

SECTION 6

PROJECT SPECIFICATIONS

In the event of any discrepancy with a part or parts of the Standardised Specifications, the Schedule of Quantities or the drawings, the Project Specifications shall take precedence.

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SECTION 6: PROJECT SPECIFICATION**SCOPE**

The Project Specification is set out in three sections. Section 6.1 covers the general description of the project, the facilities available and the requirements to be met. Section 6.2 covers variations and additions to the SABS 1200 Standardised Specifications while Section 6.3 contains the Particular Specifications that are applicable to this Contract

STATUS

In the event of any discrepancy between the Project Specifications and a part or parts of the SABS 1200 Standardised Specifications, the Schedule of Quantities or the Drawings, the Project Specifications shall take precedence.

SECTION 6.1: THE WORKS**PS-1 PROJECT DESCRIPTION****PS-1.1 The Works**

The Works consists of the installation of pressure control valves, flow meters, demand control equipment and a telemetry system at reservoirs under the Vondo RWS. The work will entail the demolishing of existing manholes constructed using reinforced concrete, the installation of the aforementioned equipment, construction of new manholes to suite site specific requirements at each of the reservoirs, the installation of a telemetry system which is linked to the SCADA SYSTEM which will be installed at the Vondo WTW. It will also include the provision, programming and installation of remote desktop monitors at the head office of the Vhembe DM. The Location of the installation of such remote monitors are to be confirmed during the construction stage. Functionality to transfer relevant data to the cellular phones of predetermined user group will form part of the installation. The project further includes the testing and commissioning of the above system and monitoring thereof for a period of twelve months during the defects liability period.

PS-2 DESCRIPTION OF SITE AND ACCESS

The site is gentle rolling with gradients varying between 1,5 % & 12.8 %. The reservoirs at which the installations must be done is located over an area with a radius of approximately 17km from the Vondo WTW. Please refer to the locality map indicating the positions of all the reservoirs involved. The Vondo WTW is situated due west of Sibasa, approximately 8,6km from the main intersection in Sibasa along the Wylliespoort Road.

The Contractor must make provision in his planning and tendering to work at the different reservoir sites spread over an area with a radius of approximately 17km. No additional payment will be made to the Contractor for this, and allowance must be made in the rates tendered to work over this extended area.

PS-3 NATURE OF GROUND AND SUBSOIL CONDITIONS

The topography of the Site varies from flat to gentle rolling. The natural grades vary between a minimum of 1,0% and a maximum of 12.8% at places.

In general, the Site north of the Thohoyandou-Louis Trichardt Road is underlain by weathered lavas of the Wylliespoort Complex while the portion of the site to the south of the Thohoyandou-Louis Trichardt Road is underlain by weathered granites.

Contractors shall familiarise themselves with all the conditions on site at the site inspection meeting and before submitting their tender. To this end all prospective Tenderers are advised to make full use of the opportunity afforded by the compulsory site inspection and any other inspections on their own if necessary.

A geotechnical investigation was not conducted. This shall however not relief Tenderers to acquaint themselves with all relevant site conditions.

PS-4 DETAILS OF THE CONTRACT

The work to be constructed under this Contract is indicated under PS-4.1 below.

PS-4.1 Construction of Demand Management Equipment, Flow Meters and a Telemetry System at Reservoirs under the Vondo RWS

The work to be carried out under this section includes the following:

- Clearing of the of the areas within reservoir sites where work need to be carried out.
- All trench excavations in accordance with site specific requirements to implement the alterations to the installations at the reservoirs.
- Preparation of the pipe bedding.
- Location and protection of existing services.
- Excavation of trenches in all materials to depths varying between 1,7m and 2,5m.
- Demolishing of existing manholes to enable the alterations to the pipework and installation of the equipment to be installed.
- Removing of sections of pipelines, of varying size, and cutting and adjusting the same to fit new valves and flowmeters.
- Construction of new manholes once installation of equipment has been completed to suite site specific requirements.
- Removal of damaged steel doors at reservoirs with control rooms and the installation of new security doors where required.
- Repair and or replacement of window frames and glazing where required at reservoirs with control rooms.
- Manufacturing and fixing of vandal protection in front of windows.
- Backfilling of excavated pipes and around manholes after completion of all work.
- Installation of air valves, inline valves, flow meters and control valves, level sensors in the reservoirs, solar panels in protection boxes as well as the installation and integration of the telemetry system with the SCADA System installed at the Vondo WTW.
- Repairing and or the replacement of damaged existing fencing and gates. The work will also include the cleaning, preparation and painting of fences and gates which are still in a good condition.
- Reinstating of topsoil and finishing of the work areas at the reservoirs.
- Repair and maintenance of the Works during the defects liability period in accordance with the requirements specified in the Contract documents.
- Final clearance of the site of the works at all the reservoir sites.

Certain items forming part of the scope of the Works shall be constructed using Labour Intensive Construction methods utilizing labour and skilled persons from the local community within the project area. Should sufficient labour not be available from within this area, labour from surrounding areas shall be sourced with the permission of the PSC and the Vhembe District Municipality.

The Contractor shall be responsible for generic training over the duration of the Contract. No separate provision has been made in the Schedule of Quantities for this and the Contractor must allow in his rates for such training. A Provisional Sum has been allowed in the Schedules of Quantities for Accredited Training during the course of the Contract.

All items forming part of the Labour-Intensive component of the project is indicated with the letters **LIC** in the Schedules of Quantities.

PS-5 DRAWINGS

The reduced scale A3 size drawings that form part of the tender documents and issued separately as Volume 2, shall be used for tender purposes only. Only drawings marked, "Issued for Construction", shall be used for the execution of the Works forming part of this Contract. It must be noted that certain specifications, which may appear on the drawings, are not necessarily repeated in the Project Specifications. Where applicable certain items in the Schedule of Quantities refer to the drawings.

PS-6 CONSTRUCTION PROGRAMME AND METHODS

PS-6.1 Preliminary programme

The commencement date will be the date on which the Contractor is given access to the site as set out in the Letter of Acceptance or in a written notice to the Contractor and confirmed in the minutes of the Site handover meeting.

The time for completion for the contract as a whole will be 15 (Fifteen) months. Tenderers may tender for an alternative time for completion in addition to a tender based on the specified time for completion in which case a preliminary programme for the execution of the works within the alternative time for completion shall also be submitted.

The Contractor shall be deemed to have allowed fully in his tendered rates and prices for all possible delays due to normal adverse weather conditions and special non-working days as specified in the Special Conditions of Contract, in the Project Specifications and in the Appendix to Tender. The Contractor shall include with his tender a preliminary programme on the prescribed form to be completed by all Tenderers. The programme shall be in detailed format with sufficient details to show clearly how the works will be performed within the time for completion as stated in the Appendix to Tender. The preliminary programme shall also indicate the critical path for the execution of the Works.

Tenderers must take into consideration when drawing up their programme that it will be expected of them to work on all the various sections of the works with different teams and must also allow therefore in the rates and amounts tendered and no additional payment will be considered in this regard. The execution of the Works shall therefore be programmed in such a way and indicated as such on the programme with the critical path for each of the different sections indicated.

PS-6.2 Programme in terms of Clause 5.6 of the General Conditions of Contract

It is essential that the final construction programme as submitted by the Contractor be furnished within the time stated in the Appendix to Tender. The preliminary programme to be submitted with the tender shall be used as basis for this programme, which shall conform in all respects to Clause 5.6 of the General Conditions of Contract – Third Edition (2015). The Contractor's attention is also drawn to Clause 5.7.1 of the GCC 2015.

PS-7 SITE FACILITIES AVAILABLE**PS-7.1 Contractor's camp site and depot**

Sites for a camp and depot will be allocated to the successful Contractor. For the purpose of tendering, Prospective Tenderers may assume that the site will be within the Project Area and more or less in the centre thereof. The approximate position thereof will be pointed out at the Site Inspection.

The Contractor shall supply, erect, maintain and remove on completion of the Works all necessary offices and shelters erected by him. The sheds for the storage of cement shall be weatherproof, adequately ventilated, with raised floors and the arrangement shall be such that cement can be used in the order in which it has been received.

All these buildings shall be subject to inspection by the Engineer who shall have access to them at all times.

The Contractor shall limit his offices, stores, workshops accommodation and ablution facilities to the site indicated by the Engineer and movement of his plant and personnel shall be limited to the portions of the site indicated.

The Contractor's office for this contract shall be as required to perform his obligations under the Contract. (Also refer to clause PSA-4.2.)

PS-7.2 Accommodation of Employees

The Contractor shall make his own arrangements for the accommodation of his employees and shall provide adequate and suitable housing for all his employees.

The Contractor shall be responsible for keeping all site facilities in a thoroughly clean, sanitary and orderly condition and shall adopt all means necessary to prevent the Site from being polluted by such facilities or in the consequence of its use.

The Contractor shall further ensure that as far as practical, suitable arrangements are made on the Site for the maintenance of health, the prevention and overcoming of outbreaks of disease and of adequate first aid and hygienic services. For this purpose, the Contractor shall provide and maintain a first aid post to suit the needs of his construction staff, as well as the staff of the Engineer.

The Contractor shall erect proper and adequate sanitary facilities for the use of his employees in the vicinity of the Works and at the camp site. Chemical toilets only will be allowed where temporary facilities have to be provided. The Contractor shall obtain the Engineer's approval on the position of such facilities before erection thereof.

PS-7.3 Power supply, water and other services

Water and power is available in the vicinity of the camp site. The Contractor shall make his own arrangements concerning the supply of electrical power, potable water and all other services. No direct payment will be made for the provision of electricity, potable water and other services. The cost thereof shall be deemed to be included in the rates and amounts tendered for the various items of work for which these services are required.

PS-8 SITE FACILITIES REQUIRED**PS-8.1 Site Facilities required by the Engineer**

The requirements of SABS1200 AB Engineer's Office as further amplified in PSAB shall be complied with. The Engineer's Representative and his staff is to be accommodated in a site office as described under PSAB 3.2, to be erected in a position to be approved by the Engineer, within the Contractor's camp. Separate sanitary facilities shall be provided for the sole use of the Engineer and his staff.

The following survey equipment shall be provided by the Contractor for use by the Engineer:

- (i) One (1) Tache
- (ii) One (1) automatic level,
- (iii) One (1) 5m staff and four (4) ranging rods.

Please also refer to PSAB: ENGINEER'S OFFICE for more details of the requirements of the Facilities for the Engineer and his staff.

PS-9 FEATURES REQUIRING SPECIAL ATTENTION**PS-9.1 Procurement Policy, Evaluation and Adjudication Criteria for Tenders**

The Vhembe District Municipality has adopted the "Preferential Procurement Regulations, 2001, Pertaining to the Preferential Procurement Policy Framework Act: No.5 of 2000" as gazetted on 10 August 2001 as guidelines for the procurement and adjudication of Tenders.

In line with the Preferential Procurement Regulations, 2017 as set out in the Regulations Gazette No. 10684 as published in the Government Gazette Volume 619, No. 40553 of 20 January 2017, the successful Tenderer **must** sub-contract a minimum of 30% of the Value of the Works under this Contract. Please also refer to **Clause PS-9.12** for further details of sub-contracting.

PS-9.1.1 Classification of Projects

According to the Draft Procurement Policy of the Vhembe District Municipality, projects will be classified in the following categories with the various requirements in terms of sureties and retention as stated below for the different categories:

- a. Micro Projects $\geq R \ 30 \ 000 < R \ 150 \ 000$
- b. Small Projects $> R \ 150 \ 001 < R \ 500 \ 000$
- c. Medium Projects $> R \ 500 \ 001 < R2 \ 000 \ 000$
- d. Large Projects $> R2 \ 000 \ 001$

This Project is therefore classified as a **large project**. In terms of the above classification of projects in terms of size the following will apply to the different categories.

1. Sureties

The following sureties shall be applicable to the different categories of projects:

- | | | | |
|----|-----------------|---|------|
| a) | Micro projects | - | Nil |
| b) | Small projects | - | 3% |
| c) | Medium projects | - | 7% |
| d) | Large projects | - | 10 % |

A surety of 10% will therefore be applicable to this Contract.

2. Retention

The following limits to retention shall be applicable to the different categories of projects:

- | | | | |
|----|-----------------|---|---|
| a) | Micro projects | - | 2.5% being reduced 1.25% for 12 months |
| b) | Small projects | - | 5% being reduced to 2.5% for 12 months |
| c) | Medium projects | - | 7.5% being reduced to 3.75% for 12 months |
| d) | Large projects | - | 10 % being reduced to 5% for 12 months |

Retention monies withheld on this Contract will therefore be 10% during the Contract Period which will be reduced to 5% for the duration of the 12-month retention or maintenance period.

3. Penalties

The following penalties shall be applicable to the different categories of projects:

- | | | | |
|----|-----------------|---|------------------------------|
| a) | Micro Projects | - | 0,2% of Contract amount /day |
| b) | Small Projects | - | 0,04% of Contract amount/day |
| c) | Medium Projects | - | 0,06% of Contract amount/day |
| d) | Large Projects | - | 0,1% of Contract amount/day |

A penalty of 0,1% of the Contract amount will therefore apply to this Contract.

