection of the control circuit is as follows (as shown in Figure 1):

a) Supply point = 32A.
b) Control Trip = 16A.
c) Control Close = 6A.
d) Indication, spring charge and DC Fail = 2A.

The designs of the components in the circuit breaker control circuits takes into account the control philosophies for closing and tripping the individual devices. The circuit is typically supplied from a 32 A power supply fed from the 220V DC external supply.

The control "trip" is the most important function of the control circuit and is supplied first, protected with a 16A protection device. Should a fault downstream in the "close" or "indication" and DC fail function appear, the protection would protect the control "trip" from losing power. Typical trip coil inrush current is 2.8A (maximum), which will give a safety factor of 5 on the 16A circuit protection rating.

The control "close" is more important than the indication and should a downstream fault in the indication and DC fail function appear the protection would protect the control close from losing power. Typical close coil inrush current is 2.8A (maximum), which will give a safety factor of 2 on the 6A circuit protection rating.

The indication and DC fail have the lowest protection rating. Should any upstream mcb operate, the DC fail operates and a DC fail alarm is activated but no operation of any protection function should take place.

The control circuits are designed to make allowance for the alarm signals to be sent to the C&I system in accordance with the requirements described by the C&I Interface Signals for MV Switchgear in Appendix 16.

External 220V DC power supply is provided for the switchgear control circuit. This is used to provide power to the protection devices as well as the spring re-charge motors.

The design of the switchgear is such that a failure and restoration of the 220V DC control supply voltage would not cause the complete isolation of the switchgear. It is required that two trip coils are used on each of the Unit Transformer Incomer Breaker and other panels as indicated in the Switchgear Schedules in Appendix 5 of this technical specification.

Application of surge suppression units for control circuits, where required, is in accordance with 240-56227573.

3.2.1.12 Protection Algorithms and Settings

The *Contractor* provides a detailed description including formulas and diagrams of the algorithms used to perform the protection functions to the *Project Manager*. This information is treated as strictly confidential. This information is provided for all protection scheme developments.

The *Contractor* provides a comprehensive set of blank forms and example setting details to cover all user settable configurations/functions in the module to the *Employer.*

The IED marshalling 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 settings/marshalling related to the different protection schemes is pre-programmed at the factory and all IED's are delivered pre-programmed in accordance with the scheme design.

The final protection settings for the relays will be provided by the *Employer* for the *Contractor* to implement. In case the settings are not available at the time of Factory Acceptance Tests (FAT's), the *Contractor* develops the preliminary settings for the purpose of testing. These settings are accepted by the *Project Manager*.

The settings/marshalling are seen as integral parts of the scheme documentation. They are provided as part of the documentation as well as in software format in the file type as required by the associated IED.

3.2.1.13 Interface with Control and Communication Systems

The different operating conditions (i.e. normal and abnormal) that are monitored by the protection schemes initiate different alarms. These alarms are communicated between IEDs and DCS via dedicated hardwired and also between IED's and the new EWS via dedicated communication bus links. The description of the concept proposed for the EWS communication network is described in section 3.2.2 of this Works Information. The provision of the new EWS is the responsibility of the *Contractor*.

The interface between the IEDs on the switchgear and the new engineering work station are facilitated by an Ethernet based Local Area Network (LAN) using IEC 61850 protocol as described in section 3.2.2 of this Works Information.

Data transfer between the new IEDs and existing DCS is done using hard wiring method and in accordance with C&I Interface Signals for MV Switchgear spreadsheet provided in Appendix 16 and the existing detailed protection schemes in Appendix 5.

Safety trip signals (e.g. Boiler trip, conveyor trip, etc.) issued from the DCS are done via interposing relays with potential free contacts. The operating voltage of the interposing relays is 24V DC. The interposing relays are designed to withstand the rated current of the closing coil for two times the longest possible closing time. SIL 3 rating interposing relays in accordance with the requirements of IEC 61511 is required. The interposing relay is also designed to withstand the making of the closing coil current at maximum system voltage rating.

3.2.1.14 Design Acceptance and Type Testing

3.2.1.14.1 Type Testing

The type tests and special tests are carried out on all types of components in accordance to their respective applicable standards.

The *Contractor* provides the relevant certificates and test reports to prove the compliance.

The *Contractor* offers components that are similar to the type of components tested. If any components differ from the one described in the type test certificates/ reports, the components will be subject to re-testing before approval by the *Project Manager*. The conditions (i.e. number of tests to be done, etc.) under which the type tests are performed will be agreed between the test authority, *Employer* and *Contractor.*

The *Employer* will accept the type testing before the *Contractor* starts with the manufacturing of the scheme.

3.2.1.14.2 Routine Tests

Routine tests are done by the accredited test authority in accordance to the applicable standards. The performance of the protection schemes is proven to comply with the technical requirements stipulated in this Works Information.

Two copies of the final routine test reports for each protection scheme are provided by the *Contractor* not later than the delivery date of the Plant.

3.2.1.14.3 Components Acceptance

All active components of the Plant that do not form part of the OEM's original design are subject to acceptance by the *Employer.* The component complies with the relevant requirements of this Works Information as a minimum.

Where required, the *Contractor* provides calculations to prove the component application, design and compliance to the requirements. The relevant schematic drawings are used for the acceptance of component application. Should the requirements not meet the component application design requirement, the additional cost is borne by the *Contractor.*

The *Contractor* provides original copies of the technical documentation of each component in a file complete with contents list as well as all calculations or justification per component. The *Contractor* submits two copies of files labelled Components Acceptance Application in this regard.

Only the Eskom approved IEDs as per 240-56227589 [List of Approved Electronic Devices to be used on Eskom Power Stations] will be accepted. The *Contractor* is responsible for ensuring that all the IEDs offered are part of the 240-56227589 for evaluation purposes.

3.2.1.15 Detail Design Freeze

After Contract Date, the *Contractor* performs Detail Design in accordance to *Employer's* requirements presented by Typical Schematic Diagrams. The designs are agreed with the *Employer* to achieve Design Freeze status.

The *Contractor* submits the following data in neat files for acceptance by the *Project Manager* before the Design Freeze status can be declared as a minimum:

a) Technical Schedules A and B
b) Compliance Schedules
c) Engineering Change Register
d) Single Line Diagrams for Switchboards
e) General Arrangement Drawings
f) Substation Layouts
g) Switchgear Schedules
h) Protection Functional and Interface Block Diagrams
i) Schematic Diagrams for Protection and Control Systems
j) Component Schedules
k) Technical Manuals
l) Architecture of EWS
m) Site Layout indicating Cable Routing for EWS
n) Cable Block Diagram for EWS
o) Accepted Prototype Scheme

The *Employer* will accept the following set of drawings, per board, before any manufacturing can take place:

a) General arrangement drawings for each switchboard;
b) Switchgear schedule for each board with reference to component schedule;
c) Schematic diagrams for each circuit (this must include all the wire numbers, termination numbers, termination strip numbers, fuse sizes and spare contacts);
d) Component schedule for each circuit on the ASSEMBLY;

For non-standard circuits i.e. incomer, chop-over, the *Contractor* will discuss the requirements with the *Project Manager* and work out a suitable design which the *Contractor* will submit for acceptance.

3.2.1.16 Design Prototype Acceptance

The *Contractor* designs, manufactures and test one complete prototype schematic for each type of standard schematic (All 4PA Schemes) as per the requirement of this works information after Contract Date. The prototype schematics comply fully with this works information.

The prototype schematics are designed and manufactured within four months from Contract Date.

The following data must be submitted before any manufacturing on the prototype schematics can start:

a) List of components used on the prototype schematics.
b) Technical Manuals for all components used on the prototype schematics.
c) Type Test Certificate of all active components. If evidence is available of type tests already made on similar component, this may, subject to the *Project Manager's* approval, be acceptable in lieu of the relevant tests.
d) Type Test Certificates and Reports
e) General Arrangement of the prototype schematics.
f) Schematic Diagrams of the prototype schematics.
g) Buswiring Diagrams of the prototype schematics.
h) Protection and Control Logic Diagrams
i) Switchgear Schedule of the prototype schematic.

After the completion of the manufacturing of the prototype schematics, they are tested in accordance with the required routine tests. The test requirements are agreed between the *Employer* and the *Contractor*. All tests and results are documented and signed by the *Project Manager* and the *Contractor*.

A technical manual for each design prototype schematics are prepared by the *Contractor* after the completion of the tests. The manual contains the information on the circuit as listed above, the test reports as well as photos of the construction, layout and wiring of the scheme. This information is used as a reference for further manufacturing. The prototype schematics are used in the first batch of protection schematics to be installed at site.

3.2.1.17 Manufacturing Release

The prototype schematics manufactured as per the approved and accepted drawings are inspected and tested for acceptance by the *Employer* before the manufacturing process of the rest of the protection schemes can start.

The *Employer* accepts the set of drawings, per board, as per schedule and clause 2.8 before any manufacturing can take place.

The *Employer* accepts the set of drawings, per buszone protection panel, as per schedule and clause 2.8 before any manufacturing can take place.

The *Employer* accepts the set of drawings, per EWS cubicle, as per schedule and clause 2.8 before any manufacturing can take place.

3.2.1.18 Plant Interfaces

The *Contractor* is responsible for providing sufficient spare contacts as per the Technical Schedule A and B in Appendix 11. These contacts would be used to trip the circuit breaker from pressure switches etc. as per the existing designs at the Power Station.

3.2.2 Engineering Work Station (EWS)

3.2.2.1 Scope of the Engineering Work Station

The scope of EWS includes the provision for the engineering, design, procurement, manufacture, factory acceptance testing, supply, delivery, off-loading, storage, erection, installation, site testing and commissioning of all equipment forming part of engineering work station.

The *Contractor* provides in his tender a conceptual design for the EWS architecture with the description of each component and their specifications. The design for the main offer for the EWS is in accordance with the proposed architecture overview provided in Appendix 7. The *Contractor* also submits an alternative offer for the EWS that provides a more reliable and optimised solution, in line with the offered devices.

The *Contractor* provides in his tender preliminary system descriptions that describe the working of the system.

The *Contractor* performs detailed Reliability, Availability and Maintainability (RAM) studies of the complete EWS system and submits with his tender, RAM study reports for both the main and alternative offers. The *Contractor* provides reliability and availability calculations using established methodologies and 240-49230030 to demonstrate the adequacy of the designs. The reliability and availability calculations should be based on reliability block diagrams and indicating any redundant equipment that may be required. In addition to the Price, the tender submission includes life cycle costs of both the main and the alternative offers.

The VisualSPAR latest version reliability simulation software package shall be used in performing the RAM analysis.

During detailed design, the *Contractor* provides a detailed philosophy (system description) document and technical operation manual for the EWS offered. The documents describe in detail, the operation of the automation system and include elements such as the philosophy of the system on each protection scheme, the operation of the HMI etc. The documents are such that engineers and technicians can easily understand the relevant portions of the philosophy of operation of the complete system once he/she has read the document.

During detailed design, the *Contractor* provides a detailed document describing how to configure the system and its components. The document is such that an engineer can easily understand how to configure the complete system once he/she has read the document. The *Contractor* provides a RAM study report of the final system configuration and individual system components.

The *Contractor* provides a detailed specification of the logical nodes with associated data sets supported by each IED offered. The *Contractor* indicates which data sets in their offer are mandatory and which are optional.

No annual license renewal is required for software or operating systems. All licenses that are required are a once-off purchase. The fact that a bug is only found after the warranty has expired does not make it acceptable and therefore all bug fixes are free of charge.

The *Contractor* and the associated supplier/s have at least 5 year experience in development, design, engineering and implementation of the EWS. All equipment used in the system will form part of the *Contractor's* current marketed range of equipment and will not be experimental nor prototype in nature. The *Contractor* provides information regarding reference sites/projects of similar nature where the offered equipment has been installed. The *Contractor* specifies for each referenced site/project, the details (description and model number) and quantity of the equipment applied. If equipment has been launched as a commercial product on the international market but has never been installed at a previously commissioned similar reference site, such equipment will have been tested rigorously and to the satisfaction of the *Employer.*

The *Contractor* provides a disaster recovery process for each communication device (i.e. network equipment, IEDs and the EWSs). This process must be auditable and a recovery test must be performed during the Factory Acceptance Testing (FAT) to gather recovery times.