PS-9.1.2 Evaluation Criteria

The bids will be evaluated in two stages. The first stage will check whether the bidders have submitted all documents as requested on the advert. Although functionality does not form part of the final tender points scoring for award purpose, tenderer will be assessed for responsiveness and functionality first and if the tender is not responsive or meet the minimum functionality score, the tenderer will be eliminated and not considered further for the second stage of evaluation. Functionality will be scored out of 100 and Bidders who do not reach the 70% threshold will not be evaluated further.

The second stage of the evaluation will be based on Price (90) and preference points for B-BBEE status level of contribution (10)

Detailed points scoring for functionality are as follows:

PS-9.1.2 Evaluation of Tenders (Cl. F.3.11)**PS-9.1.2.1 General (F.3.11.1)**

Appoint an evaluation panel of not less than three persons. Reduce each responsive tender offer to a comparative offer and evaluate it using the tender evaluation methods that are indicated in the tender data and described as methods 1, 2, 3 and 4.

The evaluation procedure consists of three phases:

- Phase 1: Tenders will be evaluated for responsiveness to the tender requirements. Tenderers who do not comply will be disqualified.
- Phase 2: Tenderers will be evaluated for functionality/quality. Tenderers who do not meet the minimum requirements will be eliminated; and
- Phase 3: Tenderers will be evaluated based on financial proposals and preference. The Tenderers with the highest points scored will be appointed.

The procedure for the evaluation of responsive tenders is Method 4: Financial offer, quality/functionality, and preference. Tenderers must however score a minimum of **70%** of the quality/functionality points prior to being evaluated on financial offer and preference. Failure to achieve the minimum functionality score will invalidate the tender and the submission will be rejected.

PS-9.1.2.2 Method 1: In the case of a financial offer: (F.3.11.1.1)

- a) Rank tender offers from the most favourable to the least favourable comparative offer.
- b) Recommend the highest ranked tenderer for award of the contract unless there are compelling and justifiable reasons not to do so.

PS-9.1.2.3 Method 2: In the case of a financial offer and preference (F.3.11.1.2)

- a) Score tender evaluation points for each financial offer.
- b) Confirm that tenderers are eligible for the preferences claimed and, if so, score tender evaluation points for preferencing.
- c) Calculate total tender evaluation points (TEV) in accordance with the following formula:

$$\text{TEV} = \text{NFO} + \text{NP}$$

Where: NFO is the number of tender evaluation points awarded for the financial offer

NP is the number of tender evaluation points awarded for preference

- d) Rank tender offers from the highest number of tender evaluation points to the lowest.
- e) Recommend the tenderer with the highest number of tender evaluation points for the award of the contract, unless there are compelling and justifiable reasons not to do so.
- f) Rescore and re-rank all tenders should there be compelling and justifiable reasons not to recommend the tenderer with the highest number of tender evaluation points and recommend the tenderer with the highest number of tender evaluation points, unless there are compelling and justifiable reasons not to do so and the process set out in this sub-clause is repeated.

PS-9.1.2.4 Method 3: In the case of financial offer and quality:

- a) Score each tender in respect of the financial offer made and the quality offered in accordance with the provisions of F.3.11.3 and F.3.11.2, rejecting all tender offers what fail to score the minimum

number of evaluation points for quality in the tender data, if any.

- b) Calculate the total number of tender evaluation points (TEV) in accordance with the following formula:

$$\text{TEV} = \text{NFO} + \text{NQ}$$

Where: NFO is the number of tender evaluation points awarded for the financial offer

NQ is the number of tender evaluation points awarded for quality/functionality

- c) Rank tender offers from the highest number of tender evaluation points to the lowest.
- d) Recommend the tenderer with the highest number of tender evaluation points for the award of the contract, unless there are compelling and justifiable reasons not to do so.
- e) Rescore and re-rank all tenders should there be compelling and justifiable reasons not to recommend the tenderer with the highest number of tender evaluation points and recommend the tenderer with the highest number of tender evaluation points, unless there are compelling and justifiable reasons not to do so and the process set out in this sub-clause is repeated.

PS-9.1.2.5 Method 4: In the case of a financial offer, quality/functionality and preference:

- a) Score quality/functionality, rejecting all tender offers that fail to score the minimum number of points for quality stated in the tender data, if any.
- b) Score tender evaluation points for each financial offer.
- c) Confirm that tenderers are eligible for the preferences claimed and, if so, score tender evaluation points for preferencing.
- d) Calculate the tender evaluation points TEV in accordance with the following formula:

$$\text{TEV} = \text{NFO} + \text{NP} + \text{NQ}$$

Where: NFO is the number of tender evaluation points awarded for the financial offer

NP is the number of tender evaluation points awarded for preference

NQ is the number of tender evaluation points awarded for quality/functionality

- e) Rank tender offers from the highest number of tender evaluation points to the lowest.
- f) Recommend the tenderer with the highest number of tender evaluation points for the award of the contract, unless there are compelling and justifiable reasons not to do so.
- g) Rescore and re-rank all tenders should there be compelling and justifiable reasons not to recommend the tenderer with the highest number of tender evaluation points and recommend the tenderer with the highest number of tender evaluation points during the rescore, unless there are compelling and justifiable reasons not to do so and the process set out in this sub-clause is repeated.

*** Score financial offers, preferences, and functionality/quality, as relevant, to two decimal places**

PS-9.1.3 Evaluation Criteria

The bids will be evaluated in two stages. The first stage will check whether the bidders have submitted all documents as requested on the advert. Although functionality does not form part of the final tender points scoring for award purpose, tenderer will be assessed for responsiveness and functionality first and if the tender is not responsive or meet the minimum functionality score, the tenderer will be eliminated and not considered further for second stage of evaluation.

The second stage of the evaluation will be based on Price (90) and (10) preference points for Specific Goals.

Detailed points scoring for Specific Goals are as follows:

TABLE 1: Experience and References

No.	TARGETED GOALS List five projects involving general civil works, Bulk Water Metering, Telemetry and SCADA Communication System installations)	WEIGHTING	POINTS CLAIMED BY TENDERER	ALLOCATED POINTS
1	Project 1:	10		
2	Project 2:	10		
3	Project 3:	10		
4	Project 4:	10		
5	Project 5:	10		
	SUB TOTAL: Experience and References	50		

Note: Tenderers should attach signed completion certificates and corresponding appointment letters as proof of having completed such projects within the past 5 years. If the works has been sub-contracted appointment letters and completion certificates from the main contractor should be attached as well as the appointment letters and completion letter of the sub-contractor (No reference letters)

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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TABLE 2: Qualifications and Experience of the Key Staff (Attach Project Organogram and Detailed CV's)**TABLE 2.1: QUALIFICATIONS OF KEY STAFF**

No.	POSITION	TENDER GOALS	WEIGHTING	POINTS CLAIMED BY TENDERER	ALLOCATED POINTS
1	Contract Manager: Civil Engineering or construction management or project management	B. Eng = 4 B-Tech = 3.5 ND = 3 N6 = 2 Any Cert= 1	4		
2	Site Agent: IT, Civil Engineering, construction management or project management	B. Eng = 4 B-Tech = 3.5 ND = 3 N6 = 2 Any Cert= 1	4		
3	Civil Construction Foreman – with trade test certificate	ND = 2 NQF 7 =2 N6 = 2 N3= 1.5 NQF5= 1.5 NQF 4= 1 NQF 3= 0.5	2		
4	Health and Safety Officer: OHS or related qualification	ND = 1 Cert = 0.5	1		
	SUB TOTAL: Financial References		11		

NOTE: Curriculum vitae with Certified copies of Qualifications and contact details should be attached to the tender document for verification by the client. Foreign qualifications copies should be certified by SAQA.

TABLE 2.2: EXPERIENCE OF KEY STAFF

	POSITION	TENDER GOALS	WEIGHTING	POINTS CLAIMED BY TENDERER	ALLOCATED POINTS
1	Contract Manager: 10 years in Bulk Water Metering, Telemetry and SCADA Communication System installations for Civil Works.	>10 yrs=4 6-9 yrs=3 3-5 yrs=2 1-2yrs=1	4		
2	Site Agent: 8 years in Bulk Water Metering, Telemetry and SCADA Communication System installations for Civil Works.	>8 yrs=4 5-7 yrs=3 3-4 yrs=2 1-2yrs=1	4		
3	Concrete Foreman 10 years in in Bulk Water Metering, Telemetry and SCADA Communication System installations for Civil Works in Bulk Water Pipeline construction.	>5 yrs=2 4 yrs=1.5 3 yrs=1 1-2yrs=0.5	2		
4	Health and Safety Office 5 years of experience as OHS in in Bulk Water Pipeline construction.	>5 yrs=1 4 yrs=0.75 3 yrs=0.5 1-2yrs=0.25	1		
	SUB TOTAL: Financial References		11		

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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Note: Project organogram of the project team should be attached. Curriculum vitae with detailed experience and contact details should be attached to the tender document for verification by the client.

TABLE 3: .Financial References

No.	TARGET GOALS	WEIGHTING	POINTS CLAIMED BY TENDERER	ALLOCATED POINTS
1	Tenderer submitted banking details proof attached	2		
2	Bank rating of "C" or better	4		
3	Registered financial Institution's full details as guarantor in the amount of 10% as specified for surety purpose shall be submitted	2		
	SUB TOTAL: Financial References	8		

TABLE 4: Plant & Equipment

No.	TARGET GOALS	WEIGHTING	POINTS CLAIMED BY TENDERER	ALLOCATED POINTS
1	2 x TLB	6		
3	1 x 20 TON EXCAVATOR	8		
4	1 x 18000 litres water tanker	3		
5	2 x 10m3 tipper trucks	3		
	SUB TOTAL: Plant and Equipment	20		

Note: Certified Proof of ownership to be submitted with the Tender. If plant will be hired, a signed letter and proof of ownership from the Plant Hire Company confirming availability, is required.

TABLE 4: SUMMARY of TABLE 1-4

No.	SUMMARY OF TABLES	WEIGHTING	POINTS CLAIMED BY TENDERER	ALLOCATED POINTS
1.	Experience and References	50		
2.1	Qualifications	11		
2.2	Experience of Key Staff	11		
3.	Financial References	8		
4.	Plant & Equipment	20		
	SUB-TOTAL	100		
	PRICING	90		
	Specific Goals	10		
	HDI	4		
	Locality	3		
	Youth	1		
	Woman	1		
	Disability (Attach proof from Doctor)	1		

NB: Functionality will be scored out of 100 and Bidders who do not reach the 75% threshold will not be evaluated further.

The 90/10 point scoring system will be used on the second stage of the evaluation

The percentage scored for functionality will be calculated as follows:

- The value awarded for each criterion will be multiplied by the weight for the relevant criterion to obtain the score for the various criteria;
- The score for each criterion will be added to obtain the total score; and
- The following formula will be used to convert the total score to percentage for functionality:

$$P_s = \frac{S_o}{M_s} \times 100$$

where:

P_s = percentage score for functionality by bid under consideration

S_o = total score of bid under consideration

M_s = maximum possible score

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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PS-9.1.4 Calculation of Points for Price

In this case the 90/10 Preference Point System will be applicable. The following formula will therefore be used to calculate the points scored for price:

$$P_s = 90 \left(1 - \frac{P_t - P_{\min}}{P_{\min}} \right)$$

Where:

P_s = Points scored for comparative price of bid or offer under consideration

P_t = Comparative price of bid or offer under consideration

$P_{\min}$ = Comparative price of lowest acceptable bid or offer.

Points scored must be rounded off to the nearest 2 decimal places.

PS-9.1.5 Calculation of Points for Specific Goals

Points will be awarded to a bidder for attaining the following Specific Goals in accordance with the table below:

Specific Goals	Number of Points (90/10 System)	Number of Points (80/20 System)
HDI	4	8
Locality	3	6
Youth	1	2
Woman	1	2
Disability (Attach proof from Doctor)	1	2
TOTAL	10	20

PS-9.1.6 Calculation of Total Points for Price and B-BBEE Status Level of Contributor

The points scored for price will be added to the points scored for Specific Goals to obtain the bidder's total points scored out of **100**.

PS-9.2 Quality control and quality assurance measures

The Contractor shall be solely responsible for the production of work that complies with the Specifications to the satisfaction of the Engineer. To this end it will be the full responsibility of the Contractor to undertake appropriate quality control and quality assurance measures on Site. The Engineer will audit the Contractor's quality assurance (QC & QA) system on a regular basis to ensure that adequate independent checks and tests are carried out and to ensure that the Contractor's own control is sufficient to identify any possible quality problems, which could cause a delay or failure.

The Contractor shall within 14 Days after commencement of the Works, present to the Engineer full details on the Quality Control and Quality Assurance measures to be implemented by the Contractor during the execution of the Works.

PS-9.3 Existing Services

The Contractor shall acquaint himself with the position of all existing services before any excavation or other

work likely to affect the existing services is commenced with. The Contractor shall obtain the necessary plans and/or assistance from the Municipality to locate all existing services prior to the start of excavation in any area.

The Contractor will be held responsible for any damage to known existing services, either shown on the drawings or pointed out to him by the Engineer or officials from the Municipality, caused by or arising out of his operations and any damage shall be made good at his own expense. Damage to unknown services shall be reported immediately and repaired without any delay. The cost of such repairs shall be paid for under Dayworks in the Schedules of Quantities. Should the Contractor proceed with work in any area without consulting with the Municipality and existing services are damaged, the repairs of such services will be for the account of the Contractor. To this end the Contractor shall obtain confirmation in writing that an area has been inspected with representatives from the different sections of the Municipality and Telkom and that all existing services has been pointed out to the Contractor by such representatives.

PS-9.4 Survey beacons

The Contractor shall take special precautions to protect all permanent survey beacons or pegs such as benchmarks, stand boundary pegs and trigonometrically beacons, regardless whether such beacons or pegs were placed before or during the execution of the Contract. If any such beacons or pegs have been disturbed by the Contractor or his employees, the Contractor shall have them replaced by a registered land surveyor at his own cost.

PS-9.5 Disposal of spoil or surplus material

The Contractor is responsible to arrange for the necessary permission and to spoil all surpluses and unsuitable material, builders' rubble and other objectionable material at a legal site approved by the Engineer. He shall be responsible for all arrangements with the Local Authorities necessary to obtain such spoil sites.

PS-9.6 Stockpiling of material required for the construction of the sidewalks under the Labour Intensive Portion of the Works

The Contractor shall stockpile suitable excavated material that may be required for the construction of the sidewalks and infill next to the edge of the concrete surface layer, backfilling and reinstatement of the site at positions approved by the Engineer.

PS-9.7 Site supervision and testing

The Contractor shall ensure that efficient supervisory staff, the required transport, instruments, equipment and tools are available to control the quality of his own workmanship. His attention is drawn to the fact that it is not the duty of the Engineer or the Engineer's representative to act as foreman or surveyor.

PS-9.8 Ordering of materials

The Contractor shall check all dimensions and quantities of fittings and equipment shown on the Drawings marked, "Issued for Construction," before orders are placed. **The Contractor shall not order from the Schedules of Quantities as all quantities reflected tin the Schedules of Quantities are provisional quantities.**

PS-9.9 Safeguarding of excavations

Safeguarding of excavations is the responsibility of the Contractor and shall confirm to all specifications and regulations in this regard to ensure that such operations conforms to the requirements of the Occupational

Health and Safety Act (Act 85/1993).

PS-9.10 Safety

The Contractor will be responsible for the safety of his personnel and the Site in general at all times. All laws, rules and regulations shall be strictly followed in this regard and all the necessary precautions and measures shall be taken to ensure the safety of personnel, the public and equipment.

PS-9.11 Overhaul

No payment will be made for overhaul on this Contract unless provision is made therefore in specific items. The Contractor shall make provision in his rates for the carting away and spoiling of any rubble to an approved spoil area approved by the ECO.

PS-9.12 Security

The Contractor shall provide security watchmen for the Contract as he deems fit at no extra cost to the Employer. The Contractor must ensure that all his employees as well as the employees of his subcontractors are able to identify themselves as members of the construction team.

PS-9.13 Health and Safety Requirements

It is a requirement of this contract that the Contractor shall provide a safe working environment and to direct all his activities in such a manner that his employees and any other persons who may be directly affected by his activities are not exposed to hazards to their health and safety.

By entering into a contract with the Employer, the Contractor assumes full responsibility for the application and enforcement of all aspects of the Occupational Health and Safety Act (Act 85/1993) which has been enacted to provide for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; to establish an advisory council for occupational health and safety; and to provide for matters connected therewith.

The Contractor shall ensure that all his employees comply at all times with all the requirements of the Act and Regulations. In terms of Article 3 of the General Administrative Regulations the Contractor, in his capacity as employer for the execution of the work under this contract, shall have a copy of the Act and the relevant regulations available at the workplace if he has 20 or more persons in his employment.

Copies (February 1998) of the Occupational Health and Safety Act and Regulations (Act 85 of 1993) may be obtained from the compiler, Lex Patria Publishers.

PS-9.14 Conditions of Employment of Local Labour

The Contractor is referred to Clause PAB-4 of the Particular Specification for Labour Intensive Work Methods for the special requirements applicable to temporary labour employment.

PS-9.15 Labour Intensive Construction

The objective of the Municipality with the project is to maximize the creation of job opportunities for the duration of the project. However, due to time constraints it is not possible to implement labour intensive construction methods on all aspects of the project. Aspects that can be executed with LIC methods will be trimming of trenches after bulk excavations, placement, spreading and compaction of bedding, widening of

excavations for valve chambers and final finishing of the backfilled trenches and shaping for stormwater drainage around chambers.

PS-9.16 **Variations exceeding 15%**

Clause 6.11 of the GCC shall not form part of this Contract.

PS-10 **ADVERSE WEATHER CONDITIONS**

No extension of time for completion will be granted on account of normal inclement weather but extension of time shall be determined for abnormal rainfall of wet conditions in accordance with the formula given below, separately for each calendar month or part thereof. It shall be calculated for the full period for the completion of the contract including any extension thereof:

$$V = (Nw - Nn) + \frac{(Rw - Rn)}{X}$$

If V is negative and its absolute value exceeds Nn then V shall be taken as equal to minus Nn.

The symbols shall have the following meanings:

V	=	Extension of time in calendar days in respect of the calendar month under consideration.
Nw	=	Actual number of days during calendar month on which a rainfall of Y mm or more has been recorded.
Rw	=	Actual rainfall in mm for the calendar month under construction.
Nn	=	Average number of days, as derived from existing rainfall records provided in the table below on which a rainfall of Y mm or more has been recorded for the calendar month.
Rn	=	Average rainfall in mm for the calendar month, as derived from the rainfall records supplied in the table above.

Note: X = 20
Y = 10 mm

The total extension of time shall be the algebraic sum of the monthly totals for the period of construction, but if the grand total is negative the time for completion shall not be reduced due to abnormal rainfall. Extensions of time for part of a month shall be calculated using pro rata values of Nn and Rn.

The factor (Nw – Nn) shall be considered to represent a fair allowance for variations from the average number of days during which rainfall exceeds Y mm.

The factor $\frac{(Rw - Rn)}{X}$ shall be considered to represent a fair allowance for variations from the average in the number of days during which rainfall does not exceed Y mm but wet conditions prevented or disrupted work.

Rainfall records at a rainfall station located in Levubu should be obtained from the South African Weather Service and shall be reproduced in the same format as the example shown in the accompanying table. The monthly averages (Rn and Nn) for this period shall be for the purposes of this contract be taken as normal. The values of X and Y are 20 and 10 respectively.

A 10-year rainfall record for **Station No. 067702 THOHOYANDOU** is attached.

RAINFALL RECORDS FOR PERIOD : 1994 TO 2003
RAINFALL STATION: 067702 THOHAYANDOU
SOURCE OF INFORMATION: SA WEATHER SERVICES, ENVIRONMENTAL AFFAIRS & TOURISM

YEAR	COEFF	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL
	Nn	4.6	3.8	2.3	1.3	0.7	0.2	0.2	0.2	0.6	1.8	4.1	4.4	24.2
	Rn	193.7	233.8	69.5	52.9	20.3	9.9	8	5.8	22.6	67.1	117.5	126.5	927.5
1994	Nw	7	1	0	1	0	0	0	1	1	1	2	4	18
	Rw	191	74	12.7	20.1	2.8	1.5	0	13.8	12	39.2	56	135.6	558.5
	V	2.3	-10.8	-5.1	-1.9	-1.6	-0.6	-0.6	1.2	-0.2	-2.2	-5.2	0.1	-24.7
1995	Nw	4	2	3	3	0	0	0	0	0	1	6	3	22
	Rw	198	204	114.1	88.6	11.3	0.1	0	5.1	8.5	16.3	128.9	62.6	837
	V	-0.4	-3.3	2.9	3.5	-1.1	-0.7	-0.6	-0.2	-1.3	-3.3	2.5	-4.6	-6.7
1996	Nw	7	6	2	0	5	0	0	1	1	2	3	4	31
	Rw	256	420.7	40.3	32.7	122.8	7.1	0	22.5	14	49.2	61.9	120.9	1 147.60
	V	5.5	11.5	-1.8	-2.3	9.4	-0.3	-0.6	1.6	0	-0.7	-3.9	-0.7	17.8
1997	Nw	7	1	3	1	0	0	0	0	2	1	4	2	21
	Rw	165	43.5	70	23	15.5	0	3	0	76	37.9	101	48.2	583.2
	V	1	-12.3	0.7	-1.8	-0.9	-0.7	-0.4	-0.5	4.1	-2.3	-0.9	-6.3	-20.4
1998	Nw	5	1	0	1	0	0	1	0	1	5	4	8	26
	Rw	204	11.8	8.6	65	0	0	23	2.9	29	161	137.1	279.8	921.9
	V	-1.5	-13.9	-5.3	0.3	-1.7	-0.7	1.5	-0.3	0.7	7.9	0.9	11.3	-0.9
1999	Nw	4	5	2	0	0	0	1	0	0	1	7	10	30
	Rw	184	169.7	93.1	31	12.7	5.6	38	0	7.1	76.8	168.6	49.6	836
	V	-1.1	-2	0.9	-2.4	-1.1	-0.4	2.3	-0.5	-1.4	-0.3	5.5	1.8	1.2
2000	Nw	8	12	8	4	1	0	0	0	1	1	4	3	42
	Rw	557	1016.0	269.4	72.7	22.3	20.3	8.6	0.5	36	43.7	111.9	52	2 210.50
	V	21.6	47.3	15.7	3.7	0.4	0.3	-0.2	-0.5	1.1	-2	-0.4	-5.1	82
2001	Nw	0	7	3	2	1	0	0	0	0	0	6	5	24
	Rw	18.3	337.9	86.5	114	15.4	2.9	6.4	0.7	15	16.5	262.1	246.7	1 122.10
	V	-13.4	8.4	1.6	3.7	0.1	-0.6	-0.3	-0.5	-1	-4.3	9.1	6.6	9.5
2002	Nw	2	0	0	1	0	1	0	0	0	3	2	1	10
	Rw	86	5.3	14.5	79.5	0	24.4	0	12.9	15	112	37.6	166.3	552.9
	V	-8	-15.2	-5.1	1	-1.7	1.5	-0.6	0.2	-1	3.4	-6.1	-1.4	-32.9
2003	Nw	2	3	2	0	0	1	0	0	0	3	3	4	18
	Rw	79	54.6	72.3	2.6	0.1	37.2	0.7	0	14	119	109.4	103	591.8
	V	-8.3	-9.8	-0.2	-3.8	-1.7	2.2	-0.6	-0.5	-1	3.8	-1.5	-1.6	-23
	Σ Nw	46	38	23	13	7	2	2	2	6	18	41	44	
	Σ Rw	1 937	2 338	782	529	203	99	80	58	226	671	1175	1 265	

This record and rain gaugings from this station, taken during the Contract Period, shall be used for calculation of extension of time.

The Contractor shall also erect a rain gauge on Site to record the actual rainfall in the vicinity of the project. The rain gauge shall be under the control of the Engineer and gauge readings shall be taken on a daily basis and verified by the Site Agent of the Contractor.

PS-11 LABOUR INTENSIVE WORK METHODS
PS-11.1 LABOUR INTENSIVE WORK

It is a condition of this contract that labour intensive construction methods as detailed in Particular Specification PAB be applied wherever possible.

Areas identified for labour-intensive methods for this contract are as set out in the tender and measured in the Schedule of Quantities.

The Contractor shall employ labourers and artisans for the execution and completion of the work only from the local community. The steering committee and appointed Labour Desk Officer will assist the Contractor to

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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identify labourers and artisans in the local community.

PS-11.2 **Skilled Labour**

Tasks requiring skilled labour, which in the opinion of the Tenderer may not be available locally, must be indicated in the forms (**Form I**) to be completed by the Tenderer.

PS-11.3 **Use of Mechanical Equipment**

Some activities in this contract have been identified as being suitable for labour-intensive construction methods. The activities where approval will be given to utilise mechanical equipment are the following:

- **Compaction of backfill:**

Compaction of backfill of the pipe trenches as well as the backfill at road crossings may be done with hand-operated mechanical vibratory rollers.

- **Transport of materials:**

Haul distances exceeding 100 m.

- **Breaking up of hard material:**

Pneumatic breakers may be used to break up non-pickable material. In case of long sections of solid rock blasting will be allowed.

The Tenderer must indicate at tender stage what type of mechanical equipment he intends to be using and for which activities.

If mechanical equipment is utilised for any activities identified to be carried out by labour-intensive methods without the written approval of the Engineer and without the consent of the PSC, no payment will be made for such activities.

PS-11.4 **Accredited and Generic Training**

It is a condition of this contract that formal training of semi-skilled as well as unskilled labour be provided to develop skills and to enhance the ability of the semi-skilled and unskilled labour to be employed under this Contract, to secure future employment of a similar nature.

Generic training shall be regarded as being included in the rates in the Schedule of Quantities as tendered while a provisional sum has been provided in the Schedules of Quantities for accredited training. Details of the training programme shall be finalized once a Contractor has been appointed.