The *Contractor* provides for an OPC link to the existing Arnot Power Station Historian. The *Contractor* provides for collecting via a LAN cable and receiving a time stamping signal from the existing Station GPS clock located in the same room at the station EWS. The *Contractor* clearly states the type of clock signal (NTP or SNTP) required by his/her equipment. The *Contractor* also engineers the EWS to receive information from electrical equipment at the Power Station as per this technical specification.

3.2.2.2 General Specification

The *Contractor* designs and supplies a system of which the architecture is based on the seven layer model of the International Standards Organisation (ISO) for communication between devices. The design and functionality of the communication system and components is based on IEC 61850 standard. Any solution/s offered by the *Contactor* that do not comply with IEC 61850 or which are not specified in IEC 61850 are based on open standards, and are presented to the *Employer* for acceptance.

The architecture, protocols and all equipment are designed for the substation environment and not for industrial process control or office environment. It is implied that all protection, communication and control equipment complies with the same environmental requirements (i.e. EMC and EMI) as those currently required for numerical protection relays, specifically Class IV as defined in IEC 61000-6-5.

All equipment is designed to work efficiently in the environment where they are installed, without any decrease in performance, reliability and life expectancy. The temperature range in which all equipment forming part of the EWS is able to operate is -10 ºC to +55 ºC, irrespective of HVAC provided for the room(s). The room/s where the servers are housed will be controlled according to Eskom standard 240-56355731: Environmental Conditions for Process Control Electronic Equipment used at Power Stations. The HVAC for all substations is provided in accordance with section 2.2.4 of this technical specification.

3.2.2.3 System Design

The *Contractor* designs the EWS for extremely high reliability and availability, through total redundancy at every level including data busses. The EWS structure follows the electrical reticulation system configuration to minimise the effects of equipment failure on the overall plant. A functional distribution of network switches is designed and installed by the *Contractor*. Redundant equipment and communication paths do not have common points of failure. The *Contractor* provides separate cabinets for different redundant equipment. All

common modes of failure are considered and eliminated in the design, specifically in terms of power supplies, communication paths, routing etc.

The offered system has a sufficient number of Ethernet ports to cater for all the IEDs required as per section 3.2.1 of this works information, and it is possible to add future devices at all levels of the network when the substation is expanded in future. This implies that the system is extendable or expandable.

The EWS is designed for the future reality of eventually replacing the system, without requiring the extensive shut down of plant or running plant without monitoring and control functionality during the replacement.

The communication network equipment is reliable, flexible and modular. The architecture, design and equipment do not introduce significant risk to the *Employer* when compared to conventional substation designs. Further, the system, including hardware, firmware, software, configuration and networking requires minimal maintenance. No moving parts such as fans are allowed, since they significantly reduce reliability. It also introduces an onerous maintenance requirement. Substation hardened networking hardware and software is used.

It must be possible to separate defective components from the system, by switching off or blocking the respective communication processes or drivers, so that the rest of the system continues to function properly. Redundant equipment such as network switches and servers are completely independent, and can fail, have parts replaced, have updates installed, be completely replaced, be booted up and shut down independently without affecting the functionality of EWS.

Equipment hot swapping between power supplies is seamless and does not have any effect on the equipment such as loss of data or equipment restarting. Data is not lost when there is a complete loss of the auxiliary power supply to the system.

All communication devices are suitable to transfer maximum data between the IED and the other devices in the communication network without any restrictions that might limit speed, capacity and quality of data transferred.

The communication architecture, protocol and configuration is able to provide high speed operation, since peer-to-peer communication requires much data sharing and the communication network is also used for protection purposes, i.e. transferring trip signals. The performance of the system is in accordance with the requirements mentioned in section 8 of this technical specification and requires a fast communication network. The communication speed of the network is selected appropriately.

IEDs are addressable, more specifically each data source/receiver or devices have a unique address for identification in the substation, and also in the entire network to which it is connected. This implies that all IEDs have unique user configurable Internet Protocol (IP) addresses.

Substation Configuration Language (SCL) files, based on IEC 61850 Part 6, are used to describe the substation. Since the data model in IEC 61850 is well defined, it is required that the network and all equipment allow for interoperability (i.e. it is possible for IEC 61850 compliant Intelligent Electronic Devices (IEDs) from different manufacturers to efficiently communicate over the EWS).

3.2.2.4 Functional Specification

3.2.2.4.1 Engineering Work Stations

The EWSs are used for the following functions:

a) Configuration of IEDs
b) Settings of IEDs
c) Monitoring

d) Fault/event recording
e) Archiving

The EWS system is dedicated entirely to the purposes of IEDs configuration and setting, system monitoring, event recording and archiving. There is no sharing of resources with other control systems, specifically; no processors, network switches, busses, servers, PC equipment etc. may be shared with other control systems.

All equipment provided is able to perform self-diagnostics and alarm failures, both locally at the equipment and remotely at the work stations. The alarm information is sent to the work stations over the network. Failure of any device on the network is alarmed via an alternate path of the redundant network.

All the necessary diagnostic tools are ‘on board’ and are therefore part of the EWS. It is possible to perform diagnostic and monitoring functions locally, through the substation LAN and on a portable EWS.

The amount of engineering time spent to configure the system is minimised through the provision of a suitable substation configuration tool that may be used to configure all devices provided by the *Contractor* and the communication system. Interoperability as defined in IEC 61850 and the offered substation configuration tool minimises the amount of time required to configure a system with different suppliers’ IEDs.

A communication network management function/tool that is able to provide the system administrator with up to minute information about various crucial statuses of the communication network, for example the network size, its operating conditions, alarms, system loading and error statistics is provided. The network management function/tool is also used to add new devices to the network, configure them and to perform certain diagnostic investigations.

Programming functionality on a bay and substation level is provided using the portable EWS with user friendly software. A graphical configuration system is therefore available and operational. It is important to note that what is referred to here is the interface between the user and the programming tool in terms of what is visually seen on the computer screen by the programmer. To simplify the configuration process, a library with system tested function blocks for power automation specific functions is integrated.

Mathematical configurations are also possible, for example to calculate the I^2t summated analogue value and compare it with set points before issuing a derived alarm when the setting is exceeded. As a second example, it is possible to add the respective phase currents from the different bays to each other in real time and to perform a programmed characteristic algorithm on it.

The set of engineering workstation functions are developed during the design phase of the project. A final list of functions agreed upon between the *Employer* and the *Contractor* at the final design review are signed off at the design freeze.

The communication system is capable of transferring data stored on the IED’s for condition monitoring purposes, such as the record of events or disturbances as well as measured values (e.g. voltage, current, power, temperature, etc.) for normal running conditions.

All event data, fault records, as well as the continuous daily binary and analogue values are stored on the EWS. The Station Historian will be provided by *Others,* where some of this information will be stored for the life of the Power Station. The *Contractor* is responsible for providing all the required interfacing equipment/tools with the existing Station Historian. More information on the Station Historian can be found in section 3.2.2.6.6.

It is not allowed for any information pertaining to or required for supervision, indication, alarms, metering, measurements, event logs, fault records etc. to be transported, stored or archived directly on a business LAN. All networks used for this purpose are dedicated to the EWS. If an interface is required between the EWS and the business LAN, the EWS network is to be separated from the business LAN by a high reliability fire wall provided by the *Contractor*.

As the prime function of EWS is to configure and monitor the main reticulation systems within the Power Station, the technology used for the HMI systems associated with it, needs to be specifically developed for electrical, and not primarily for the processes and plants like boilers, turbines, chemical plants, etc.

The EWS includes all the functionality required by the Eskom Operating Regulations for High Voltage Systems (ORHVS) and the Eskom Plant Safety Regulations (PSR), e.g. showing the application of manual earths, permits that are in force, prohibit signs etc.

The *Contractor* is responsible to employ a comprehensive method of display, access across all types of display is provided, while at all times providing the EWS operator with an overview of high-level plant status. Navigation is clear, simple and unambiguous. Selection of any display should not require more than two keystrokes. In alarm or abnormal conditions only one keystroke is required to access the relevant display. In all cases, a standardised back track facility is available for the operator to escape from displays.

Every reticulation system state change (breaker opening and closing) is recorded and an active mimic screen have the ability to page sequentially back through plant states.

A comprehensive and integrated alarm handling system is employed, which clearly distinguishes between different alarm types and priorities. Separate alarm lists are developed for electrical reticulation system alarms and EWS alarms. Alarm priorities are developed and finalised during detail design. Alarm responses are developed for each alarm detailing the cause and remedial action, and are linked to the individual alarms and readily accessible by the EWS operator through a link on the work station alarm screens. In addition to the alarms and alarm responses, system displays are provided which show the real time health of the entire EWS and location of alarms.

Alarm information is not lost or inaccessible while navigating though displays, and alarm presentation dynamically provides the operator with information matched to the current situation and its criticality. The work station operator is alerted to new active alarms while navigating through displays, irrespective of which display the operator is on. Alarms from plant on permit may be required to be inhibited. True system errors are fully indicated as to type, cause and remedial action. The history of alarms should be logged on the HMI alarm screens.

No set or sequence of key strokes causes the operator monitoring and control functionality to fail or freeze. Any incorrect operation is highlighted to the operator by audible signal or text message.

3.2.2.4.2 *Servers*

The following functions are provided on the EWS servers:

a) Fault/ event recording
b) Supervisory
c) Data capturing
d) Network configuration
e) Self-diagnostics and network management
f) Archiving

g) Server to EWSs

3.2.2.5 System Architecture

3.2.2.5.1 Board Level Architecture

The IEDs on the switchgear panels are interconnected via board level network switch (es). Each board has its own board level network switch. Each IED on a board is connected to its board level switch in a star topology.

Board level switches are not shared between IEDs on different boards. The only situation where an IED not residing on a particular board is allowed to be directly interfaced to a particular board's level switch is the case where there is only a single IED on a board, and that breaker is either directly feeding (e.g. Maintenance Isolator) or is being directly fed (e.g. Incomer or Bus Section on Low Voltage Board) by the board on which the board level switch resides.

Communication between IEDs is via the board level switches. The connection from each circuit's IED to the board level switch is a singular connection and hence no redundancy is available at this level.

The proposed board level architecture can be seen as part of Conceptual Engineering Work Station drawing Arnot EWS has two level switches; board level switch and Station level switches. The following section provides a brief explanation of these levels:

3.2.2.5.2 Substation Level Architecture

The architecture for The board level switches in a single substation are connected together making a ring topology with the two switches at the station level. At the board level, each IED on a board, including the board's buszone panel IEDs and the LV boards IEDs are connected to the board level switch in a star topology. Each of the redundant links from each board level network switch goes to a different unit level network switch in order to prevent a common mode of failure for both links.

3.2.2.5.3 Station Level Architecture

The station level architecture consists of the connection of all the substation level networks to the station level network switches and of other devices connected to the station level switches.

The station level architecture consists of redundant star connections from each of the redundant substation level switches (units 1-6 3.3kV Boiler boards, and 11kV Unit boards, 11kV Station boards and 3.3kV substation boards) through dedicated links, to redundant station level switches. Each of the redundant links from each substation level network switch goes to a different station level network switch in order to prevent a common mode of failure for both links.

Two redundant EWS serves, two redundant HMIs, portable EWS Station Historian are connected to the station level switches. Two local printers are required at the Station level. The interface of the EWS to the GPS Time Server and Station Historian is provided at this level. All interfaces at this level are implemented using a star topology.

Each station level switch connects to both the redundant servers. Provision is made for a dedicated communication port on each station level network switch for a portable EWS to be connected to the EWS LAN.
The proposed station level architecture can be seen as part of Conceptual Engineering Workstation drawing

3.2.2.6 System Interface Specification

The *Contractor* designs the system interfaces as per the requirement stated below in the following subsections.

3.2.2.6.1 MV Switchgear

MV Switchgear will have IEDs as per section 3.2.1 of this works information. The process and reticulation switchgear is interfaced to the DCS using a conventional hard-wiring method whereby each signal is allocated a dedicated wire. The interface is facilitated by a dedicated I/O card of the DCS. The control of process and reticulation switchgear is facilitated by the DCS. The reticulation and process switchgear will be connected to the IEC 61850 based EWS Network.

3.2.2.6.2 LV Switchgear

Selected reticulation LV Switchgear will have IEDs as per section 3.2.1 of this works information. The LV reticulation switchgear is interfaced to the DCS using a conventional hard-wiring method whereby each signal is allocated a dedicated wire. The interface is facilitated by a dedicated I/O card of the DCS. The control of reticulation switchgear is facilitated by the DCS. The selected LV reticulation switchgear will be connected to the IEC 61850 based EWS Network, via the upstream MV switchboard Ethernet switch. Only the LV Switchgear reticulation circuit breakers are required to be interfaced with the EWS. The *Contractor* makes provision accordingly.

3.2.2.6.3 Buszone Protection Panels

MV Switchgear buszone protection panels will have IEDs as per section 3.2.1 of this works information. The buszone panels are interfaced to the DCS using a conventional hard-wiring method whereby each signal is allocated a dedicated wire. The interface is facilitated by a dedicated I/O card of the DCS. The monitoring of the buszone is facilitated by the DCS. The buszone panels IEDs will be connected to the IEC 61850 based EWS Network, via their respective MV switchboard Ethernet switch. The *Contractor* makes provision accordingly.

3.2.2.6.4 Transformers

All affected transformers (as per Single Line Diagrams provided as part of this *works information*) alarm and trip signals are required to be monitored via the EWS. Transformers are protected by IEDs. The alarm and trip signals are sent via the fibre optic cable from the IED to the EWS for monitoring purpose.

3.2.2.6.5 Station GPS

The time synchronisation of the IEDs internal clocks are done over the EWS network by synchronising to the existing time server that is linked to the master GPS. The *Contractor* is responsible to design the interface between the EWS and the master GPS. The master GPS is provided by *Others*. The fibre optic cable to the GPS is provided by the *Contractor.* The link to the time server is provided at the station level using either the Network Time Protocol (NTP) or Simple Network Time Protocol (SNTP).

The *Contractor* designs the link to the time server and EWS networks to minimise latency and ensures IEDs are time synchronized to a 1ms accuracy. Time stamping of events is done at the IEDs with a resolution of 1ms.
The time syncing of all the IED’s will be achieved by interfacing the IEC 61850 switchgear network through its Ethernet switches to the SOR GPS clock located in the same room as the EWS equipment (refer to appendix 7. This will be completed by interfacing the station level Ethernet Switch to the NTP/SNTP Time Server (Meinberg Lantime M300) located in the IDF room. The NTP time server has a spare port (Lan 1) which will be used to interface with the Ethernet switch (Station level Ethernet Switch 2) for the purpose of

distributing the time signal to all the MV switchgear IEDs (refer to appendix 7). The Meinberg Lantime M300 supports both NTP and SNTP and will need to be configured to provide the time required time protocol.

3.2.2.6.6 Station Historian

The existing Station Historian at the Power Station, acts as a secondary central point of information storage. Information from the EWS is required to be sent to the Station Historian. The *Contractor* is responsible for sending information from the EWS to the station historian, via a redundant OPC link at station level. The fibre optic cable, all infrastructure requirements, software and configuration requirements on the EWS for the OPC link are provided by the *Contractor*.

The Station Historian currently communicates via TCP/IP. The *Contractor* provides additional connectivity server together with accompanying software to achieve the interface. The engineering and configuration necessary on the existing Station Historian is provided for by the *Contractor*. The infrastructure requirements, software and configuration requirements on the Station Historian to be able to accept this information will be provided by *Contractor*.

3.2.2.6.7 Power Requirements

The power supplies will be provided by the *Employe*r in the form of a dedicated circuit on the essential board. The *Contractor's* EWS equipment will be connected to the power supplies via cables provided by the *Contractor*. The *Contractor* provides the Employer with the detailed EWS equipment electrical consumption list for allocation of a correct size power circuit.

3.2.2.7 Technical Specification for Communication Hardware and Applications

The *Contractor* supplies communication hardware and application that conforms to the requirement stated below in the following subsections.

3.2.2.7.1 Computers

The computers employ industrially hardened PC technology with proven state-of-the-art hardware based on the latest version of Microsoft Windows XP operating system with a RAM of 8GB or more. All computers will have a minimum storage capacity of 2 months.

The engineering system is an open system allowing data to be downloaded and uploaded in the COMTRADE format. Further, it is possible to import/export messages to/from Microsoft Excel and Access for simple manipulation.

It is made possible to save all database and configuration data on both removable and non-removable media for back up purposes without taking the system off-line. It is possible to provide redundant storage media for configuration database. The system supports archive marking for variables. Marked variables are automatically archived.

The engineering software employ an intuitive MS Windows Explorer style interface, which allows the user to manage all aspects of the Input/Output (I/O) signals, Human Machine Interface (HMI), network and hardware configuration. The use of differing, inconsistent user interfaces is avoided as much as possible.

The communication ports are designed to be compatible with the communication bus system used on EWS. Provision is also made to accommodate the interface with other related systems through an Ethernet port. The computers are equipped with the communication software that is compatible with IEC 61850 communication protocol.

The system offers fast compile and download times.

Standard printers are connected to the fixed EWSs for the purpose of printing reports, configuration files, HMI screen drawings, etc. PDF printer software is also installed to allow for soft copy prints on all computers supplied.

All software is in the English language.

An installation procedure with the required installation files is to be stored at the Power Station, where any computer which has a major failure can be re-placed, configured and fully operational with-in 6 hours.

3.2.2.7.2 Servers

The EWS server is of a redundant active-passive type and has high availability. The data between the redundant servers is kept in synchronism at all times.

The health and status of the servers are continuously monitored, and any failure is alarmed via the alternate path. The loss of a single server does not affect the operation of the EWS, nor does it result in any data loss. No data corruption occurs in the event of a server crash or restart.

Individual servers can be removed and replaced without adversely affecting the operation of the EWS.

The server supports both client-server as well as peer to peer modes of operation. All the applications required for a fully functional EWS run on the same platform. The software used in the server is compatible with the software used on the EWS. All software applications that are required to run 24/7 run as operating system services.

The EWS server is required to have a dedicated screen that can be switched between the redundant servers.

Provision is also made for the EWS Server to interface with communication devices on other related systems such as LV Switchgear. In other words, the EWS Servers are expandable in a way that during design, provision is made to add information storage devices as required (i.e. a minimum of 60 days of all historical plant information is stored and available on-line for all the above-mentioned systems). If such a link is required, it can be facilitated by a Remote Terminal Unit (RTU) that has protocol conversion functionality, if necessary.

a. Communication Interface

The following interface ports can be considered for communicating to auxiliary systems:

a) RJ45, RS-232C, RS-422, and RS-485 with full and half-duplex operation, and selectable baud rates (19200, 38400, 57600, and 115200)
b) IEEE 802.3 Ethernet port with 100 Mb/s speed. Communication protocol is IEC 61850 standard
c) Using IEC 60870-5-101 via a fibre optic coupler

b. Database and Information Management

The *Contractor* provides an intelligent database that is maintained by the EWS server and access is provided to all EWSs. The purpose of the substation database is to collect and manage non-real time data in the substation environment.

It is also able to handle data archiving and trending, data compression and organisation of internal data flow. It must send data to the right place where it is required, for example Quality of Supply (QoS) data to the power quality database and non-real time data to the regional engineering database.

The data that is collected and stored consists of event records, disturbance records, statistical metering data, condition monitoring data, quality of supply data, back-up of settings, back-up of automation algorithms, wave form recordings, etc. other data that is also stored is IED technical manuals, software manuals, network data, etc.

The database is able to receive solicited or unsolicited messages/data from IEDs. It implies that the EWS is not only able to receive unsolicited data, but also solicit/extract data from the IEDs connected to it, by sending relevant messages to each IED.

Compact flash memory is used for storage of software and data instead of a hard disk drive. Hard disk drives are only used in addition to flash memory, and are only used as an absolute last resort. Hard disk drives may only be used if *approved* by the *Employer* in writing.

The system supplies tools for automatically backing up the database to removable media or to an alternate storage location. The backup utility executes the database backups automatically based on either of the following configurable criteria:

a) Time-based (e.g. every 24 hours)
b) Based on the size of the database (e.g. after the size reaches 1 MB)

All disturbance records are uploaded automatically to the substation database within 30 seconds of it being recorded. It is made possible to select whether the original records in the IEDs' memory is deleted or kept after transmission, in order to prevent the substation database memory from filling up.

It is possible to upload the engineering database contents (for example disturbance records, event records, condition monitoring data, etc. but excluding SCADA data) to an enterprise database once a day. Only changes in the database (and not the complete database) are uploaded. The time at which these uploads are performed is user settable.

The system is able to perform the back-up operations both off-line and on-line.

c. Archiving Capability

The *Contractor* ensures historical subsystem has the following specifications:

a) Provides the ability to define archiving rates in increments of milliseconds, seconds, minutes, hours, or days.
b) Is able to store all analogue tags at a resolution of 1 second or better, and all events at a resolution of 2 ms or better.
c) Stores a minimum of 6 months of all historical plant information on-line. The recording function stores data on the First in First out (FIFO) basis.
d) Allows an individual archive rate to be programmatically modified and/or utilised as part of the control logic requirements.

3.2.2.7.3 Engineering Workstations

Two fixed EWSs are provided by the *Contractor* at IDF room. One portable EWS is supplied by the *Contractor* in addition to the fixed EWSs, which can be fully operational if connected to any point on the IEC 61850 network.

The Human Machine Interface (HMI) level is derived from the project created on the EWS, automatically, to avoid duplicate input of information. Multi-layer technology is available for picture designing to enable clear engineering. The engineering supported with graphical resources, pure programming is not acceptable.

It is made possible to optionally obtain an application for analysis of historical data. This application must always use the original data as a base for further calculations or analysis. It is made possible to visualise variables in a user-friendly graphical format. Furthermore, it is made possible to export this data into a comma separated value file format for further analysis in other software packages, for example Microsoft Excel. It is also possible to perform all these functions online as well as offline.

It is made possible to handle the system engineering even without in-depth knowledge of object-oriented programming. Block programming sources is accessible to users. The system is able to detect errors in the configuration, test the connection between two different data types and reject them when applicable.

3.2.2.7.4 Switching Devices

The *Contractor* ensures that 100 Mbps switched Ethernet network with redundant bus architecture is used for the Board Level Architecture and 1 Gbps switched Ethernet network with a redundant bus architecture used for the Unit Level Architecture and the Station Level Architecture.

Substation hardened LAN/Ethernet equipment such as switches and routers are used in the substation environment. LAN equipment suitably specified for the substation environment is used. This refers mainly to the characteristics of the equipment, for example the electromagnetic interference specification, insulation levels, etc.

All communication equipment forming part of the SA system complies and is tested in compliance with the standard IEEE 1613™: Standard Environmental and Testing Requirements for Communications Networking Devices in Electric Power Substations. Ethernet switches used in substation automation applications comply with IEC 61850-3 standard for EMI (Electromagnetic Interference) immunity and environmental requirements to ensure reliable operation of networking equipment in substation environments.

Managed Ethernet switches are used, with features such as:

a) IEEE 802.1p Priority Queuing, to allow frames to be tagged with different priority levels, in order to ensure that real-time critical traffic makes it through the network, even during high periods of congestion.
b) IEEE 802.1Q VLAN (Virtual Local Area Network), to allow for the segregation and grouping of IEDs into virtual LANs in order to isolate real-time IEDs from data collection or less critical IEDs.
c) IEEE 802.3x Full-Duplex operation on all ports
d) IEEE 802.1w Rapid Spanning Tree Protocol
e) IGMP (Internet Group Multicast Protocol) Snooping / Multicast Filtering that allows for multicast data frames, to be filtered and assigned only to those IEDs which request to listen to them.

The communication system performs error free data transmission. It is able to perform a “fail soft” recovery from various different conditions, for example communication link congestion. It is unnecessary to provide redundant communication services, but it is possible to support redundancy. It is also able to support complete redundancy, even though it is not required in all cases.

3.2.2.7.5 Communication Cables

The communication channel between different devices and systems are facilitated by fibre optic links. The *Contractor* provides this fibre optic cabling between the different EWS equipment. Multimode fibre optic cables are used for all the short distance communication requirements, and the single-mode type are only considered for long distance communication. The *Contractor* provides the total cost for fibre optic cables as

well as the price per metre costing. Costing takes into consideration the distance between the substations and as well as cable routing, using EWS Architecture Overview drawing in appendix 7 as the basis. Estimated cable lengths and routing between substations is provided by the *Employer*, however the *Contractor* advises and designs for optimised alternative solutions for EWS network configuration.