PS-12 **SUB-CONTRACTING OF A PORTION OF THE WORKS TO EMEs or QSEs**

In line with the Preferential Procurement Regulations, 2017 as contemplated in the Regulations Gazette No. 10684 as published in the Government Gazette Volume 619, No. 40553 of 20 January 2017, the successful Tenderer must sub-contract a minimum of **30%** of the Value of the Works under this Contract to EME's or QSE's in either one or more of the following categories:

- a. an EME or QSE;
- b. an EME or QSE who is at least 51% owned by black people;
- c. an EME or QSE who is at least 51% owned by black people who are youth;
- d. an EME or QSE who is at least 51% owned by black people who are woman;

- e. an EME or QSE who is at least 51% owned by black people with disabilities;
- f. an EME or QSE who is at least 51% owned by black people in rural or underdeveloped areas or townships;
- g. a cooperative which is at least 52% owned by black people;
- h. an EME or QSE who is at least 51% owned by black people who are military veterans

Definitions:

“**EME**” means an exempted micro enterprise in terms of a code of good practice on black economic empowerment issued in terms of section 9(1) of the Broad-Based Black Economic Empowerment Act

“**QSE**” means a qualifying small business enterprise in terms of a code of good practice on black economic empowerment issued in terms of section 9(1) of the Broad-Based Black Economic Empowerment Act

PS12-1 Tenderer to Submit Details of Portions of the Works he Intends Sub-Contracting

Tenderers must as part of their Tender submit details of the portions of the Works, he intends sub-contracting to EMEs and/or QSEs. A Schedule has been provided as part of the returnable documents under **Section 9** of the Tender Document which must be completed in full providing all the required details. The total value of all such work must be a minimum of 30% of the value of the Works as tendered. Should the total value of the work as indicated in the schedule be less the required minimum of 30 % the tender will be disqualified.

It is therefore of utmost importance to ensure that the schedule is completed properly and with care.

PS-12.1 Process to be Followed in the Selection and Appointment of EMEs and/or QSEs

Vhembe DM will make available a list of all approved local EMEs and QSEs on their data base to the successful appointed Contractor.

The appointed Contractor shall compile Schedules of Quantities with specifications for the work to be carried out by sub-contractors and follow an internal transparent tender or quotation process. These tenders or requests for quotations shall be advertised within the project area and a briefing session conducted with the prospective sub-contractors. Upon closure to the tenders or request for quotations an evaluation process shall be followed to reach the final selection of EME's and or QSE's to be appointed as sub-contractors on the project.

The Social Consultant shall be available to assist with the process.

The Main Contractor shall guide and manage the appointed sub-contractors to ensure that quality work is delivered within the available budget and timeframes for the project and the Main Contractor shall remain responsible for the entire project.

PS-13 Promotion of Local Production and Content

In accordance with the in the Preferential Procurement Regulations, 2011, it is a condition that only locally produced goods, services or works or locally manufactured goods, with a stipulated minimum threshold for local production and content will be considered.

Tenderers must please refer to Form MBD 6.2 under Section 9, page 9 – 43 of this document and ensure that all the required information is provided and that Form MBD 6.2 is completed in full. Failing to do so will lead to disqualification of a Tender.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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PS-14 Signing of a Service Level Agreement with the Vhembe DM

The successful Tenderer will be required to sign a Service Level Agreement (SLA) with the Vhembe DM. The SLA will be made available to the successful Contractor after being appointed. The SLA must be signed before the Site will be handed over to the appointed Contractor.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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6.1.2 AMENDMENTS TO THE STANDARD AND PARTICULAR SPECIFICATIONS**INTRODUCTION**

In certain clauses the standard, standardised and particular specifications allow a choice to be specified in the project specifications between alternative materials or methods of construction and for additional requirements to be specified to suit a particular contract. Details of such alternative or additional requirements applicable to this contract are contained in this part of the project specifications. It also contains additional specifications required for this particular contract.

The number of each clause and each payment item in this part of the project specifications consists of the prefix PS followed by a number corresponding to the number of the relevant clause or payment item in the standard specifications. The number of a new clause or payment item, which does not form part of a clause or a payment item in the standard specifications and is included here, is also prefixed by PS followed by a new number. The new numbers follow on the last clause or item number used in the relevant section of the standard specifications.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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PSA **GENERAL****PSA-3** **MATERIALS****PSA-3.1** **Quality**

Where there is a standardization mark programme for any material, all such material supplied shall bear the official standardization mark.

Alternative materials or equipment proposed by the Contractor shall be tested. The test, as well as the materials or equipment, shall be approved by the Engineer prior to any such materials or equipment being built into the Works and all costs involved in testing shall be deemed to be included in the rates tendered.

PSA-4. **PLANT****PSA-4.2** **Contractor's Office, Stores and Services**

It is not a requirement of this Contract that the Contractor provide an approved field laboratory on Site, although he may elect to do so. If no laboratory is provided, the Contractor shall nevertheless arrange to have the required quality control tests (e.g. Density, concrete strength etc) performed by an approved commercial laboratory, and his tendered rates shall include full compensation for such tests.

Before commencing any establishment on Site, the proposed layout of the Contractor's offices, stores and services shall be approved by the Engineer. The Engineer will approve the layout or otherwise request modifications within five working days after receipt of the Contractor's written proposal.

The Contractor's camp shall be kept neat and clean at all times and all surplus or rejected material shall be removed from the site.

PSA-4.3 **Restriction on the use of plant** (Additional sub-clause)

Except for the type of plant, and to the extent permitted in terms of the project specification or approved by the Engineer, the Contractor shall use only hand tools and hand equipment in the construction of the Works or portions of the Works that are required in terms of the project specification to be constructed using labour-intensive construction methods.

PSA-5 **CONSTRUCTION****PSA-5.1** **Survey**

Co-ordinated reference pegs shall be preserved as specified in subclause 5.1.2.

PSA-5.1.1 **Setting out of the Works**

For any new work the Contractor shall establish his own reference lines from which the work can be set out.

Where labour-intensive work is specified, the Contractor shall also be responsible for the setting out of the daily tasks.

PSA-5.2 **Dealing with Water on the Works**

Add the following paragraph:

"It shall be noted that any claim for extension of time or for additional compensation dealing with water on the Works will not be considered, as this payment item shall be deemed to take in account of all additional resources or costs that may be required or incurred. The Contractor shall be deemed to have acquainted himself with the site conditions during tender stage. This will include the diversion of rivers to accommodate the laying of pipes through rivers."

PSA-5.3 Training (Additional Sub-clause)

It is a condition of this contract that on-the-job training be provided for local labour. The cost of on-the-job training for unskilled labour shall be deemed to be spread over the rates and prices tendered for other items in this contract. Accredited training shall not form part of this Contract.

PSA-6 **PROVISIONAL SUMS**

Provisional Sums are allowed in the Schedule of Quantities for execution on instruction by the Engineer only and include:

PSA-6.1 Additional Tests

Any additional tests over and above the quality control tests which are the responsibility of the Contractor in terms of the specifications, required by the Engineer on soil, concrete, any other material or workmanship.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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PSAB ENGINEER'S OFFICE**PSAB-3 MATERIALS****PSAB-3.1 Nameboards**

Two (2) contract signboards are to be erected in the positions indicated by the Engineer. Each signboard shall comprise of an information board and supports in accordance with drawing No. 12T1201E/G03.

PSAB-3.2 Office Building

The Contractor shall provide suitable temporary office accommodation for the Engineer, consisting of two offices with 12m² and one with a 30 m² of floor area respectively. The smaller offices shall be furnished as prescribed in the Standardised Specifications SABS 1200 AB while the larger office shall be equipped with a boardroom table, large enough to accommodate 20 people complete with chairs for the purpose of Site Meetings and PSC Meetings. The offices shall be for the sole use of the Engineer and his representative. All offices shall be lockable with sufficient lighting. Light fittings shall be of the fluorescent type and the offices shall both be furnished with two (2) double plug points in positions to be indicated by the Engineer during site establishment. All offices shall be equipped with air conditioning units capable of cooling in summer and heating in winter while a refrigerator shall also be provided for the sole use of the Engineer and his personnel.

Three high back office chairs shall also be provided, one for each office.

The position of the Engineer's office and carports shall be erected within the Contractor's camp site in a position to be indicated by the Engineer during site establishment.

PSAB-3.3 Carports (Additional Clause)

The carport shall be so constructed that the vehicles parked under it will at all times be protected against the direct rays of the sun. The carport shall be at least 30 m² in area with at least 6 supports and the floor shall consist of a layer of crushed stone to alleviate dusty and muddy conditions.

All weather concrete pathways from the Carports to the offices shall also be provided to enable walking from the carports to the office and between offices during rainy and muddy conditions. Pathways shall be at least 1,2m wide to enable pedestrians to pass one another.

PSAB-4 PLANT**PSAB-4.1 Telephone**

The telephone shall be a cellular phone similar to a Samsung Galaxy A55 5G with all costs paid by the Contractor. At the end of the Contract the phone shall revert back to the Contractor.

PSAB-4.2 Survey Equipment (Additional Clause)

The Contractor shall provide the following survey equipment on site for the full duration of the Contract:

- (a) 1 tachometer capable of reading to 20 seconds of arc complete with tripod;
- (b) 1 automatic level complete with tripod and 2 levelling staffs graduated metrically;
- (c) 1 steel tape of length 30 m;
- (d) 1 measuring wheel;

- (e) 4 ranging rods, at least 2,1m in length
- (f) 12mm diameter steel pegs as may be required for checking of setting out

All equipment may be shared by arrangement between the Contractor and the Engineer's representative. The Contractor shall insure the equipment against any loss, damage or theft and he shall indemnify the Engineer against any claims in this regard.

The Contractor shall maintain the equipment in good working order and keep it clean throughout the contract period.

Payment for survey equipment will be on a monthly basis as a time-related item under Item 8.4 of SABS 1200 A.

PSAB-4.3**Portable Computer and Laser Colour Printer (Additional clause)**

The Contractor shall provide a portable computer (notebook) and laser printer for the sole use of the Engineer for the duration of the Contract.

NOTEBOOK:

The notebook shall at least have the following specifications:

MSI CREATOR M16 A12UC062ZA

Creator M16 A12UC, Black, 16inch QHD+ 60Hz, RTX3050 4GB, i7-12700H, 8GB*2 RAM, 512GB SSD, Win11 P, Bag, 2yr.Warranty

MSI 1 Year Warranty Extension Card

MSI 1 Year Warranty Extension Card (Physical Retail Pack) 957-1XXXXE-071

TS1TMTE110S

Transcend 110S 1 TB Solid State Drive - M.2 2280 Internal – PCI Express (PCI Express 3.0 x4)

FPP-M365-BUS STD

MICROSOFT 365 BUSINESS STANDARD - MEDIALESS - 1YR SUBSCRIPTION - KLQ-00654.

Microsoft Comfort Keyboard 5050 – Model 1728 (Cordless keyboard and Mouse)

Durable Laptop Carry Bag

PRINTER:

Ink jet printer (HP OfficeJet Pro 7440 or similar approved) shall at least have the following specifications:

- A4/A3 Inkjet Colour output
- Print, copy, scan, fax, web
- 18ppm mono
- 2 x 150 sheet cassette trays of which one should be adjustable to A3
- Auto document feeder
- Wi-Fi and LAN connectivity
- Scan to or print from USB flash drive
- Sufficient cartridges for the duration of the project

PSC SITE CLEARANCE**PSC 3 MATERIALS****PSC 3.1 Disposal of Materials**

Add to Sub-Clause 3.1:

"Notwithstanding the requirements of Sub-Clause 3.1, the material obtained from clearing and grubbing and from demolition of structures, shall be disposed of in the spoil areas indicated and approved by the ECO.

Burning of combustible material shall not be permitted on the site of the Works. The Contractor shall meet the requirements of this Sub-Clause and any additional requirements of the Local Authority in this regard. The Contractor shall be held responsible for any injury to persons or damage to property caused by the starting of any fires on site by his employees, regardless of whether such injury or damage is the direct or indirect result of such fires. He shall further indemnify the Employer against all claims arising from such an occurrence."

PSC-4 PLANT

Add the following:

PSC-4.1 Labour Intensive Construction

The following provisions shall apply in respect of those portions of the Works covered by the specifications which are required in terms of the Contract, to be executed utilizing Labour Intensive Construction Methods:

- (a) The Contractor shall utilise hand tools such as saws, picks, shovels, rakes, tampers, sledgehammers etc. as far as possible to cut down vegetation before grubbing as required.
- (b)

PSC 5 CONSTRUCTION**PSC 5.1 Areas to be cleared and grubbed**

Add to Sub-Clause 5.1 to read:

"Only areas designated by the Engineer in writing shall be cleared and grubbed in accordance with Sub-Clauses 5.3 and 5.4." In general a strip of 2m on the outside of the fence as well as the entire area within the fenced off area at the reservoirs shall be cleared and shall be kept cleared for the entire project duration until the Certificate of Completion is issued.

PSC 5.2 Cutting of trees**PSC 5.2.1 Preservation of Trees**

Add to Sub-Clause 5.2.3.1: General

"Trees shall be cleared in accordance with Sub-Clause 5.3 only upon written approval of the Engineer. Any tree damaged or removed unnecessarily by the Contractor shall be replaced with an indigenous

tree to be planted where indicated by the Project Steering Committee at no additional cost to the Contract. The Contractor shall be responsible for the cost of provision, planting and tending the tree until such time as it has taken root."