The *Contractor* is responsible to ensure that cables installed outside the boards have adequate protection to minimise the possibility of physical damages. Environmental conditions are also taken into consideration while selecting such a cable.

The colour of the outer insulation (i.e. sheath or jacket) of all the fibre optic cables is GREY. The cables have Low Smoke and Fumes (LSF) sheath to ensure that the cables are not liable, like ordinary PVC cables, to produce corrosive halogens and copious smoke in the event of a fire.

The communication cables are designed such that there is minimal number of connections to limit the losses. The attenuation as well as the bandwidth of the communication link is optimised to allow for optimal data transfer.

3.2.2.7.6 Time Synchronisation System

The *Contractor* is responsible to design the system in such a way that all devices connected to the EWS network are synchronised over the network using either the NTP or SNTP. The internal clocks are time synchronised for time stamping with a resolution of 1ms. The time synchronised devices, such as the IEDs automatically recover, without any user intervention, should there be an interruption of the time synchronisation signal. The routing/distribution of the time signal is also the responsibility of the *Contractor*.

For general purposes, ±1 ms is sufficient accuracy, and for higher accuracy data such as analogue data sharing, 1 µs ± 0,5 µs.

3.2.2.8 Performance

Message types are subdivided into performance classes. There are two independent groups of performance classes, one for control and protection, another one for metering, monitoring and disturbance recording applications. The transmission time for the different message types complies with the performance requirements specified in IEC 61850-5 Clause 13.

The port-to-port transmission time of a protection command by making use of a GOOSE message as defined in IEC 61850 over the Ethernet LAN is less than 4ms. The delivery time of a message is the time allowed to transfer routinely updated data elements from a sending to a receiving IED and it must be less than the average update interval. It implies that peer-to-peer communication is a minimum requirement for a system that is expected to perform protection functions and communicate over the LAN network within the specified 4 ms time frame.
The communication system is, under maximum conditions, i.e. when all devices are communicating simultaneously; only operate at a maximum of 30% of capacity.

There are three categories of timing constraints for data transfer intervals and all three are provided for:

a) high speed, less than 4 ms;
b) medium speed, 4 ms < t < 15 ms, and
c) slow speed t > 15 ms.

The following functional performance and timing criteria is also adhered to:

a) time to send a control command/message (< 20 ms)
b) time to send or receive a protection message (< 4 ms) (port to port time)

c) time to send and receive an interlocking message (< 20 ms)
d) time to display a state change (< 500 ms)
e) time to display analogue input (< 500 ms)
f) time to display alarm (< 500 ms)
g) time to change HMI screen view (< 1000 ms)
h) time to change control mode (e.g. from local to remote) (< 50 ms)
i) automation function execution time (< 20 ms) (calculation of algorithm, excluding the field execution)
j) Boot up of the complete system and its respective components do not take longer than 30 seconds. The *Contract* supplies typical boot up times of other systems of similar size/complexity

The speed of operation/execution of any operation of any kind is not slower or worse than with a conventional protection, control and automation system implemented via hard wiring instead of Ethernet communications.

As a guideline from IEC 61850-5 Clause 15, during abnormal or emergency loads the substation bus is able to handle at least two times the loading of the normal load.

The overall substation automation communication system has an availability of at least 90% as well as the reliability of 95%. The Mean-Time-To-Failures (MTTF) or Mean-Time-Between-Failures (MTBF) (whichever one is relevant) of all components used to build the EWS is at least 50 years.

The basic philosophy is predisposed towards simplicity. Equipment that may reduce the reliability of the system is duplicated. This includes for example computer hard drives (if provided at all). Devices such as power supplies, communication links, computers (where applicable) and analogue inputs are also designed in such a way that the MTTF defined above may be adhered to.

The design life expectancy of all equipment and software forming part of the EWS is least 20 and 10 years, respectively.

As part of the detail design package to be compiled after *Contract* award, the total system structure as well as detailed calculations of bus loading, reliability and availability is provided to the *Employer* for *Acceptance.*

3.2.2.9 Security and Access Control

Access security in the substation communication domain is extremely important and is managed similarly to the office environment. It should be noted that the consequences of a security breach can be severe and could lead to an outage at a specific substation, but also to a network wide outage or blackout should individuals with criminal intent attempt and succeed to breach security of the substation automation and control communication network. This implies that the necessary security levels such as firewalls and virus protection are built into the design by the *Contractor*.

The *Contractor* installs approved Eskom Virus protection programs on all computers, preventing the substation automation network to be infected by viruses and other malicious software. The virus protection will be automatically updated daily through the Eskom LAN.

The EWS connects via a redundant firewall.

A suitable security access control process is implemented for the system. This access control system provides access to the substation bus. Each user is issued with a login name and password, which is user selectable after the first login. This ensures for example that only authorised users have the rights to operate switchgear and others are only able to perform monitoring functions.

The *Contractor* derives the suitable access categories for the EWS. The following defines the proposed categories of access and allowable actions per category:

Table 3: Definition of access categories for security purposes

Category 1:	Allow access for the purpose of viewing data, settings, disturbance records, etc. and getting access to the substation SCADA system/HMI excluding the ability to perform any controls. In this level the user is unable to make any changes. This level does not necessarily require a password attached to it, this may be the default view.
Category 2:	Allow the operator to have access to the substation HMI system for the purpose of controlling plant.
Category 3:	Allow the protection staff to have access to protection relay configuration and settings, disturbance records, CM equipment configuration, etc.
Category 4:	Allow communication bus maintenance to be executed (network administrator rights, full access).

It is made clear that the above categories do not reflect any ranking and are not mutually exclusive. For example: protection staff would be provided access to the system for category 1 and 3, operating staff only to category 2, etc. Also, category 1 is not higher than 4, and 4 is not higher than 1.

3.2.2.10 Specific Testing Requirements

The *Contractor* is responsible for ensuring that the terms and definitions for testing comply with those specified in IEC 61850-10 Clause 3.

The *Contractor* also ensures that the EWS undergoes conformance testing as laid out in IEC 61850-10 Clause 5 and 6. The EWS also undergoes performance testing, which includes communications latency, time synchronisation and accuracy testing as laid out in IEC 61850-10 Clause 7.

The required values of accuracy and allowable error are documented in IEC 61850-5 Clause 13.

For each bus interface type a protocol FAT should be done to prove that both devices concur to the protocol prior to installation and can be used on site.

3.2.3 C&I interface

All interfacing for time synchronization for the protection equipment to the GPS based master station must be provided by the *Contractor*, up to a terminal strip on the protection panel

The *Contractor* plan, co-ordinate and execute all cold commissioning activities. The Employer witness and accept the activities. Cold commissioning consists of:

(1) All field equipment checks
(2) Loop checks
(3) Testing of system functionality

The functional tests form part of the cold commissioning of the control system and include the checking of all:

(1) Measurement loops
(2) Interlocks/Protections
(3) Sequence controls
(4) Analogue controls.

3.2.4 HVAC systems

The HVAC works shall comply with 240-102547991 General Technical Specification for HVAC Systems Standard and 240-70164623 Design Guideline for HVAC in the Eskom Coal Fired Power Stations.
The engineering, quality control, inspections, plant and material selection, preparation of installation drawings, testing, balancing, commissioning and preparation of operating and maintenance manuals, are to be managed and executed by the Contactor in a systematic manner as follows:

a) Detailed Design (where required)

b) Plant and material selection;

c) Installation drawings;

d) Plant installation;

e) Testing, balancing and commissioning Documentation;

f) Quality control

g) Operating Instruction and Maintenance Manuals; and

h) Inspection Record Cards/Checklists and final hand-over

The Works include the following:

a) Replace the existing HVAC system with dedicated packaged air conditioning units together with matching fresh air units for each room with 100% standby capacity

b) Associated electrical works for complete HVAC system.

c) Associated Controls and accessories for complete HVAC Works

d) Associated building and civil works for complete HVAC works

e) Interfacing with fire detection system

f) Testing, balancing and commissioning of the complete HVAC works

g) Decommissioning and removal of all old equipment and make good where required for complete HVAC works

h) Provision of Painting and corrosion protection for complete HVAC works

i) Provision of operation & maintenance manuals and provision of new where required

j) Update the Plant Codification & Labelling and provide new where required for the complete HVAC works

k) The *Contractor* makes provision for spares and maintenance support as per the requirements set out in this document

The exclusions from HVAC refurbishment Works, which will be provided by others, are detailed by appended Limit of Supply and Service as well as the division of works of the technical specification.
The construction of the Works will be undertaken while Arnot Power Station remains live during the complete duration of the execution of works. Hence, the installation of new Works is to be carried out in a systematic manner to ensure no loss of services in essential areas can be accommodated at any stage.

3.2.4.1 Commissioning

The *Contractor* does comprehensive pre-commissioning, commissioning as well as quality monitoring on all the HVAC systems in exact accordance with CIBSE Commissioning Codes C (Automatic Controls), A (Air Distribution), R (Refrigeration Systems), and or ASHRAE Commissioning Guideline.
The Commissioning Report must:

a) Demonstrate that the services were commissioned in compliance with CIBSE Commissioning Codes or ASHRAE Commissioning Guideline for all mechanical services.

b) Include commissioning dates, records of all functional/commissioning testing undertaken, a list of any future seasonal testing, and a written list of outstanding commissioning issues.

c) Include the outcomes and changes made to the building as a result of the commissioning process, accounting for all of the recommendations.

d) Reference appended extracts of commissioning records for major plant and equipment; and

e) Comply to safety requirement as per OHSA when handling mechanical and electrical equipment or chemical substances

The commissioning includes the setting of all controls, dampers etc., and the balancing of the systems to meet the required design air volumes. The *Contractor* is required to include in the commissioning manuals readings obtained at all grilles, at the air handling units and other fans, at points on the ductwork prior to branch connections and pressure and velocity readings on the supply, return and extract ducts. Ducts are tested and balanced according to SANS 10173 latest revision
The commissioning procedure to be adopted is prepared by the Commissioning Authority. During commissioning the *Contractor* set the installation to work and competent personnel demonstrates and explain the operation and maintenance procedures for the installation and for each item of plant to the Employer. During commissioning if any item is found to be unsatisfactory the fault is rectified and/or new components fitted and commissioned by the *Contractor* at their own expense. The *Contractor* then rebalances and commission the system or part thereof affected at their own expense.
After successful completion of the commissioning and proof period of the installation and any maintenance materials as listed in the Specification and those normally supplied by equipment Manufacturer are handed over; the defects liability period commences. Items of equipment which are of a specialist nature e g automatic controls etc. are commissioned by the manufacturer's representative who instruct the Employer on the function and proper operation of the equipment.

The contract is deemed to be complete when the following have been completed in accordance with the relevant specifications:

a) The Plant is erected and commissioned.

b) Signed erection and safety clearance certificates.

c) The final drawings have been submitted.

d) All documentation has been submitted including testing reports and the associated certificates received. All Quality Control Plan (QCP) documentation received. Final Draft of the Technical, Operating, Maintenance manuals delivered.

e) The Plant and all documentation/drawings are coded and labelled.

f) All special tools have been supplied.

The complete system is to be subjected to performance tests under full working conditions. This is done in the last month of the defect period. The *Contractor* shall supply the necessary field-testing instruments (thermometers and flow meters) and detailed description of field testing arrangement to prove a capacity/performance measurement accuracy of ± 5% for performance acceptance testing.

3.2.5 Civil and Structural

- The *Contractor* assesses all existing floors within the Switchgear Rooms on the 45ft level to determine current structural conditions.
- The *Contractor* verifies the weight of the new Buszone panels (with its components and equipment) to determine the loading on the existing floors. Assessments shall be done in accordance with the 240-56364545 Structural Design and Engineering Standard together with the relevant SANS design codes.
- If the assessment findings conclude the floors capable of supporting the new panels, the *Contractor* then installs the new panels.
- The *Contractor* cores through the switchgear room floors on the 45ft level for all new cabling.
- Core locations and specifications will be determined by the *Contractor* with approval from the Employer.
- The *Contractor* ensures that the structural integrity of the operating floor slab, supporting beams and columns are not compromised
- The *Contractor* is responsible for both the design and construction of all works.

3.2.5.1 Design and Construction Requirements

- The *Contractor* takes full professional accountabilities for all of the works in their scope including any existing structures to which additional loads are introduced and provides the following for review and acceptance:
    - Consolidated detailed design report signed by a Professional Civil Engineer which includes:
        - Design criteria/parameters, specifications and standards used, loadings, assumptions, calculations results including detailed design calculations, design models, sources of information and any record of other information associated with the completed works.
    - Detailed drawings for construction. Drawings are also submitted in CAD formats.
- The *Contractor* is required to submit as-built data and drawings of the completed works upon handover. As-built drawings are submitted in PDF and native CAD formats.

- All submitted drawings to be signed by a Professional Civil Engineer with ECSA registration number stated on drawing.
- Any discrepancy or ambiguity between the Employer's Specifications or requirements is immediately brought to the attention of the Project Manager for clarification.

3.2.5.2 Codes and Standards:

Table 4: Codes and Standards

240-56364545	Structural Design and Engineering Standard
240-86973501	Engineering drawing Standard
SANS 10100	Structural Use of Concrete
SANS 2001-BS1	Construction works Part BS1: Site Clearance
SANS 2001-CC1	Construction works Part CC1: Concrete works (structural)
SANS 10140	Identification Colour Marking
SANS 10162 – 1	The structural use of steel Part 1: Limit-states design of hot- rolled steelwork
SANS 10160	Basis of structural design and actions for buildings and industrial structures
240-107981296	Constructability Assessment Guideline
SANS 1200 Series	
SANS 2001 Series	

3.3 Procedure for submission and acceptance of *Contractor*'s design

3.3.1 Project implementation phases and acceptance

The *Contractor* undertakes all phases of engineering and design and is shown in the Accepted Programme from the investigating phase, concept phase, system engineering & design through technical clarification, design freeze, procurement and production engineering to installation, commissioning and testing and addresses the following throughout the execution of the different project phases:

a) The translation and incorporation of plant layout drawings, C&I P&ID, Electrical interfaces, Mechanical functionality, and third-party documentation as specified in the *works* onto the *Contractor's* documentation to ensure an integrated documentation system.

b) The design, engineering, commissioning and testing of all interfaces are performed by the *Contractor*.

c) The detailed engineering of the field interfaces and interfaces within the control and indicating equipment, for both the hardware and software configurations.

d) Strict adherence to the plant outage duration's during de-commissioning and removal of old equipment. Emphasis is placed on planning and up-front work to achieve the prescribed outage times, prevent rework.

e) The *Contractor's* design and engineering take into account the performance requirements as specified for the control and indicating equipment's management and monitoring facilities as well as system. In particular an integrated and working control and indicating equipment's is provided which meets safety, reliability, availability, operability and maintainability criteria, performs all protection functions, supervisory control functions, and information sharing functions.

f) The *Contractor* provides the various documents during the various phases as per the Accepted Programme and Completion of each *section* of the *works* is when the relevant documents are accepted by the *Project Manager*.

3.3.2 Design Review Procedure

The *Contractor* is the Design Authority as defined in the Design Review Procedure (240-53113685). The *Contractor* is responsible for following this design procedure and conducts all the design reviews as specified in this procedure. The *Contractor* is responsible for conducting the following design reviews:

a) Design Freeze Review
b) Integrated Design Review
c) Construction Completion Review
d) Acceptance Testing Review

3.3.3 Engineering Change Procedure

The *Contractor* takes note of the *Employer's* Engineering Change Procedure (240-53114026). Engineering changes includes any proposed change originating from engineering, *Contractor*s, project management or construction management.

The Engineering Change Procedure applies to the *Employer's* personnel or *Contractor's* performing engineering or engineering related work where the quality of the engineering work performed is the direct responsibility for the *Employer*

3.3.4 Process for Submission of Documents

The *Contractor* submits all documents according to the accepted VDSS. The process for the submission of documents is described below:

a) The *Contractor* submits the documents/drawings to the *Project Manager.*
b) The *Employer's* Document Controller registers the documents.
c) The *Employer's* Document Controller will supply the documents/drawings to all relevant parties within the *Employer's* project team.
d) The *Employer's* project team reviews the documents/drawings and will submit all comments or inputs to the *Project Manager* and the *Project Manager* submits to the *Contractor* for consideration.
e) If the *Employer* finds major deficiencies in the submitted documents/drawings, the *Contractor* revises the documents/drawings and resubmits to the *Project Manager*.
f) The *Employer* reviews the documents/drawings and if no major deficiencies are found, the *Contractor* organises a Design Review session.
g) The *Employer* and the *Contractor* conduct a Design Review.

h) If any fundamental errors were found in the designs or further actions are required, the *Contractor* record all concerns raised and revises the designs.
i) The *Contractor* organises a Design Review session once all designs were revised according to the concerns raised by the *Employer.*
j) If no fundamental errors were found in the designs during the Design Review session, the *Contractor* compiles the Design Review minutes or report and submits it to the *Project Manager*.
k) The *Employer's* Document Controller registers the report.
l) 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*.
m) The *Project Manager* will accept the *Contractor's* design once the report/minutes are accepted by the *Employer's* project team.

3.3.5 Time Required for Acceptance of Designs

Not later than one month after receipt, the *Project Manager* will return one copy of the drawing marked "Accepted"; "Accepted with Comments" or "Not Accepted", as may be appropriate. The notations "Accepted" and "Accepted with Comments" authorize the *Contractor* to proceed with the manufacture of the Plant covered by such drawings subject to the corrections, if any, indicated thereon. Where prints or drawings have been "Not Accepted" or "Accepted as Noted" the *Contractor* makes the necessary revisions on the drawings and submit further copies for acceptance in the same procedure as for the original submission of drawings. Every revision shows by number, date and subject in the revision block on the drawing.

3.4 Other requirements of the *Contractor*'s design

3.4.1 Plant coding and labelling

Labelling is the responsibility of the *Contractor* and is done by the *Contractor* in accordance with the *Employer's* standard OPG 0163, "KKS Guidelines Identification System for Power Station".

a) Plant codification is done in accordance with the KKS-system as used at Arnot Power Station. The *Employer* in conjunction with the *Contractor* does the codification.

b) The *Employer* shall only supply codification numbers to the *Contractor* after receiving protection zone designs and schedules for the control and indicating equipment.

c) The *Contractor* ensures that the KKS codes are applied in a uniform and consistent way and that all codes allocated are unique.

d) The *Contractor* is responsible to supply identification labels (engraved on aluminium anodised) to provide the *works*.

e) The *Contractor* ensures that all plant, materials, component and documentation to supply the *work* is codified correctly.

f) Abbreviations to descriptions are done in accordance with standard specification GGS 0443.

g) The *Contractor* uses all levels of the coding system to ensure clear identity of signals on the control and indicating equipment. As a minimum, 17 characters are used in the KKS code to uniquely identify each detector signal.

h) All control and indicating equipment shall be identified via a KKS number scheme irrespective of the control and indicating equipment addressing method

3.5 Use of *Contractor*'s design

3.5.1 System Interface

The *Contractor* is responsible for all system interfaces which forms part of the *works*. The *Employer* will provide the relevant information defining the system interfaces. The *Contractor* caters for all the identified interfaces.

3.5.2 Equipment Layout

All panels are installed at least 800mm from the wall.
The *Employer* will provide the existing and proposed substation layouts. The substation layouts can be seen in Appendix 6. The *Contractor* is responsible for the as-built substation layouts after the Plant is installed.

The *Contractor* is responsible for the final positioning of the Plant forming part of the *works*. The *Contractor* assesses any possible clashes with the existing structures and equipment in the substations. The *Contractor* notifies the *Project Manager* of any possible clashes before the Plant is delivered to site.

3.5.3 Current and Voltage Transformers

The *Contractor* reuses the existing current transformers and voltage transformers. The details of the existing CT's and VT's are specified in the existing schematic diagrams and switchgear schedules found in Appendix 5.

The *Contractor* verifies the characteristics of the installed CT's with those indicated in the drawings through routine tests as agreed with the *Employer.* Whereby a CT or a VT fails the agreed routine tests, the *Contractor* informs the *Project Manager* for sourcing of a replacement CT or VT to be installed by others and tested by the *Contractor.* The *Contractor* submits copies of the CT's and VT's test results with the SAT file.

The *Contractor* is responsible for all the secondary circuit starting from the CT and VT terminals. Although some of the wiring on the existing protection schemes will be reused, it remains the responsibility of the *Contractor* to ensure that the wiring is still in good reusable condition through conducting the required verification tests agreed with the *Employer.*

3.6 Design of Equipment

No additional requirements for the design of equipment over and above those specified in Clause 23.1 of the contract data.

3.7 Equipment required to be included in the *works*

None

3.8 As-built drawings, operating manuals and maintenance schedules

a) **Language**

All documentation, including reports, manuals, etc. is in the English language.

b) **Type Test Reports**

Type test reports represent the design of each component and equipment type offered. The type test report is provided in full, containing all records of the tests conducted as well as the drawings. Soft copies are provided for all type test documentation.

c) **Manuals**

The technical, training, maintenance and operating manuals are provided for each type (e.g. for different ratings, voltage levels etc.) of component or equipment. Technical manuals include all technical data, information on the component/equipment construction as well as the technical data and leaflets of each individual component used in this project. Where generic manuals are provided, an addendum is provided indicating the applicable project specific components.

Manuals are of a good quality and cover the following as a minimum:

i. Technical descriptions of the equipment and component parts
ii. General arrangement drawings
iii. Installation instructions with drawings or pictures
iv. Operating and maintenance instructions for all components
v. Detailed parts lists (accompanied by exploded view type drawings clearly detailing the part and uniquely identifying it)
vi. Spare part ordering instructions

Any special instructions pertaining to storage of spare parts or their shelf life is included in the maintenance manual. All drawings requested for component location, dismantling and re-assembly for maintenance are included in the maintenance manual. All special tools required for operating and maintenance of the equipment are presented in a form of a schedule in the operating and maintenance manual, respectively. The content of the training manual is based on the content of the technical, operating and maintenance manuals.

3.8.1 Drawing Requirements

The *Contractor* provides drawings for the required components and equipment. The *Employer* provides typical drawings for tender purposes only and will form the basis for the design and also formatting.

The *Contractor* supply reproducible drawings according to the applicable VDSS. The *Contractor* develops the following minimum requirements for the drawings:

3.8.1.1 Drawing Numbering System

The following Eskom drawing numbering system is proposed for the new MV Switchgear drawings. The *Contractor* may assign his own drawing number as required to meet his document control system requirements:

Table 5: The proposed drawing numbering system

Sheet number		
A-F	*Contractor*	Cover Sheet
G-Z	Employer	Cover Sheet
1-30	Employer	Switchgear Schedule
31-40	*Contractor*	Summary Sheet

41-49	*Contractor*	Bus Wiring Arrangement
50-55	*Contractor*	General Arrangement Drawing
56-100	*Contractor*	Schematic Drawings
101-199	Employer	Cable Block Diagram
200-299	Employer	Cable Schedule
300-399	Employer	Cable termination Drawings
400-499	Employer	Schematic Drawings

The number of each switchboard drawing shall be noted on the single line drawing for easy referencing.

3.8.1.2 General Arrangement Drawings

The *Contractor* provides general arrangement drawings completely dimensioned, showing:

a) Arrangement of equipment offered and also superimposed on the existing equipment (i.e. switchgear protection), where applicable.
b) Plant, front view, and other elevation views.
c) Required clearances for opening doors and for removing breakers.
d) Conduit or cable entrance locations for bottom entrance.
e) Venting duct arrangement and opening requirements (if required).
f) Busbar locations and configurations.
g) Incoming and outgoing cable termination positions.
h) The height of all cable glands above floor level.
i) Instrument transformers (i.e. VT's and CT's) physical positions.
j) Position of control panels and associated relays and IED's.
k) Position of earth switches.
l) Terminal block locations.
m) Earthing connections.
n) Details and position of the holding down bolts.