PSC-5.2.2 Individual trees

The Contractor shall pay a penalty of R 1 000-00 for each designated tree removed or damaged by him. Trees so designated shall be marked with danger tape to be supplied by the Contractor. Upon completion of the Works, the tape shall be removed. The clearing of the pipeline routes and access road to Reservoir through indigenous areas shall only be done in the presence of the Engineer or his representative and only vegetation indicated by the Engineer or his representative shall be removed.

PSC-5.3 Clearance of the Site and Final Finishing on Completion of the Works

After completion of this Contract all the reservoir sites shall be completely cleared of all building rubble and all loose boulders, tree stumps etc. unearthed during the construction operations on that portion of the whole of the site which was handed over to the Contractor for the purpose of execution of this Contract. All reservoir sites shall be kept clear of vegetation during the entire contract period until the issuing of the Certificate of Completion.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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PSD EARTHWORKS**PSD-2 INTERPRETATIONS****PSD-2.1 Supporting specifications**

Replace Sub-Clause 2.1 with the following:

"PSD-2.1 Any of the other SABS 1200 Specifications may form part of the Contract Documents."

PSD-2.3 Definitions

Replace the definition "Borrow" with the following:

"Borrow material: Material, other than material obtained from excavations required for the Works, obtained from sources such as borrow pits or the authorized widening of excavations. 'Borrow' shall have a corresponding meaning."

Replace the definition "Specified density" with the following:

"Specified density: The specified dry density expressed as a percentage of modified AASHTO dry density."

Replace the definition "Stockpile" with the following:

"Stockpile (Verb): The process of selecting and, as may be necessary, loading, transporting and off-loading material in a designated area for later use and a specific purpose."

The term "dispose" and the term "spoil" shall be synonymous.

Add the following definitions:

"Fill: An embankment or terrace constructed from material obtained from excavations or borrow. In roads it includes the earthworks up to the underside of the selected sub-grade level.

Fill (material): Material used for the construction of an embankment or terrace.

Roadbed: The natural in situ material on which the fill, or in the absence of fill, any pavement layers, are to be constructed."

PSD-3 MATERIALS**PSD-3.1.1 Method of classifying**

Add the following:

"Classification of material other than 'soft excavation' shall be agreed upon in writing with the Engineer before excavation may commence.

The Contractor shall immediately inform the Engineer if and when the nature of the material being excavated changes to such an extent that a new classification for further excavation is warranted. Failure on the part of the Contractor to advise the Engineer thereof in good time shall entitle the Engineer to classify, at his discretion, such excavation as may have been executed in material of a

different nature."

PSD-3.1.2 **Classes of Excavation**

Add to the Sub-Clause 3.1.2:

a) **Normal Conventional Construction Methods**

"Notwithstanding the provisions of this Sub-Clause, or anything to the contrary in these specifications, or the Schedule of Quantities, intermediate excavation, boulder excavation Class A and Class B shall be classified as soft excavation and shall be fully allowed for in the rates for soft excavation, with the proviso that boulders requiring drilling and blasting in order to be removed or loaded, as specified in Sub-Clause 3.1.2 (a) (1) and (2), shall be measured separately as hard rock excavation. Allowance is made in this Contract for only two classes of excavation, these being Soft and Hard. Contractors are to take special note of this clause as no claims for the excavation of intermediate material will be entertained."

b) **Labour Intensive Construction Methods**

For the purpose of labour intensive construction the excavation of material will generally be classified as follows for purposes of measurement and payment:

(i) **Soft excavation**

Soft excavation shall be excavation in material that can be efficiently removed and loaded with picks, shovels and other hand tools. Soft excavation shall include all boulders with a volume of less than 0,125 m³ and a maximum dimension of 500 mm, which can still be removed by hand methods.

(ii) **Hard excavation**

Hard excavation shall be excavation in material which can only be removed efficiently with mechanical equipment such as jackhammers, drilling and blasting, etc. Hard excavation shall also include boulders with a volume exceeding 0,125 m³ and the maximum dimension exceeding 500 mm, which cannot be broken down and removed by hand methods.

PSD-3.2 **Classification for Placing Purposes**

Add to Sub-Clause 3.2:

"All backfill or fill material shall be material having a CBR of at least 15 at 90% of Mod AASHTO density. All backfill shall be placed in layers not exceeding 150 mm of thickness and compacted to a minimum of 90% of Mod AASHTO density. Maximum particle size shall not exceed two-thirds of the thickness of the layer being compacted."

PSD-3.3 **Selection**

Add the following Sub-Clause:

"PSD-3.3.3 **Selection in borrow pits and excavations**

The approval of a borrow area for a certain purpose does not necessarily mean that all material within that area is suitable for the specified purpose. What it does mean, is that the borrow area contains

some suitable material. The onus is on the Contractor to ensure that only material that is indeed suitable, is selected and used for the specified purpose.

Where the Contractor is required to select material from excavations for a specific purpose, the above provisions relating to borrow areas shall apply mutatis mutandis to excavations.

The Contractor shall not waste or contaminate material that has been selected for a specific purpose."

PSD- 5 CONSTRUCTION

PSD-5.1 Precautions

PSD-5.1.1 Barricading and Lighting

Re-word Sub-Clause 5.1.1.1 as follows:

"In terms of Sub-Clause 13 (h) of the General Safety Regulations of the Machinery and Occupational Safety Act 1983 (Act 6 of 1983), as published in the Government Gazette No. 10252 Volume 51 dated 30 May 1986, every excavation which is accessible to the public, or which is adjacent to public roads or thoroughfares, or whereby the safety of persons may be endangered shall be:

- a) adequately protected by a barrier or a fence at least one metre high and as close to the excavation as is practicable, and
- b) provided with red warning lights, or any other visible boundary indicators at night, or when visibility conditions are poor.

The Contractor shall employ watchmen to ensure that barricades and lights are effective at all times."

PSD-5.1.1.2 Safeguarding of excavations

Re-word the first three lines of Sub-Clause 5.1.1.2 to read:

"The Contractor, or his agent or representative appointed in writing, shall be deemed to be, and shall be both the "employer" and "a person who is competent to pronounce on the safety" of all bracing and shoring, as set out in Clause 13 (Demolition and Excavation) of the General Safety Regulations of the Machinery and Occupational Safety Act 1983 (Act 6 of 1983), as published in the Government Gazette No. 10252 Volume 251 dated 30 May 1986. Safeguarding of excavations on Site will be the Contractor's full responsibility."

PSD-5.1.2 Existing Services

PSD-5.1.2.1 General

Add the following:

"Although every effort has been made to locate existing services on site, not all services may be shown on the Project Drawings, or be visible on site. The Engineer may order excavation by hand in order to search for and expose such services. Once a service has been exposed it will be deemed a "known service" in terms of SABS 1200 A Sub-Clause 5.4.

Where an existing or known service is damaged by the Contractor through his own negligence, he

shall bear the cost of making good such damage, whether the work is carried out by himself or by the relevant Authority. The Contractor shall further be penalised R 500.00 each time he damages a known service."

PSD-5.2 Methods and Procedures

PSD-5.2.2 Excavation

PSD-5.2.2.2 Borrow pits

Add the following:

"A commercial source shall, for the purposes of this Specification, mean a source of material provided by the Contractor, not the Employer.

Where it is specified that material shall be obtained from commercial sources, the Contractor shall be responsible and include in his prices for fill from commercial sources, for finding a source of suitable material, for making all arrangements for procuring the material with the owner of the source, for the payment of any royalties, charges or damages and, for transporting the material to the Site regardless of the distance involved. No payment will be made for the removal of overburden or stockpiling at the commercial source and no extra over payment for excavating in intermediate, hard or boulder material shall apply."

PSD-5.2.2.3 Disposal

Re-word Sub-Clause 5.2.2.3 to read:

"All surplus or unsuitable material excavated from trenches or manhole box cut shall be spoiled in areas designated by the Engineer. Spoil material shall be nominally compacted to prevent erosion."

Add the following new Sub-Clauses after Sub-Clause 5.2.2.3:

"PSD-5.2.2.4 Selection and stockpiling

The approval or designation of a particular borrow area for a particular purpose will not imply that all the material is suitable for that purpose or should be used for that purpose. The Contractor shall select suitable material from that source, discard unsuitable material and reserve material for other purposes as necessary. When required and as ordered by the Engineer, material shall be stockpiled for later use when the excavation thereof is unavoidable in order to excavate the material required at the time."

PSD-5.2.5 Transport

PSD-5.2.5.1 Freehaul

Amend Sub-Clause 5.2.5.1 to read:

"The freehaul distance within which the Contractor will be required to move material without separate compensation shall be within a radius of 5,0 km of the centre of the Site. This will not be restricted to the site and may include the hauling of fill, selected material from the nearby quarry or designated borrow site and all haul within this radius will be regarded as freehaul."

PSD-5.2.5.2 Only overhaul outside the freehaul distance of 5km shall be payable under this Contract.

PSD-6 TOLERANCES**PSD-6.1 Position, dimensions, levels, etc.**

Degree of Accuracy II shall apply. Over-break, where applicable shall be filled in with 15 MPa concrete at Contractor's cost.

PSD-7 TESTING**PSD-7.2 Taking and Testing of Samples**

The Contractor is responsible for his own quality control and shall therefore take an adequate number of samples and carry out the prescribed tests to ensure that the material conform to the requirements in respect of quality, density, etc. (quality or process control).

Such test results and the positions where samples were taken must be submitted to the Engineer. The number and positions of tests shall be adequate to prove to the Engineer that the work as a whole complies with the requirements.

The Engineer may have additional or control tests carried out by an independent commercial laboratory at the Employer's cost and he will make the results available to the Contractor (acceptance control). Should these test results show that the work or the material does not comply with the specifications the Contractor shall take the necessary steps to rectify same and he will also be responsible for the cost of

such testing. Payment for additional testing of completed portions of the Works, which test successful will be made under PSA-6.1.

Add the following new Sub-Clause:

"PSD-7.4 Contractor's Laboratory

Contractors are to allow in their rates for all process control testing required on this contract in terms of the relevant specifications."

PSD-8 MEASUREMENT AND PAYMENT**PSD-8.1 Basic Principles**

PSD-8.1.1 No separate payment will be made for temporary stockpiling of excavated material prior to placement in fill.

PSD-8.3 Scheduled Items**PSD-8.3.3 Restricted Excavations**

Add to Sub-Clause 8.3.3.

1) "Notwithstanding the provisions of 8.3.3, excavation carried out under this item will include

unstable sloping materials and adequate safety precautions shall be taken to leave blocks of materials/provide shoring to stabilise excavations.

- 2) Notwithstanding the provisions of Sub-Clause 8.3.3 and amendments thereto, excavation carried out under this item is to include for wet or saturated conditions for culvert foundations in the depth range 0 to 3 m and the rate shall include full compensation for site drainage, access and working platforms necessary to excavate the works.
- 3) Notwithstanding the provisions of Sub-Clause 8.3.3 and amendments thereto, Intermediate and Boulder excavation is to be included in the rates for Soft excavation."

PSD 8.3.6 Overhaul

Add the following:

"No overhaul shall apply to material from commercial sources or to material disposed of to sites provided by the Contractor or by other means employed by the Contractor."

PSD 8.3.8 Existing Services (Sub-Clause 8.3.8)

Add to Sub-Clause 8.3.8:

"In terms of SABS 1200 A Sub-Clause 5.4, all services constructed under this Contract shall be

deemed to be known services, and no payment shall be made for their protection. The cost of complying with the requirements of SABS 1200 D Sub-Clause 5.1.2 shall be deemed to form part of the rates for constructing the intersecting service."

PSD 8.3.12 Road Traffic Signs and Marking

Change the heading of this Item from "Road Traffic Signs and Marking" to

"Accommodation of Traffic".....Unit: Sum

No separate items will be scheduled for the different signs required as per the drawings or the SARTSM requirements for the accommodation of traffic. The sum tendered shall cover all cost to accommodate the traffic for the duration of the Contract period according to the requirements of Item 1.5.1

PSDB EARTHWORKS (Pipe trenches)**PSDB-3 MATERIALS****PSDB-3.1 Classes of Excavation**

Add the following new sub-clause:

Classes of excavation where Labour Intensive Construction Methods are specified

The excavation of material will, in the case of work which is required in terms of the Contract to be executed utilising Labour Intensive Construction Methods, be classified as follows for purposes of measurement and payment:

(a) Soft – (Hand excavations)

Excavation of boulders not exceeding 0,04 m³, in material that can be excavated and removed from the excavation by an average able bodied labourer or group of such labourers, at a rate of not less than 2,4 m³ per 9,0 (nine) hour working day per labourer, using only picks, shovels and similar hand tools.

(b) Soft – (machine excavation)

Excavation in trenches with the use of machines where hand excavation is not possible, but material is still classified as soft excavation in terms of the relevant specification in SABS 1200.

(c) Intermediate

Intermediate excavations shall be excavations in material which requires ripping or loosening by mechanical means prior to removal of the loosened material utilising the methods as described in (a).

(d) Hard rock Excavation

Hard rock excavation shall be excavation of under composed boulders exceeding 0,04 m³ and excavations in solid rock occurring in bulk or in banks or ledges, which requires loosening or breaking up by drilling, wedging, splitting or blasting or by other approved quarrying methods.