3.8.1.3 Schematic Drawings

The *Employer* provides typical functional protection and control block diagrams in the Referenced Documents of section 3.2.1, which will have to be used as guidelines for the development of schematic drawings for the protection, control and monitoring schemes. Schematic diagrams provided by the *Contractor* will show the following:

a) All protection and control devices and their contacts, each of which are labelled with its correct ANSI device function number, or reference.
b) Device terminal numbers, terminal block numbers and terminal numbers.
c) All internal interconnections, bus wiring, inter-panel wiring and connections to external equipment such as Control and Instrumentation (C&I) panel.
d) All control and protection switches
e) Power supply connections

3.8.1.4 Wiring Diagrams

The *Contractor* provides detailed wiring diagrams to show the following:

a) Approximate physical locations of all items in each control panel.
b) All interconnecting wiring between control panels.
c) Identification of all terminals, terminal blocks, and wires by numbers.

d) Clear identification, by some distinguishing method, of all wiring which will be installed by the *Contractor*. This will include, but not be limited to, leads from external current transformers, trip circuits from remote devices, auxiliary contacts to remote devices, incoming dc control power, and separate incoming ac power. This also includes spare auxiliary contacts and relay contacts which are wired to terminal blocks for future use.

3.8.1.5 Single-Line Functional Diagrams

The *Contractor* provides single line diagrams for each circuit to illustrate the functionality and interfaces between protection, control and metering systems. Such a diagram will show the following:

a) All power circuit equipment and their descriptions including type and specifications.
b) Electrical connections of instrument transformers (i.e. VT's and CT's) with relation to the cabling of protected Plant.
c) Details of the instrument transformers
d) Protection devices and the description of functions provided with their ANSI device numbers.
e) Protection scheme
f) Metering points
g) Tripping and control (including interlocking logic)

The *Contractor* provides single line diagrams for Engineering Workstation to show the functionality and interfaces between the different components and subsystems. Such a diagram shows the following as a minimum:

a) All Engineering Workstation devices and their descriptions including type and specifications.
b) System architecture for the conceptual design illustrating all the communication links from station level up to board level.

3.8.2 Operating and Maintenance Manual

The *Contractor* provides operating and maintenance manuals as per the requirements stipulated in Technical Schedule A and B in Appendix 11.

The procedures are provided by the original equipment manufacturer detailing descriptions of the maintenance work for each component and equipment offered. The procedure covers the requirements for maintenance of the components and equipment over the design life.

3.8.3 Maintenance Schedule

The *Contractor* ensures that the MV Switchgear Protection design and construction and component selection is such that maintenance interval is 2 years or more.

The equipment of the same rating should be fully interchangeable to allow for low inventory and reduced down-times.

The *Contractor* ensures that the MV Switchgear Protection offered, as well as the EWS has a production lifetime for at least 10 years after Contract Date (this excludes production for spares only). The equipment and MV Switchgear Protection supplied are the same over the *works*.

4. Procurement

4.1 People

4.1.1 Minimum requirements of people employed on the Site

Specify any constraints relating to people employed to Provide the Works; for example permits for foreigners, training (other than H & S), use of labour from designated areas and industrial relations.

4.1.2 BBBEE and preferencing scheme

Specify constraints which *Contractor* must comply with after contract award in regard to any Broad Based Black Economic Empowerment (B-BBEE) or preferencing scheme measures.

4.1.3 Accelerated Shared Growth Initiative – South Africa (ASGI-SA)

If the ASGI-SA requirements are to be included in this contract specify constraints which *Contractor* must comply with after contract award in regard to any ASGI-SA requirements. The ASGI-SA Compliance Schedule completed in the returnable tender schedules is reproduced here. If ASGI-SA does not apply, delete this paragraph.

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* shall keep 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.

4.2 Subcontracting

4.2.1 Preferred subcontractors

ECC does not make use of nominated subcontracting, but the *Employer* may list which sub*Contractor*s or suppliers the *Contractor* is required to enter into subcontracts with. This is usually only required where Plant and Materials need to be obtained from a particular supplier or group of suppliers in order to comply with operational standards.

Where tenderer of the protection and related equipment is not the Original Equipment Manufacturer (OEM), the license agreements with OEM, their distributors and/or agents shall be in place, with proof of this provided by the tenderer in writing with the tender submission The duration of the agreement should match that of the Contract.

4.2.2 Subcontract documentation, and assessment of subcontract tenders

Specify any constraints on how the *Contractor* is to prepare subcontract documentation, whether use of the NEC system is compulsory or not (compulsory is recommended) and how subcontract tenders are to be issued, received, assessed (using a joint report?) and awarded.

4.2.3 Limitations on subcontracting

The *Employer* may require that the *Contractor* must subcontract certain specialised work, or that the *Contractor* shall not subcontract more than a specified proportion of the whole of the contract.

4.2.4 Attendance on subcontractors

State requirements for attendance on Sub*Contractor*s, if any

4.3 Plant and Materials

4.3.1 Quality

All Plant and Materials are new, unused, and free from defects and imperfections.
The *Contractor* will not use Plant or Materials which are generally recognised as being unsuitable or otherwise to be avoided for the purpose for which they are intended.

Only components of high reliability will be utilised, with a proven operating history, to enable the Plant to achieve required reliability and availability. Plant and Material design, engineering and manufacture will accord with the best modern practice applicable to high-grade products of the type to be furnished, so as to ensure the efficiency and reliability of the *works* and the strength and suitability of the various parts for the *works.*

Plant and Materials withstand ambient conditions and the variations of temperature arising under working conditions without distortion, deterioration or undue strains in any part.

All parts are made accurately, and where practicable, to standard gauges so as to facilitate replacement and repairs. Like parts are interchangeable.

No repair of defective Plant and/or Materials will be permitted without the *Project Manager's* approval and any such repair, if approved, will be carried out to the satisfaction of the *Employer.*

The *Contractor* ensures that co-ordinated and formally documented management system is in place for the assurance of quality as specified in ISO 9001, Quality management Systems – Requirements.

The *Project Manager* is free to specify hold and witness points during the installation and on-site testing stages of the project. The *Contractor* issues preliminary notification of such hold and witness points by fifteen working days advance notice to the *Project Manager* and confirms such hold and witness points at least seven days prior to the activity.

Typical holding points are listed below:

a) Type Testing Approval
b) Prototype approval
c) Design Review
d) FAT
e) Delivery to Site
f) Erection
g) SAT
h) All manuals and drawings (in the specified format)
i) Commissioning

In addition to maintaining appropriate inspection and test records to substantiate conformance to requirements, the following records are safely stored for a minimum period of seven years following the final completion of the *works:*

a) Construction, layout and component approvals
b) Type and routine test certificates
c) Construction drawings and approvals

All the work is done in accordance with the quality management system of Arnot Power Station as set out in the quality manual, in addition to the ISO 9001:2008 quality management system, as well as Eskom Quality Standard QM 58. High quality standards are also assured by conforming, but not limited, to the following:

a. The use of sound design and engineering principles,
b. The design process uses a good performance and functional specification,
c. It is ensured that the installation conforms to the Technical Specification.
d. Design Review Procedure is followed
e. Engineering Change Procedure
f. Electrical Asset Creation Process
g. QA/QC on project (manufacturing, installation, commissioning)

4.3.2 Plant & Materials provided "free issue" by the *Employer*

No new Plant and Materials will be free issued by the *Employer*, except the re-use of existing plants and materials (if the *Contractor* envisages using it).

4.3.3 *Contractor*'s procurement of Plant and Materials

The functional units, such as the EWS and Buszone panels are suitable for handling and removal by providing mechanism for crane hooks. The functional unit is suitable for handling and removal by providing mechanism to avoid damage to the functional unit. During transportation the electrical components are packaged in such a way that damage is prevented. Components of the functional unit that are transported separately are marked accordingly and are easily identifiable.

The *Contractor* supplies the labelling for the Plant that forms part of the *works*. The *Contractor* provides labels for the MV Switchgear protection and EWS according to 0.00/10343. The *Contractor* makes use of the KKS codes provided on the Switchgear Schedules and Existing protection Schemes in Appendix 5.

The labels are affixed in such a way that they are easily legible and not obstructed by the wiring or by other components.

Clamping methods applied to the labels ensures that removal of the labels requires force.

The KKS codes are used accordingly on documentation (e.g. drawings, manuals, equipment lists, cable schedules etc.) as a unique identification means. References to plant are accompanied by the relevant KKS code for that item of plant.

Abbreviations to descriptions on the labels are generally not acceptable. Where abbreviations are unavoidable, due to the limited number of characters that can be engraved/etched on labels, the abbreviations are submitted to the Project Manager for acceptance. The *Contractor* makes use of the Employer's Standard Plant Related Abbreviations for Inter-System Use GGS0968.

4.3.4 Spares and consumables

Development of the Plant and Materials is not considered complete until the *Contractor* has provided a comprehensive list of spares to be held in stock which, at minimum, include one of each of the different rectifier and controller modules, auxiliary relays, MCBs, switches, lamps as well as empty sub-racks, plugs and sockets and consumable items, if any.

The *Contractor* provides as part of the tender proposal, a recommended parts list as well as a proposal for the execution there of. The *Contractor* makes use of the list of spares template provided by the *Employer* in Appendix 17.

The *Contractor* prices each spare item individually in the price schedule and the lists include a description of the item, a reference number and the pricing details.

The *Employer* is responsible for purchasing of recommended spares.

The *Contractor* is responsible for ensuring that consignment spares are available when required.

All spares is delivered in approved packaging suitable for storing such parts over a period of ten (10) years without damage or deterioration.

Each recommended spare part is uniquely identified with a part number, which can be cross referenced to a part list and associated drawing.

The *Employer* prefers that support from the OEM is available locally in South Africa.

4.4 Tests and inspections before delivery

The *Employer* carries out quality inspections at his discretion.
All inspections and testing to be performed in accordance with the Quality Control Procedure (QCP) developed by the *Contractor*.

4.4.1 Factory Acceptance and Testing (FAT)

The *Employer* will inspect and test some parts of the Plant at the manufacturer's premises before dispatch, where required. The *Contractor* advice on a period required for the inspection and testing activities of part of the Plant. The *Supervisor* then advice on the parts of Plant and Materials he needs to inspect and/or test and the *Contractor* makes allowance in the delivery time to cater for this requirement.

The *Contractor* supplies a detailed procedure that is used for Factory Acceptance Testing (FAT) to be accepted by *Project Manager*, 30 calendar days prior to starting date of the first FAT. The *Contractor* gives the *Supervisor* at least 14 calendar days' notice of the date on which any panel is ready for inspection and testing.

The following tests and checks are conducted by the *Contractor* as a minimum:

a) Visual inspections to verify the mechanical and/or physical integrity of the Plant as well as specifications of the major and/or active components.
b) Dielectric test of auxiliary wiring and control circuitry.
c) Verification of the functionality of the different circuit protection schemes integrated in the switchboards. The verification to include continuity checks on the circuits.
d) Verification of the functionality of the different components and systems measurements and metering panels.
e) Verification of the functionality of the substation automation system.

4.4.1.1 Factory Inspection and Clearance for Dispatch

The *Supervisor* will inspect the protection schemes, or panels (Buszone and EWS), HVAC material forming part of the Plant before they are released from the *Contractor's* premises. This inspection entails a thorough

check to ensure complete compliance with this specification including schedules, design drawings and other applicable standards.

The *Contractor* obtains clearance from the *Supervisor* before despatching of the Plant. This factory release inspection and clearances provided by the *Employer* do not release the *Contractor* of any of his obligations under the contract.

No Plant will be released for dispatch without the AS MANUFACTURED documentation and drawings accompanying them.

4.5 Marking Plant and Materials outside the Working Areas

The *Contractor* is requested to mark all identified items of Plant and Material with the Contract and Order numbers.

Plant and Material is delivered to either the Site or the *Contractor's* works.

The following requirements apply to the off-Site marking of Plant, Materials and Equipment:

a) The *Contractor* gives two (2) weeks' notice to the *Supervisor* and it is shown in the Accepted Programme.

b) The notification to the *Supervisor* is accompanied by a comprehensive inventory of all Plant, Materials and Equipment ready for marking by the *Supervisor*.

c) Plant, Materials and Equipment located at the *Contractor's* Sub*Contractor*/s or sub-suppliers are not considered ready for marking.

d) Only Plant, Materials and Equipment physically located at the *Contractor's* facility are considered ready for marking.

4.6 *Contractor*'s Equipment (including temporary works).

The *Contractor* supplies, installs, maintains and removes all temporary construction facilities and utilities necessary to provide the *works*.