Class of excavation for each portion of the works is subjected to approval by the Engineers' Representative. Places where ripping is required prior to excavation in soft or intermediate material will be indicated by the Engineers' Representative.

PSDB-5 CONSTRUCTION**PSDB-5.3 Site clearance**

Add the following to the clause:

"The Contractor shall dispose of all surplus and unsuitable material on a site to be found by him and approved by the ECO and the Engineer. All costs related to the disposal of surplus material shall be deemed to be included in the tendered rates.

Where pipes are to be laid the Contractor will be allowed to clear and grub a strip 2,5 m wide along the centre-line of the trench. No vegetation outside this strip may be damaged without the written approval of the Engineer.

All trees with a girth of 250 mm or a height of 2,5 m within this strip, shall be protected and may only be trimmed or removed after a written order by the ECO and the Engineer."

PSDB-5.6.4 Disposal of intermediate and hard rock material

Surplus and/or unsuitable excavated material must be disposed of at a site found by the Contractor in close vicinity of the Site and approved by the ECO and the Engineer.

PSDB-5.6.5 Deficiency in backfill material

Any deficiency in backfill material from trench excavations because of removal of excessive quantities of organic material, unsuitable parts of the trench bottom, intermediate or hard rock, shall be made up from suitable surplus material from other excavations on the site.

PSDB-5.6.8 Transport for Earthworks for Trenches

For this contract all haul will be regarded as free haul and the cost of transportation of all materials will be deemed to be included in the rates and prices tendered in the schedule of quantities.

No overhaul will be payable on this Contract.

PSDB-7 **TESTING**

PSDB-7.1 Notwithstanding the contents of Clause 7.1, the Contractor shall bear the cost of all quality control tests regardless of whether the tests indicate acceptable compaction or not.

The following are the minimum frequencies for the process control tests to be executed by the Contractor:

- (a) Normal trench backfilling: one density test on every second layer for every 200 m of pipe trench.
- (b) Backfilling in areas subject to vehicle loads: one test on each layer of 150 mm at each road or railway crossing.

The positions of the minimum number of density tests shall be determined randomly by the Contractor and shall be clearly documented with the results. The results of the tests shall be submitted to the Engineer and shall prove to the Engineer that the work as a whole was done satisfactorily. Additional tests, over and above the minimum tests could be ordered by the Engineer. Payment for the additional tests ordered shall be made under Item PSA-6.1 if the tests indicate that the density is as specified. If any tests fail, the cost of such tests shall be for the account of the Contractor.

PSDB-8 **MEASUREMENT AND PAYMENT**

PSDB-8.3 Scheduled Items

PSDB-8.3.2 Excavation

- Payment for pipeline excavation will be made in three instalments as follows:

50 % at completion of excavation, 40 % at completion of backfilling and the final 10 % after final approval which will take account of surface finishing, disposal of all unused material and approval and acceptance of all test results as specified.

Contractor's Paraph

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PSGA CONCRETE (SMALL WORKS)**PSGA 3 MATERIALS****PSGA 3.2 Cement****PSGA 3.2.1 Applicable specifications**

The standard cement specifications SABS 471, SABS 626, SABS 831, SABS 1466 and SABS 1491 have been withdrawn and are replaced by the new specifications SABS ENV-197-1: Common cements, and SABS ENV 413-1: Masonry cement. These specifications will be applicable to this contract and the descriptions and types of cements specified will be based on the designations as defined in these specifications.

PSGA 3.2.3 Storage of Cement

Amend sub clause 3.2.3 as follows:

"Maximum storage period for cement will be ten weeks under dry conditions."

PSGA 3.4 Aggregates**PSGA 3.4.2 Use of Plums**

Amend sub clause 3.4.2 as follows:

"The use of plums as aggregate in structures will not be allowed".

PSGA 5 CONSTRUCTION**PSGA 5.4 Pipes and Conduits**

Replace sub clause 5.4 as follow:

"Except with the written approval of the Engineer, no pipes other than those shown on the drawings shall be embedded in the concrete, and the approval of the Engineer for the position of all services to be embedded shall be obtained before concreting commences. The clear space between pipes of any kind embedded in reinforced concrete and the clear space between such pipes and reinforcement shall not at any point be less than:

- a) 40 mm or,
- b) 5 mm plus the maximum size of coarse aggregate, whichever is the greater."

PSGA 5.5 Concrete**PSGA 5.5.1 Quality****PSGA 5.5.1.5 Durability**

The exposure conditions for structures will be deemed to be "severe".

PSGA 5.5.1.6 Prescribed Concrete Mix

Replace sub clause 5.5.1.6 as follows:

"No prescribed concrete mix will be used in this contract."

PSGA 5.5.1.7 Strength Concrete

Replace sub clause 5.5.1.7 as follows:

"The strengths of the various concretes required are detailed on the drawings. The maximum size of aggregate must be suited to the work in hand and is subject to the Engineer's approval."

PSGA 5.5.3 Mixing**PSGA 5.5.3.2 Ready-Mixed Concrete**

Replace sub clause 5.5.3.2 as follows:

"Ready mixed concrete will only be permitted with written approval of the Engineer and if so, the test results obtained by such a production entity will NOT be part of the quality control system."

PSGA 5.5.10 Concrete Surfaces

Add the following sub clauses to sub clause 5.5.10:

PSGA 5.5.10.4 Surface Finishes**PSGA 5.5.10.4.1 Shuttered Surfaces**

Immediately following the removal of the forms, all fins and irregular projections shall be carefully removed from all surfaces. Any cavities in the concrete surface, caused by form ties, honeycombs, broken corners or edges or other defects shall after inspection by the Engineer, be thoroughly cleaned, saturated with water for at least one hour and filled with a mortar in the proportions by volume of one (1) part of cement to naught comma seven five (0,75) of the sand proportion used in the concrete in which the cavity occurs. Every effort should be made to match the colour of concrete. Care should be taken, in the choice of any release agent used, to ensure that the finished concrete surface is not permanently stained or discoloured.

PSGA 5.5.10.4.2 Surfaces which are not shuttered

On completion of placing and compacting the concrete as specified before, the top surface shall be struck off with a template cut to the required cross-section and tamped with a tamping board to compact the concrete thoroughly and to bring mortar to the surface, leaving the surface slightly rough but generally at the correct elevation and finally finished by wood float.

- 1) Top of Walls to Valve Chambers:

The top of all walls shall receive wood-floated finish.

- 2) Floors of Valve Chambers:

The surface shall first be given a tamped surface finish as specified above and then left for approximately one hour after which it shall be brushed with a soft brush to break up all laitance formed on the surface.

"PSGA 5.6 No-Fines Concrete**PSGA 5.6.1 Classes of No-Fines Concrete**

"No-fines concrete shall be classified by the prefix NF and the size of aggregate to be used. Class NF 19 means a no-fines concrete with a 19mm nominal size aggregate.

The volume of aggregate per 50kg of cement for each class of concrete shall be as follows:

Class	Aggregate per 50kg cement
NF38	0, 33m ³
NF19	0, 33m ³
NF13	0, 27m ³ "

PSGA 5.6.2 Batching**PSGA 5.6.2.1 Water**

The quantity of water added shall be just sufficient to form a smooth grout which will adhere to and coat completely each and every particle of aggregate, and which is just wet enough to ensure that at periods of contact of aggregate the grout will run together to form a small fillet to bond the aggregate together. The mix shall contain no more than 20 litres of water per 50kg of cement.

PSGA 5.6.3 Placing

No-fines concrete shall be placed in accordance with the procedure agreed to by the Engineer. It shall be placed in its final position within 30 minutes of mixing.

The concrete shall be worked sufficiently to ensure that it completely fills the space to be concreted and that adjacent aggregate particles are in contact with one another. Excessive tamping or ramming shall be avoided and under no circumstances shall the concrete be vibrated.

PSGA 5.6.4 Curing

All no-fines concrete shall be protected from the elements and loss of moisture. Protection against loss of moisture shall be accomplished by one or more of the following:

- Retaining formwork in place.
- Covering exposed surfaces with sacking or other approved material kept continuously wet.
- Covering exposed surface with plastic sheeting.

No-fines concrete shall be cured for at least 7 days.

PSGA 5.6.5 Covering of No-Fines Laver

Before the floor is cast on the no-fines, the surface will be covered with building paper to prevent mortar from the wet concrete entering the no-fines layer. The building paper will be properly protected against unnecessary damage before the floor is cast, and if damaged during the fixing of the steel, be replaced just before casting of the floor."

PSGA 8 MEASUREMENT AND PAYMENT**PSGA 8.1 Measurement and rates****PSGA 8.1.1 Formwork**

Add the following sub clause 8.1.1.7 to sub clause 8.1.1:

No separate payment shall be made for the finishing of un-shuttered surfaces as described above, and payment therefore will be deemed to be included in the rates tendered for concrete.

PSGA 8.1.2 Reinforcement**PSGA 8.1.2.2 and PGA 8.1.2.3**

Replace sub clauses 8.1.2.2 and 8.1.2.3 with the following:

"Mild steel and high tensile steel will be measured separately. Welded mesh will be scheduled separately for each type and mass per square meter of mesh.

The rate for steel reinforcement shall cover the cost of supply, cutting, bending, placing in position, and fixing of the reinforcing and supporting steel scheduled, and the provision of all spacer devices and binding wire, as well as the cost of tests in terms of SABS 920.

The rate for welded mesh shall cover the supply, cutting and placing of mesh, as well as the cost of all waste due to laps."

Add the following sub clauses to sub clause 8.1.4:

PSGA 8.1.4 No-Fines Concrete

a) Cast in situ no-fines concrete

Unit: square meter (m³)

The unit of measurement for cast in situ no-fines concrete shall be the cubic meter of concrete IN PLACE for the various thicknesses indicated on the drawings. Quantities shall be calculated from the dimensions shown on the drawings.

PSG **CONCRETE (STRUCTURAL)****PSG-2.4** **Explanation of terms**

Add the following sub-clause:

"PSG-2.4.4 **Pre-cast concrete**

Concrete components of the general quality described in this specification, which have been cast and cured either on the site or elsewhere and have been placed in position to form an integral part of the structure."

PSG-3 **MATERIALS****PSG-3.2** **Cement****PSG-3.2.1** **Applicable specifications**

The standard cement specifications:

SABS 471: Portland cement (ordinary, rapid-hardening and sulphate-resisting);

SABS 626: Portland blast furnace cement;

SABS 831: Portland cement 15, and rapid-hardening Portland cement 15;

SABS 1466: Portland fly-ash cement; and

SABS 1491: Portland cement extenders (Part 1: Ground granulated blast-furnace slag, Part 2: Fly ash, and Part 3: Condensed silica fume), have been withdrawn and are replaced by the new specifications SABS ENV-197-1: Common cements, and SABS EENV 413-1: Masonry cement. These specifications will be applicable to this contract and the descriptions and types of cements specified will be based on the designations as defined in these specifications.

PSG-3.2.3 **Storage of cement**

Add the following:

"Cement shall not be stored for longer than 12 weeks without the permission of the engineer."

PSG-4 **PLANT****PSG-4.1** **General**

Add the following sub-clause:

"PSG-4.1.1 **Minimum plant**

The contractor shall have available and in sound working order the following minimum plant for the construction of the concrete surface layer:

- (a) Two concrete mixers each of sufficient capacity to complete the required daily task rate to ensure the timeous completion of the project.

- (b) Two weigh batchers to supply the mixers.
- (c) Four concrete vibrators of which shall be powered by an internal combustion engine.
- (d) Sufficient in number, wheel burrows for the transport of concrete from the concrete mixer to the position of placing.
- (f) Elevated storage tanks of adequate capacity to ensure that sufficient water will be available before the commencement of every major concrete-placing operation.

PSG-4.5.1

Design

Add the following:

"Any or all formwork required for any part of the works shall be designed by the contractor, and before commencing with the erection of any formwork, the contractor shall submit to the engineer, for approval, the methods which he proposes to use. The engineer shall have the authority to order any alterations to the design or in the sizes of any part of the formwork which he may consider necessary. The fact that the engineer approved or has altered any part shall not be construed as to relieve the contractor of his responsibility with regard to the strength and stability of such formwork."

PSG-5

CONSTRUCTION

PSG-5.1.2

Fixing

Delete the words "or, if permitted by the engineer, by welding" from the second sentence of the second paragraph.

Add the following:

"The engineer will inspect the reinforcing after it has been fixed in place, the formwork has been cleaned, cover blocks have been positioned, and before the placing of concrete commences. Welding of reinforcing steel will not be permitted."

PSG-5.2.1

Classification of finishes

- (c) Special

Add the following:

"This finish is obtained by first giving the surface a smooth finish with joints between formwork panels forming an approved regular pattern suitable for the appearance of the structure. All projections shall then be removed, irregularities repaired and the surface rubbed or otherwise treated until it is smooth

and of even texture, appearance and colour.

If the finish of exposed surfaces does not comply with the requirements for uniformity of the texture and appearance, the contractor shall, when instructed to do so by the engineer, rub down the exposed surfaces of the entire structure or any part thereof as specified below, entirely at his own cost. Before rubbing, all repairs must be completed.

The surface shall be saturated with water for at least one hour. Initial rubbing shall be carried out with a medium coarse carborundum stone, with a small amount of mortar being used on the face, in the

proportions of the cement-and-sand portion of the concrete being repaired. Rubbing shall be continued until all form marks, projections and irregularities have been removed and a uniform surface has been obtained. The paste produced by the rubbing shall be kept in place. The final rubbing shall be carried out with a fine carborundum stone and water. This rubbing shall continue until the entire surface is of a smooth, even texture and uniform in colour. The surface shall subsequently be washed with a brush to remove surplus paste and powder."

PSG-5.2.5 Removal of formwork

Add the following:

"The contractor shall make provision for the continued support of beams and slabs while the formwork is being removed and/or for back-propping of beams and slabs."

PSG-5.3 Holes, chases and fixing blocks

Add the following:

"Cover blocks for reinforcing and fixtures may be cast into the concrete provided the strength or any other desirable characteristic (such as the appearance) of the concrete section is, in the opinion of the engineer, not affected or impaired."

PSG-5.5.1.7 Strength concrete

Add the following:

"The concrete mixes for the concrete surface layer shall be designed by the PCI or similar approved laboratory and the requirements of subclause PSG 5.5.11 shall be taken into account."

PSG 5.5.3.2 Ready-mixed concrete

Add the following:

"Ready-mixed concrete may be used on the site. Samples for testing shall be taken on location by the contractor of every load delivered to the site."

PSG-5.5.7 Construction joints

Add the following:

All construction joints between the different sections shall be painted with bitumen based paint and sufficient time allowed for the paint to dry before the construction of successive panels. It is the contractor's responsibility to ensure that construction joints are watertight. All construction joints shall be formed to the detail as indicated on the drawings and the formation of such joint shall be an integral part of the shuttering used for the construction of the concrete road surface. The contractor's proposed method for ensuring the water-tightness of such joints shall be submitted to the engineer for his approval."

PSG-6 **TOLERANCES**

PSG-6.2.3 Specified permissible deviations

Add the following:

"Degree of accuracy II is applicable except for pre-cast concrete work, where a degree of accuracy of I is applicable.

Every permissible deviation is binding on its own. The accumulative effect of permissible deviations will not be considered. The maximum permissible vertical deviation is subject to the other permissible deviations."

Replace Sub-Clause 6.2.3(d)(5) with the following:

	Permissible deviation		
	Degree of Accuracy		
	I	II	III
	mm	mm	mm
Vertically, per meter height	5	3	2
Subject to a maximum of	50	20	10

The maximum permissible deviation from a 3 m long straight line connecting two points on the surface of a finished floor is 5 mm."

PSG-7 TESTS

PSG-7.1.1 Facilities

Add the following:

"The contractor shall provide the facilities necessary to test the concrete cubes made at the frequency specified in sub-clause 7.1.2.

The facilities shall consist of sufficient storage capacity and the testing of cubes by an approved laboratory.

The cost of all testing including the cost of sampling, storage and transport of samples shall be included in the rates tendered for concrete work."

PSG-7.3 Acceptance criteria for strength concrete

Add the following:

"Test results obtained from the supplier of ready-mixed concrete will not be accepted for evaluation in terms of sub-clause 7.3 but samples for testing shall be taken of such concrete at the point of placing."

PSG-8 MEASUREMENT AND PAYMENT

PSG-8.1.2 Reinforcement

Replace the contents of this sub-clause with the following:

"The unit of measurement for steel bars shall be the ton of reinforcement in place in accordance with the drawings or as authorized by the engineer.

The unit of measurement for welded steel fabric shall be the kilogram of fabric reinforcement in place and the quantity shall be calculated from the nett area covered by the mesh, excluding laps. Clips, ties,

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separators, stools and other steel used for positioning reinforcement shall not be measured, unless shown on the bending schedules. The tendered rate shall include full compensation for the supply, delivery, cutting, bending, welding, placing and fixing of the steel reinforcement, including all tying wire, stools, supports and waste."

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PSL MEDIUM PRESSURE PIPELINES

The following amendments should be included as standard amendments to all documents where the construction of pipelines is involved.

PSL 3 MATERIALS**PSL 4.3 Steel Pipes, Fittings and Specials****PSL 3.4.2 Pipes with Nominal Bore up to 150mm**

This paragraph will only be applicable to steel pipes with nominal bore up to 65mm. Steel pipes with a nominal bore range of 80 to 150 shall be fabricated with flanges.

PSL 3.4.3 Pipes with Nominal Bore over 150mm

Steel pipes with a nominal bore over 150mm shall comply with the applicable requirements of API 5L.

Steel pipes with a nominal bore range of 80mm to 300mm shall be fabricated with flanges.

PSL 3.8 Jointing Materials

Add the following additional sub-clauses:

PSL 3.8.8 Gaskets for flanged joints shall be of compressed asbestos fibre to BS 2815 Grade "A" and full faced with a minimum thickness of 3mm.

PSL 3.9 Corrosion Protection**PSL 3.9.5 Joints, Bolts, Nuts and Washers**

All aboveground bolts, nuts and washers to be hot-dip galvanized to SABS 763. The threads of all bolts must also be treated with a Mobil Tag E compound.

All underground-flanged couplings shall be protected with petroleum jelly mastic to a minimum of 100mm from the flanges and covered with plastic tape wrapping.

PSL 7 TESTING

Add sub clause 7.2 as follows:

PSL 7.2 Valves

"All valves shall, where not otherwise indicated, be pressure tested. Test certificates are to be furnished to the Engineer before delivering valves to site and who is to be allowed access to the manufacturing works for inspections at his discretion."

PSL 8 MEASUREMENT AND PAYMENT

Add sub clause 8.2 as follows:

PSL 8.2 Pipelines

"Pipes installed in the ground but not tested will be regarded as material on site and payment will be affected accordingly until the pipelines are tested either in sections or completely according to

specification."

6.1.3 PARTICULAR SPECIFICATIONS**PARTICULAR SPECIFICATION****PA CONSTRUCTION OF STEEL PIPELINES****CONTENTS**

PA 1	SCOPE
PA 2	STANDARDS
PA 3	MATERIALS
PA 4	DESIGN AND SETTING OUT
PA 5	ENTRY AND WORK UPON LAND
PA 6	SITE PREPARATION
PA 7	EARTHWORKS
PA 8	LAYING AND JOINTING OF PIPES AND SPECIALS
PA 9	REPAIRS TO COATINGS AND PROTECTION OF JOINTS
PA 10	CROSSING OF ROADS AND STREAMS
PA 11	HYDROSTATIC TESTING
PA 12	STERILISATION
PA 13	DRAINAGE OF PIPELINE
PA 14	MISCELLANEOUS CONSTRUCTION WORKS AND WORKMANSHIP
PA 15	FINAL PAINTING
PA 16	MARKER BEACONS, BENCH MARKS, TRIANGULATION BEACONS AND MARKING OF VALVE CHAMBERS
PA 17	COMPLETION DRAWINGS
PA 18	SUPERVISION AND INSPECTION
PA 19	MEASUREMENT AND PAYMENT

PA 1 SCOPE

This specification covers the construction of pressure pipelines of steel for the conveyance of water at ambient temperatures.

PA 2 STANDARDS

The following Standard Specifications, Codes of Practice and Regulations are referred to and shall apply as specified hereinafter. The latest issues shall apply:

SABS 135	ISO Metric black bolts, screws and nuts
SABS 136	ISO Metric precision hexagon-head bolts, screws and nuts

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SABS ENV-197-1	Common Cements
SABS ENV-413-1	Masonry Cements
SABS 509	Malleable cast iron pipe fittings
SABS 533	Black polyethylene pipes for the conveyance of liquids
SABS 546	Cast iron fittings for fibre-cement pressure pipes
SABS 558	Cast iron surface boxes and manhole and inspection covers and frames
SABS 763	Hot-dip (galvanised) zinc coatings
SABS 920	Steel bars for concrete reinforcement
SABS 952	Polyethylene sheet
SABS 966	uPVC pressure pipes
SABS 974	Rubber joint rings
SABS 986	Precast reinforced concrete culverts
SABS 1024	Welded steel fabric for concrete reinforcement
SABS 1083	Aggregates from natural sources
SABS 1090	Sand for plaster and mortar
SABS 1149	Flat and taper steel washers
SABS 1223	Fibre-cement pressure pipes and couplings
SABS 044	Code of practice for welding
BS 2815	Compressed asbestos fibre jointing
Act 85/1993	Occupational Health and Safety Act (as amended)
Act 15/2003	Explosives act and regulations (as amended)

PA3 MATERIALS

PA 3.1 PIPES AND FITTINGS

PA 3.1.1 Steel pipes, specials and couplings

PA 3.1.1.1 Steel pipes and specials shall conform to Particular Specification PB – Manufacture of Steel Pipes and Fittings.

PA 3.1.1.2 Linings and coatings to steel pipes and specials shall conform to Particular Specification PB - Manufacture of Steel Pipes and Fittings.

PA 3.1.2 Galvanized steel pipes and fittings.

PA 3.1.2.1 Galvanized steel pipes shall conform to SABS 62, medium and heavy thicknesses.

PA 3.1.2.2 Steel fittings shall be galvanized heavy weight fittings and shall conform to BS 1740 in applications where pressures exceed 1.4 MPa. For pressures 1.4 MPa or lower, galvanized malleable iron fittings to BS 143 and/or SABS 509 will be acceptable.

PA 3.1.3 Flanges

Except where specified to the contrary elsewhere in the documents, all flanges shall be steel-plate for welding and shall conform to BS 4504 or SABS 1123. Should the required flange size fall beyond the range of BS 4504, mating dimensions shall be in accordance with ISO standard 2084 with thicknesses adequate to withstand closed - end test pressure.

Flanges of 125 mm NB and larger shall have a minimum pressure rating of 1 MPa, with flat joint faces machine finished to a roughness value of 12.5 micrometers and with weld preparations in accordance with BS 2633, fig. 39 or 40. Weld preparation in accordance with fig. 41 shall be acceptable for flanges 100 mm NB and smaller.

PA 3.1.4 Bolts, nuts and washers

PA 3.1.4.1 Bolts and nuts shall conform to SABS 135 or SABS 136. Bolts shall be of sufficient length for at least two and maximum four screw threads to protrude from the nut when assemblies are fully tightened. When bolts are in vertical position, nuts must be on the bottom side. Bolts, nuts and washers to be hot-dipped galvanized to SABS 763 Type C.

PA 3.1.4.2 Washers shall be of appropriate material and dimensions shall conform to SABS 1149.

PA 3.1.5 Gaskets

Gaskets for flanged joints shall be of compressed asbestos fibre to BS 2815 Grade "A" and full faced with a minimum thickness of 3 mm to suit pressures. Faces to be prepared with bolt grease to prevent sticking to flange faces.

PA 3.2 VALVES

PA 3.2.1 Valves shall conform to Particular Specification PC - Supply of Valves.

PA 3.2.2 Stop cocks shall be brass or gunmetal heavy pattern screwdown types conforming to SABS 226.

PA 3.3 WATER METERS

PA 3.3.1 Water meters shall be capable of metering flow within an accuracy of 2 % of true flow over rated flow ranges. Turndown ratios shall not be less than 1:10 for single meters and 1:20 for compound meters.

PA 3.3.2 Each meter shall be installed complete with strainers or dirt traps on the upstream side.

PA 3.3.3 Meters of 40 mm size and smaller shall be rotary piston type domestic meters with integrators calibrated in cubic meters. Integrators shall have at least seven effective cyclometer digits.

PA 3.3.4 Meters larger than 40 mm shall be "Meinecke" or similar type rotary meters with interchangeable mechanisms. Meters shall be supplied complete with one spare mechanism for every five or part of five meters of similar size and rating. Integrators shall be calibrated in cubic meters with at least seven effective cyclometer digits.

PA 3.4 LINING AND COATING MATERIALS

Materials, other than concrete, for the lining and/or coating of pipes, specials and fittings shall conform to Particular Specification PB – Manufacture of Steel Pipes and Fittings.

PA 3.5 POLYETHYLENE SHEETS

Polyethylene sheets shall conform to SABS 952

PA 3.6 PRECAST REINFORCED CONCRETE CULVERTS

Precast reinforced concrete culverts shall conform either to SABS 986, class "S" loading or to SATS class 1 loading.

PA 3.7 CAST-IRON MANHOLE COVERS

Cast-iron manhole covers and frames shall conform to SABS 558.

PA 3.8 FENCING MATERIALS AND GATES

Materials for fencing shall conform to Clause PA14.1 of this specification.

PA 3.8.1 Padlocks shall conform to the requirements of CKS 280 and shall be supplied with 10 master keys.

PA 3.9 CEMENT

PA 3.9.1 Cement shall be ordinary or rapid hardening Portland cement conforming to SABS ENV 197-1.

PA 3.9.2 The alkali content of Portland cement when expressed as sodium oxide (Na₂O) equivalent shall not be greater than 0,6 % by mass of cement determined in accordance with SABS Method 551 or any other reduced value as determined by the Engineer, where :

$$\% \text{Na}_2\text{O equivalent} = \% \text{Na}_2\text{O} + (0,658 \times \% \text{K}_2\text{O})$$

PA 3.9.3 All cement shall be fresh and shall be used strictly in order of delivery. All cement in storage for longer than 10 weeks and all cement in unsealed pockets shall be removed from storage and be discarded.