The *Project Manager* is free to specify hold and witness points during the installation, inspection and testing of the control and indicating equipment. The *Contractor* issues preliminary notification of such hold and witness points by ten (10) working day advance notice to the *Project Manager* and confirm such hold and witness points at least five (5) working days prior to the activity.

The *Contractor* installs, inspect and test all equipment within his scope of supply including any other items/equipment the *Project Manager* has specified (free issue items).

The *Contractor* conducts the installation, inspection and testing of the *works* within the limitations of the existing plant, maintenance work pre-formed by others, access restrictions to services such as crane usage, process conditions of other interdependent plant areas online etc.

4.7 Cataloguing requirements by the *Contractor*

5. Construction

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

5.1 Temporary works, Site services & construction constraints

5.1.1 *Employer*'s Site entry and security control, permits, and Site regulations

All Site access is controlled through the designated access gate.
The *Contractor* is informed of the access procedures through Site regulations and that such procedures may change depending on the prevailing security situation.

The *Contractor* is to comply with all Site regulations and instructions. The onus is on the *Contractor* to ensure his familiarity with the Employer's Site regulations and inspections.

Recruitment outside the *Employer's* security office is not allowed. Local privately owned recruitment offices to be utilised.

No person will be issued with an access permit without proof that the person did attend the local Arnot Power Station induction course.

A one-day access permit will be issued for persons attending the induction course. It is the *Contractor's* responsibility to arrange with the *Project Manager* one week in advance for a course booking.

5.1.2 Restrictions to access on Site, roads, walkways and barricades

All vehicles must be driven with due consideration for personnel and property. A maximum speed limit of 40 kilometres per hour will be adhered to on the premises at all times. No personnel at the back of any vehicle.

The *Contractor* shall provide and install fixed barricades and warning devices to ensure that equipment and persons are not exposed to danger or to prevent access to dangerous areas.

All welding, flame cutting and grinding work shall be properly screened to protect persons from arc flashes or eye injuries.

All grating shall be covered with an adequate protective screening when welding or flame cutting.

5.1.3 People restrictions on Site; hours of work, conduct and records

Restrictions and hours of work may apply on some Sites. It is very important that the *Contractor* keeps records of his people on Site, including those of his Sub*Contractor*s which the *Project Manager* or *Supervisor* have access to at any time. These records may be needed when assessing compensation events.

5.1.4 Title to materials from demolition and excavation

The *Contractor* has no title to materials from excavation and demolition.
All reusable equipment will remain the property of the *Employer*.
All scrap daily to the scrap yard.

5.1.5 Cooperating with and obtaining acceptance of Others

This sub-paragraph could be used to deal with two issues.

1. The cross reference from core clause 25.1 about cooperation generally as well as details about Others with whom the *Contractor* may be required to share the working areas. See clause 11.2(10) for the definition of Others.
2. Requirements for liaison with and acceptance from statutory authorities or landowners.

5.1.6 *Contractor's* Equipment

Records are to be kept of Equipment on Site including whether it is owned or hired. The *Contractor* is responsible to provide his own scaffolding, lifting equipment, mobile cranes and forklifts where required.

5.1.7 Equipment provided by the *Employer*

The *Employer* will make available his fixed overhead cranes. Only authorised personnel allowed operating these.

5.1.8 Site services and facilities

5.1.8.1 *Contractor's* Yard

A site for the *Contractor's* yard is provided by the *Employer*. A written request, indicating the *Contractor's* requirements in locality and area of storage, office and Workshop sites is submitted to the *Project Manager* as soon as possible after the Contract Date.

5.1.8.2 Potable water

Potable water for construction purposes is also available free of charge. Any installation is for the *Contractor's* account.

5.1.8.3 Sanitary Facilities

Sanitary facilities are provided by the *Employer*.

5.1.8.4 Fire Protection

The *Contractor* is to comply with requirements of Eskom Standard NWS 1494 Revision 4 "Fire prevention and protection of *Contractor's* premises on Engineering Sites" and of Site Regulations pertaining fire protection. (NWS1494 Revision 4).

Any tampering with the *Employer's* fire equipment is strictly forbidden. All exit doors, fire escape routes, walkways, stairways and stair landings must be kept free of obstruction, and not to be used for work or storage at any time. Firefighting equipment must remain accessible at all times.

5.1.8.5 Conditions of Power supply for Erection

In order to comply with the Electrical Installation Regulations under the Occupational Health and Safety Act, no 85 of 1993 the following requirements are met before electricity is supplied it is expected that the *Contractor* is in possession of a valid certificate of compliance. Your electrical installation is inspected and tested by an accredited person to ensure that it complies with the requirements of the Occupational Health and Safety Act, 1993 and the code of Practice for wiring of premises, SANS 10142. After you have obtained the certificate of compliance, the *Employer* is to inspect your electrical installation and if satisfied, it is connected and supplied from the construction power supply.

The *Contractor* provides at his own expense all temporary wiring and cabling to lead power from the *Employer's* supply points, to where it is required, maintain same and remove on completion. These points of supply are the points designated by the *Project Manager*.

Warning:
Phase rotation may change during power supply breaks. *Contractors* are responsible to check rotation of their Equipment before recommencing work.

There is no charge for electricity used for construction purposes and no connection fee is levied for the point of supply.

The *Contractor* shall provide everything else necessary for providing the Works.

5.1.9 Facilities provided by the *Contractor*

The *Contractor* provides, erects and maintains for own use, adequate size office accommodation and stores together with such drainage, lighting, heating and hot and cold-water services as may be required in the area designated by the *Project Manager*.

The *Contractor* is to dismantle and clear off site all such temporary structures and associated foundations and infrastructure.

5.2 Completion, testing, commissioning and correction of Defects

5.2.1 Work to be done by the Completion Date

On or before the Completion Date the *Contractor* shall have done everything required to Provide the Works except for the work listed below which may be done after the Completion Date but in any case, before the dates stated. The *Project Manager* cannot certify Completion until all the work except that listed below has been done and is also free of Defects which would have, in his opinion, prevented the *Employer* from using the *works* and Others from doing their work.

	Item of work	**To be completed by**
	As built drawings of	Within days after Completion
	Performance testing of the *works* in use as specified in paragraph of this Works Information.	See performance testing requirements.

Work to be done by the Completion Date

Completion of each section of the *works* is when the following is approved by the *Employer* in accordance with the Works Information.

Investigation phase

Design and engineering phase

- Technical clarification stage.
- Design freeze stage

Production engineering phase

- Procurement, fabrication and delivery stage.

- Factory acceptance test stage

Construction and erection phase.

Commissioning phase

- SIT stage
- Commissioning stage.
- SAT stage.

Operational test phase.

- Use of the *works* before Completion is certified

The *Employer* uses the *works* to return the part of the *works* to service in order to commission and perform the Site Acceptance and Operational testing before Completion of the *section* of the *works.*

Commissioning

Each individual system is subjected to this phase. This means that each sub system as well as the system as a whole is subjected to this phase. This phase shall be done in accordance with the requirements of NFPA 72 Section 14 and SANS 10139.

Commissioning procedures and Test Certificates

The *Contractor* prepares commissioning procedures and test certificates for the commissioning of the control and indicating equipment. The format of this procedure and certificate is for the *Project Manager*'s acceptance.

Installation activities

The *Contractor* is responsible for planning, organising, and execution of the various functions involved in the different segments as part the installation scope of work. The works are subjected but not limited to the following:

a) The installation of the control and indicating system equipment.

b) The integration of the equipment and installation field detectors and sensors

c) The installation of the relevant GUI equipment, and peripheral devices and engineering room equipment.

d) The installation of the communications and control networks systems.

e) The erection and installation of new cubicles/panels and any infrastructure required to house equipment in the engineering room and plant.

f) The erection and installation of any infrastructure, in addition to the civil work done, required to house or contain the *Contractor's* equipment.

g) The *Contractor* is responsible for the provision and storage of all temporary or expendable materials required.

Note: The sequence of supply and installation to be reflected in the activity schedule and accepted program.

Site integration tests (SIT)

The *Contractor* carries out SIT to ensure the correct performance of the control and indicating equipment's management and monitoring functions. Most importantly, this is performed to ensure safety of plant and personnel, and to ensure compliance with the Works Information

The proposed test procedures, together with test dates, are prepared by the *Contractor* and submitted to the *Project Manager* for acceptance during the system engineering and design phase.

Control and indicating optimisation

The *Contractor* performs the optimisation of the control and indicating equipment to meet the performance requirements of the *works*.

Site acceptance test (SAT)

With this test the *Contractor* demonstrates that the fire detection system meets all the requirements of the Functional Design

Operational testing
The *works* is run continuously by the *Employer* for a period of 336 hours without any hardware or software malfunction. During this period any and all management and monitoring functions may be exercised.

In the event of any hardware or software Defect, the *Contractor* corrects the Defect and based on the nature/merit of that Defect, the *Project Manager's* sole discretion can then allow the 336-hour test to continue or inform *Contractor* that the test be restarted.

This testing phase will entail a 336-hour window for a fully function Emergency Management System.

During the operational test, the w*orks* is not deemed in use until the *Project Manager* certifies Completion.

Verification

A third-party inspection is conducted on the completed installation to confirm operability and conformance to the code of practice. The following to be submitted with tender documents:

- Third party inspector's proof of accreditation
- Include in the price list

If any rectifications are necessary to provide full compliance and certification of the installation, costs will be for the *Contractor's* account.

Access given by the *Employer* for correction of Defects

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

Performance tests after Completion
The *Contractor* has to demonstrate after completion of the *works* that *his* design and installation is compliant to the reference standard used in this specification.

Training and technology transfer

Included in the Works is extensive training for the *Employer's* personnel on all aspects for the Engineering, Maintenance and Operating personnel.

Training of the *Employer's* personnel

a) Product training of advanced maintenance and engineering staff as specified is required before the commencement of any design work.

b) Training provided by the *Contractor* is directly applicable to Arnot Power Station control and indicating equipment system hardware and software components.

c) Training for the *Employer's* Operating, Maintenance and Engineering staff takes place off-site and at Arnot Power Station.

d) All the training material and manuals, provided by the *Contractor*, including third party documentation are in English.

e) Training dates are indicated in the Accepted Programme. At design freeze the *Contractor* submits the final training programme for acceptance by the *Project Manager*.

f) Training for the *Employer's* Engineering and Maintenance staff to commence after the Design Freeze phase. For the *Employer's* Operating staff, the training is completed before SIT commences.

g) Training manuals are continuously updated by the *Contractor* up to Completion of the whole of the *works*. The training programme on the updated manuals relating to modifications necessary to achieve the Completion of the whole of the *works* is presented to the *Project Manager* for acceptance one week prior to the operational test phase. The training relating to the updated training manuals in the different training categories are presented during the operational test phase.

h) Practical hands-on training, by the *Contractor*, of the *Employer's* personnel during the whole implementation forms an integral part of the training process.

i) Training on all the components of the control and indicating equipment for the *Employer's* maintenance and engineering staff are official and accredited.

j) On completion of the training programmes the *Employer's* personnel are tested, evaluated and declared competent by the *Contractor*.

Training categories

There are four (4) categories of training provided by the *Contractor*:

a) Basic Maintenance staff training, the training includes as a minimum: (Applicable to all the components and levels of the control and indicating equipment)

i. Familiarisation with documentation including drawings and system configuration.
ii. Hardware and software familiarisation.
iii. Change panel text, zone text, individual point text
iv. Add/delete addressable devices
v. Modify addressable devices
vi. Change individual point addresses
vii. GUI displays, LCD displays reports and logs configuration.

viii. Programs storage, backup and reloading.
ix. Archived data storage, backup and reloading.
x. Control and communication network configuration
xi. Hardware installation, configuration and planned maintenance.
xii. Software installation, configuration and planned maintenance.
xiii. Maintenance of the control and indicating equipment through the use and interpretation of diagnostic, maintenance and monitoring functions, routines and error codes on-line for fault finding and the detection of faulty equipment on the detection zones, right through to the network.
xiv. Basic process of the control and indicating algorithms, control, zones, detection loops, operations as applied at Arnot Power Station to Provide the Works.
xv. Utilisation of the SMS server to access and generate required documentation for maintenance purpose for all the levels of the process control and monitoring system.
xvi. Power distribution and isolation facilities (220V AC and 24VDC)
xvii. UPS and Battery Chargers maintenance, diagnostic and configuration functions.

b) Operating personnel training includes as a minimum:

i. Familiarisation with the process of control and indicating equipment.
ii. Familiarisation with documentation i.e. operating manuals.
iii. GUI operating functions including mouse & keyboard handling, interpretation of displays, supervisory plant control, plant monitoring, navigation, alarms, messages, user configurable displays and functions, display conventions, logs, reports, retrieval of historic information, use of peripheral devices.
iv. LCD displays and navigation
v. Power distribution and isolation facilities (220VAC and 24VDC)
vi. UPS and Battery Chargers operating and diagnostic functions.
vii. Alarm & Event Viewer user training.

c) Training of engineering staff includes as a minimum: (Applicable to all the components and levels of the control and indicating equipment)

i. All the elements of the Maintenance staff training.
ii. Software development, debugging and testing.
iii. Software configuration and high-level programming.
iv. Development and configuration of GUI displays, LCD displays, logs, reports and navigation design.
v. Database administration, configuration.
vi. Backup, archiving and disaster recovery of all software components.
vii. Control and communication network design, configuration and fault finding.
viii. Development, configuration, administration and operation of the integrated forward documentation system.
ix. Security administration at all the levels of the control and indicating equipment.
x. Engineering drawings updates, modification implementation on all the levels of the control and indicating equipment, administration.
xi. Power distribution and isolation facilities (220V AC and 24VDC)
xii. UPS and Battery Chargers maintenance, diagnostic configuration functions.

d) End user training

i. Familiarisation with the control and indicating equipment.
ii. The GUI, LCD operating and navigation functions.
iii. Generation of reports.

- **Number of participants**

Categories:

a) 4
b) 6
c) 4
d) 12

The *Employer* bears the cost of salaries, accommodation, other allowances and travelling expenses of his personnel, but all other costs are borne by the *Contractor.* The *Contractor* provides a quotation with rates for additional (repeat) training courses, if required by the *Employer*, with a validity period of one (1) year after Completion of the whole of the *works*.

Participation of the *Employer's* staff

a) The *Employer* intends to second staff part and full time to the *Contractor's* team without affecting the Prices. The aim is to allow "on the job" training in order to become familiar with all the equipment.

b) The *Employer* also intends to second engineering personnel during the design, engineering, and installation and commissioning up to the testing phases.

c) *Employer's* seconded staff is not to be viewed as part of the *Contractor's* resources required to Provide the Works. The *Employer* may withdraw such staff at any time.

d) The *Contractor* provides any requisite training to the *Employer's* staff before secondment.

Training constraints

a) Maintenance and engineering personnel

Two sessions are performed by the *Contractor*.

b) Operating personnel

Two sessions are performed by the *Contractor*.

c) Operating personnel

Two sessions are performed by the *Contractor*.

d) End user staff

Two sessions are performed by the *Contractor*.

Operational maintenance after Completion

The *Employer* may require the *Contractor* before the *defects date* to perform certain duties after Completion and take over which relate to maintenance of the *works*.

Plant and Materials standards and workmanship

This section of the Works Information contains all the specifications for the work which is left behind; the permanent works. It is likely to be the largest section by far and may even be compiled in volumes, e. g. Section 6 Volume 1: Civil Engineering Works. In design and construct contracts, it may be compiled in accordance with systems within the *works*; e. g. Section 6 Volume 4: Crushers.

Because practice varies widely between employers it is not practical in a general template such as this to deal with all arrangements. Only the discipline-based section subheadings are provided below in the order the *works* are likely to be constructed together with some notes of a general nature.

5.3 Investigation, survey and Site clearance

Some contracts may require the *Contractor* to carry out further investigation of existing facilities or of the Site before commencing final design. There could be constraints on Site clearance especially in pipeline or transmission grid servitudes.

5.4 Building works

Reference could be made to the latest Model Trade Preambles published by the Association of South African Quantity Surveyors. However these have been developed for use with the JBCC series of contracts and an approach where description of the work is made part of the bill of quantities, which is not the case in other forms of contract. Only parts of the Model Trade Preambles could be referenced by an ECC contract, with a covering note dealing with the changes in terminology. Further changes are required depending on which parts are to be selected.

This subsection would typically comprise
a) Particular specifications provided by the *Employer*
b) List of standardised specifications applicable to the *works* and
c) Variations to the standardised specifications

5.5 Civil engineering and structural works

Reference could be made to the SANS1200 series of specifications developed and published by South African National Standards. However these are now very out of date and originally developed for use with SAICE general conditions of contract for works of civil engineering which have themselves been superseded twice.
All SANS 1200 specifications are in the process of being updated to make them more compatible with a wider range of contracts, including NEC, and users should check availability of the new SANS 2000 series of specifications.

Sections 3, 4 and 5 of SANS1200A are probably already covered in section 5 of this Works Information.

This subsection would typically comprise
a) Particular specifications provided by the *Employer*
b) List of standardised specifications applicable to the *works* and
c) Variations to the standardised specifications

If use is made of the 1200 series, users should include a covering note dealing with the changes in terminology, such as the one provided below. Further changes are required depending on which specifications in the 1200 series are selected.

5.6 Electrical & mechanical engineering works

These specifications are usually project specific and developed by the *Employer* to suit his operations. Either include these specifications here, or refer to them in attached Annexure.

Check the specifications for inconsistencies in terminology and that they do not contain any provisions already dealt with in the chosen NEC *conditions of contract* or clash with them in any way.

5.7 Process control and IT works

These specifications are usually project specific and developed by the *Employer* to suit his operations. Either include these specifications here, or refer to them in attached Annexure.

Check the specifications for inconsistencies in terminology and that they do not contain any provisions already dealt with in the chosen NEC *conditions of contract* or clash with them in any way.

5.8 Other [as required]

6. List of drawings

6.1 Drawings issued by the *Employer*

This is the list of drawings issued by the *Employer* at or before the Contract Date and which apply to this contract.

Note: Some drawings may contain both Works Information and Site Information.

Drawing number	Revision	Title
		11kV Unit Board ~~1~~
		3.3kV Boiler Board

Drawing number	Revision	Title
26.41/37520		3.3KV & 380V Boiler Board 1 - 6 Switchgear Room Layout
26.41/38321		3.3KV & 380V Substation Board 1A and 2A Switchgear Room Layout
26.41/38321		3.3KV & 380V Substation Board 1B and 2B Switchgear Room Layout
		11kV Station Board 2&4 Switchgear Room Layout
		11kV Station Board 3 Switchgear Room Layout
Drawing number	**Revision**	**Title**
26.41/38321		3.3KV & 380V Substation Board 1A& 2A Switchgear Room Layout
26.41/38321		3.3KV & 380V Substation Board 1B& 2B Switchgear Room Layout
26.41/37528		Unit 1 11KV & 380V Unit Boards Switchgear Room Layout
26.41/37520		Unit 3 3.3KV Boiler Board Switchgear Room Layout
0.41/25375		Unit 4-6 11KV & 380V Unit Boards Switchgear Room Layout
Drawing number	**Revision**	**Title**
0.52/30478		Motors >1MW Protection Scheme
0.52/30479		Motors < 1MW Protection Scheme
0.52/30482		Transformers > 10MVA Protection Scheme
0.52/30481		Interconnector Protection Scheme
0.52/30483		Transformers < 10MVA Protection Scheme
0.52/30476		Incomer Protection Scheme

0.52/30477		Bus Section Protection Scheme
0.52/30474		Maintenance Isolator Protection Scheme
0.52/30475		Double Buszone Protection Scheme
0.52/30480		Arc Protection Scheme (selective and multiple tripping)
Drawing number	**Revision**	**Title**
0.00/10335(Sheet 1- 4)		Wiring termination standard
0.54/430		Isolators padlocks
26.41/37564		Switchgear cable lugs - standard dimensions

7. Appendices

Appendix 2: Typical Functional Block Diagrams

0.52-30474-0-0.pdf 0.52-30475-0-0.pdf 0.52-30476-0-0.pdf 0.52-30477-0-0.pdf 0.52-30478-0-0.pdf 0.52-30479-0-0.pdf

0.52-30480-0-0.pdf 0.52-30481-0-0.pdf 0.52-30482-0-0.pdf 0.52-30483-0-0.pdf

Appendix 3: Protection Scheme Quantities

Arnot Protection Schemes Quantities.x

Appendix 4: MV and LV Switchgear List

MV and LV Switchgear Boards.xl

Appendix 5: Existing Switchgear Schematic Drawings

SHEET 1.pdf Station Board 2AND4 Panel Arrangement.p Substation 1A&2A Panel Arrangement.p Substation 1B&2B Panel Arrangement.p 11KV UNIT BOARD 1 Panel Arrangement.p 3.3KV Boiler Board 1A&1B Panel Arrange

3.3KV BOILER BOARD 1C Panel Arra 11KV UNIT BOARD 2 Panel Arrangement.p 3.3KV BOILER BOARD 2Aand2B PAN

NOTE: UNIT 2 – UNIT 6 ARE IDENTICAL

Appendix 6: Existing Substation Layouts


3.3KV AND 380V SUB-STATION BOARDS


3.3KV & 380V SUB-STATION BOARD


UNIT 1 11KV AND 380V UNIT BOARDS S


UNIT 3 3.3KV BOILER BOARD SWIT


UNIT 4-6 11KV AND 380V UNIT BOARDS L

Appendix 7: Conceptual Engineering Work Station


Arnot Engineering Work Station Architec

Appendix 8: LV Incomer and Main Feeder Standard Schematics


UNIT 1 380V TURBINE BOARD ESS


UNIT 1 380V TURBINE BOARD NO

NOTE: UNIT 1 – 6 ARE IDENTICAL

Appendix 11: Technical Schedule A and B


EWS Technical Schedules A and B.xl


LV Switchgear Technical Schedule A


MV Protection Technical Schedules A


MV Switchgear LV Compartment Door T

Appendix 16: C&I Interface Signals for MV Switchgear


Interfaces for the Existing 2PA Protectio


Existing CI_Interfaces for MV Switchgear_Rev 0.xls


CI_Interfaces for MV 11kV Boiler Board 1 to 6A and B Interface


11kV Boiler Board 1C Interface.xlsx


11kV Station Board 3 Interface.xlsx


11kV Station Board 4 Interface.xlsx


11kV SUBSTATION BOARD 1A and 2A In


11kV SUBSTATION BOARD 1B and 2B In


11kV Unit Board 1 Interface.xlsx


11kV Unit Board 2 - 6 Interface.xlsx

Appendix 18: Equipment Selection and Power Requirements


Equipment Selection and Power Requireme

Appendix 17: List of Spares Template



List of Spares Template.xlsx

C3.2 *CONTRACTOR*'S WORKS INFORMATION

This section of the Works Information will always be contract specific depending on the nature of the *works*. It is most likely to be required for design and construct contracts where the tendering *Contractor* will have proposed specifications and schedules for items of Plant and Materials and workmanship, which once accepted by the *Employer* prior to award of contract now become obligations of the *Contractor* per core clause 20.1.

Typical sub headings could be

a) *Contractor*'s design
b) Plant and Materials specifications and schedules
c) Other

This section could also be compiled as a separate file.

PART 4: SITE INFORMATION

Document reference	Title	No of pages
	This cover page	1
C4	Site Information	
	Total number of pages	

PART 4: SITE INFORMATION

Core clause 11.2(16) states

“Site Information is information which

- describes the Site and its surroundings and
- is in the documents which the Contract Data states it is in.”

In Contract Data, reference has been made to this Part 4 of the contract for the location of Site Information.

1. General description

The project scope highlighted in this works information describes the Employer’s requirements for new medium voltage switchgear protection schemes that also includes Engineering Workstation, Control & Instrumentation interface and heating, ventilation and air conditioning (HVAC) at the Power Station.

2. Existing buildings, structures, and plant & machinery on the Site

The implementation of this project comprises totally of the installation of new facilities as well as hook up to existing facilities. All areas are discussed in the relevant Works Information Documents. Where possible, the necessary drawings have been made available.

3. Subsoil information

No major earth works are required for this project

4. Hidden services

In the event of trenching to be done, consult with the *Project Manager* and or *Project Supervisor* to determine if any hidden services are known. If possible, the necessary drawings will be made available. If no drawings are available, proper detection is to be performed for mainly water pipes and electrical cables.

All excavations are to be done taking care not to damage any underground service.

5. Other reports and publicly available information