PA 3.9.4 Cement shall be stored in weather-proof and damp-proof silos or sheds.

PA 3.10 AGGREGATES FOR CONCRETE AND MORTAR

PA 3.10.1 Aggregates used in the manufacture of concrete shall conform to SABS 1083.

PA 3.10.2 The aggregates shall be evaluated for potential alkali reactivity using a method for testing developed by CSIR, i.e. "An accelerated method for testing the potential alkali reactivity of siliceous aggregates" by R.E. Oberholster and G. Davis, published in "Cement and Concrete Research" Vol. 16, PP. 181 - 189, 1986.

PA 3.10.3 The chloride content of the sand determined by SABS Method 830 shall not exceed 0,01 % per mass.

PA 3.10.4 Coarse aggregate shall be suitable for concrete subject to surface abrasion, shall be of grading category 1 and of the largest possible size that would allow placement of concrete without difficulty.

PA 3.10.5 Sand for mortar or plaster shall conform to SABS 1090.

PA 3.11 WATER FOR CONCRETE AND MORTAR

PA 3.11.1 Water used for concrete, mortar, plaster or cement slurry shall be clean and free from injurious amounts of oil, acid alkalis, vegetable and mineral matter.

PA 3.11.2 Water shall generally conform to the recommendations in the appendix to BS 3148.

PA 3.12 CONCRETE

PA 3.12.1 Concrete shall be a homogeneous mixture of cement, water, sand and coarse aggregate and shall be mixed, placed, cured and tested in accordance with SABS 1200GA.

PA 3.12.2 Concrete shall have the following minimum compressive strengths at 28 days, unless otherwise specified.

PA 3.12.2.1 Reinforced concrete - 25,0 MPa

PA 3.12.2.2 Mass concrete - 15,0 MPa

PA 3.13 FORMWORK

Formwork shall conform to the requirements of section "GA" SABS 1200.

PA 3.14 CONCRETE REINFORCEMENT

PA 3.14.1 Bar reinforcement shall conform to SABS 920.

PA 3.14.2 Welded steel fabric reinforcement shall conform to SABS 1024.

PA 3.15 BRICKS

Building bricks and blocks shall conform to SABS 227.

PA 3.16 BACKFILL MATERIAL

PA 3.16.1 General

Material for bedding of pipes and for selected backfill around pipes shall be free from vegetable matter and hard, sharp and flakey particles or other materials harmful to the pipes or to the protective coatings of pipes.

PA 3.16.2 Bedding material shall be either of the following class:

PA 3.16.2.1 Class I: Finely graded, composed of material with the following properties:

- (i) Percentage by mass passing: 4,75 mm screen - 100 %
0,425 mm screen - 80 to 100 %
0,002 mm screen - 0 to 45 %
- (ii) Liquid limit (LL) as determined in accordance with SABS Method 851 shall not be more than 30 %, when performed on all the material passing the 0,425 mm sieve.
- (iii) Plasticity index (PI) as determined in accordance with SABS Method 852 shall not be more than 15, when performed on all the material passing the 0,425 mm sieve.
- (iv) Linear shrinkage (LS) as determined in accordance with SABS Method 853 shall exceed 5 %, when performed on all the material passing the 0,425 mm sieve.

PA 3.16.2.2 Class II: Medium graded, composed of material with the following properties.

- (i) Percentage by mass passing: 4,75 mm screen - 80 % to 100 %
0,425 mm screen - 60 to 80 %
0,002 mm screen - 0 to 40 %
- (ii) Liquid limit (LL) as determined in accordance with SABS Method 851 shall not be more than 35 %, when performed on all the material passing the 0,425 mm sieve.
- (iii) Plasticity index (PI) as determined in accordance with SABS Method 852 shall not be more than 18, when performed on all the material passing the 0,425 mm sieve.

- (iv) Linear shrinkage (LS) as determined in accordance with SABS Method 853 shall not exceed 7 %, when performed on all the material passing the 0,425 mm sieve.

PA 3.16.2.3 Class III: Granular, composed of material with the following properties.

- (i) Percentage by mass passing: 9,5 mm screen - 100 %
4,75 mm screen - 70 to 100 %
0,425 mm screen - 30 to 60 %
0,002 mm screen - 0 to 35 %
- (ii) Liquid limit (LL) as determined in accordance with SABS Method 851 shall not be more than 40 % when performed on all the material passing the 0,425 mm sieve.
- (iii) Plasticity index (PI) as determined in accordance with SABS Method 852 shall not be more than 20, when performed on all the material passing the 0,425 mm sieve.
- (iv) Linear shrinkage (LS) as determined in accordance with SABS Method 853 shall not exceed 10 %, when performed on all the material passing the 0,425 mm sieve.

PA 3.16.3 Items PA 3.16.2.1 to 3.16.2.3 for selected fill are conveniently summarized in the following table:

PERCENTAGE BY MASS PASSING SCREENS					ATTERBERG LIMITS SHALL NOT EXCEED		
MATERIAL / CLASS	9,5 mm	4,75 mm	0,425 mm	0,002 mm	LIQUID LIMIT (LL) %	PLASTICITY INDEX (PI)	LINEAR SHRINKAGE (LS) %
Finely graded / Class I	100	100	80-100	0-45	30	15	5
Medium graded / Class II	100	80-100	60-80	0-40	35	18	7,5
Granular / Class III	100	70-100	30-60	0-35	40	20	10

PA 3.16.3 General for all classes selected fill

Where in the opinion of the engineer no material suitable for use as selected fill is available from the excavations within 200 m of where it is required, then the contractor shall, on the engineer's written instructions, either import selected fill to the trench side or load and transport selected fill from material selected and stockpiled at another point along the pipe trench.

If, due to the negligence of the contractor, selected materials become contaminated with the rest of the material or with other matter such that they no longer comply with the requirements stated above, the contractor shall replace them with approved material at his own expense.

Importation of selected fill shall be undertaken by the contractor from approved borrow pits to be identified by the contractor away from the working strip and shall be negotiated for by the contractor at tender stage, established, worked and finally smoothed over and tidied or reinstated in accordance with the property owners requirements. No additional payment shall be made for importation of selected fill.

PA 3.16.4 Selected backfill

PA 3.16.4.1 For pipelines with organic coatings, selected backfill shall conform to the requirements of Clauses PA3.16.2 to PA3.16.3.

PA 3.16.5 Common Fill

PA 3.16.5.1 The material for common fill shall comprise mainly soil, fine material, gravel or shattered rock available from the trench excavation, but shall not contain any stones, boulders or shattered rock fragments with maximum dimensions in excess of 150 mm.

PA 3.17 STORAGE, HANDLING AND TRANSPORT OF PIPES, SPECIALS AND FITTINGS**PA 3.17.1 General**

PA 3.17.1.1 The Contractor shall be responsible for:

PA 3.17.1.1.1 The supply, delivery, storage, care and insurance of pipes, specials, fittings, valves and other materials and equipment.

PA 3.17.1.1.2 The receipt, provision of craneage and labour for the off-loading of pipes, specials, fittings, valves, materials and equipment at the store or alongside the pipeline trench.

PA 3.17.1.1.3 The provision of suitable access along the pipeline route and within the pipeline servitude for the purpose of off-loading pipes, valves, etc. and including :

(a) Benching along mild side slopes.

(b) Handling and stringing of pipes, specials and fittings at very steep inclines where the pipes, specials and fittings were stacked either at the top or the bottom of these inclines.

PA 3.17.1.1.4 Wherever suitable access to the pipeline servitude is not available, the Contractor shall provide and maintain access as instructed by the Engineer.

PA 3.17.1.2 The Engineer shall be afforded every opportunity of inspecting such materials on their arrival at site prior to them being off-loaded. If their condition is unacceptable to the Engineer on arrival, the Contractor shall remove them forthwith from the Site and replace such materials at his own cost and to the satisfaction of the Engineer.

PA 3.17.2 Transport

Pipes and specials shall only be transported on properly constructed or adapted vehicles containing correctly shaped and padded cradles or with strong, sawdust filled bags separating pipes and vehicle body as well as individual pipes from each other. Special care shall be taken with the transport of bitumen coated steel pipes as damaged coatings might be subject to rejection in terms of Clause 3.17.1.2.

PA 3.17.3 Handling

PA 3.17.3.1 Pipes, specials and fittings shall not be subjected to rough handling at any time. Under no circumstances shall same be dropped during loading or off-loading or be allowed to collide with each other.

PA 3.17.3.2 Coated steel pipes shall only be lifted by means of broad band slings at least 500 mm wide for pipes up to

500 mm NB and 1 000 mm wide for larger pipes, or as approved by the Engineer. Slings must comply with the requirements of the Occupational Health And Safety Act, Act 85/1993 (as amended). The regulations regarding the safe working loads and bearing pressures for slings must also be adhered to.

PA 3.17.3.3 All pipes shall only be lifted by means of approved spreader beams with at least two slings. The length and stiffness of the spreader beam must be such that safe bearing pressures and deflections of the pipes, linings and coatings are not exceeded.

PA 3.17.4 Storage

PA 3.17.4.1 Pipes shall generally be distributed and stored as close as possible to the laying position in order to minimize double handling. Where pipes are strung alongside the trench, they should be placed on the side away from excavated material.

PA 3.17.4.2 Where pipes, specials and fittings are to be stockpiled in bulk storage yards, the Contractor shall make his own arrangements for a suitable area which shall meet with the Engineer's approval. The stockpiling area shall be adequately fenced and protected by a lockable gate and a watchman shall be maintained at all times.

PA 3.17.4.3 Pipes and specials shall be strung or stockpiled on level, well drained ground in a manner such that they will not be in contact with the ground, tree stumps, or other sharp objects and all vegetation and other combustible material shall be completely removed to at least 5 meters from the nearest pipe or special.

PA 3.17.4.4 Coated steel pipes shall always be supported on a sufficient number of approved soft bolsters to prevent damage or permanent deformation of coatings. Coated pipes shall not be stacked more than two pipes high, each layer separated by bolsters.

PA 3.17.4.5 The number of layers of bare steel pipes in a stockpile shall not exceed:

$$N = \frac{1\,730 \times Y \times t}{(D-t)^2}$$

Where

N = Permissible number of layers
Y = Minimum yield stress of steel in MPa
t = Wall thickness in mm
D = Outside diameter in mm

PA 3.17.4.6 Each class and size of pipe shall be stored separately in its own stockpile.

PA 3.17.4.7 All rubber rings or other materials which will deteriorate under the action of sunlight, ozone or inclement weather, shall be stored in permanent shade in lockable weatherproof sheds. Welding and the running of welding machines and electric machinery shall not be permitted in or near places where rubber or plastic products are stored and care shall be taken at all times to prevent contamination of these products by oil or other petroleum derived solvents.

PA 3.17.4.8 Valves shall be stored in orderly groups on prepared floors to prevent damage, distortion or corrosion of flanges or working parts. All metal valves may be stored in the open but full protection shall be afforded to valves with non-metallic seals or working parts. Under no circumstances shall valves be stored in direct contact with the ground.

PA 3.18 RECORDS OF MATERIALS ON SITE

Contractor's Paraph

Witness
ParaphWitness
Paraph

Client Paraph

Witness
ParaphWitness
Paraph

PA 3.18.1 The Contractor shall keep and maintain a complete and comprehensive record of each pipe, special and fitting delivered to Site. The record shall at least denote the reference number, size, pressure class, and location in the pipeline, date and condition of delivery and the location of delivery and the location of storage. Copies of the record shall be submitted to the Engineer at the end of each month or whenever requested by the Engineer.

PA 3.18.2 Where pipes, specials and fittings are delivered without reference numbers, same shall be provided by stenciling, labeling or other methods approved by the Engineer.

PA 3.19 REPAIRS

PA 3.19.1 The Contractor shall be responsible for the repair of all defects in pipes, specials, etc, delivered to and accepted on site.

PA 3.19.2 The Contractor shall inspect the coatings and linings of all factory-coated and lined steel pipes and specials as follows:

- (i) Epoxy: Shall be inspected in accordance with SABS 1217.
- (ii) Organic coatings (bitumen): Shall be inspected with an approved holiday detector equipped with rolling spring or copper bristle brush electrode operating at 15 kV at a nominal pulse frequency of 30 Hz.
- (iii) Tape wrappings: This shall be the same as for the organic coatings above except that the operating voltage shall not be less than 50 % of the stated breakdown voltage of the tape being used and should not be more than 80 % thereof.

Areas which cannot be tested whilst pipes are supported on cradles or otherwise, shall be tested whilst pipe is suspended above the trench immediately prior to laying. Defective areas of linings and coatings shall be marked when detected and shall be repaired, to the Engineer's approval, with materials specified respectively for the original and/or coating. Repaired linings and coatings shall be inspected and re-tested after repair and shall have the same properties as specified for the original ones.

PA 3.19.3 Repairs to dented steel pipes and specials shall only be attempted if the dimensions between the lowest point of a dent and the original pipe contour is less than 2 % of the outside diameter of the pipe or special for pipes and specials up to 508 mm OD and 1 % of the outside diameter for larger pipes and specials. Repair of these minor dents shall be done as approved by the Engineer and all such repairs shall be tested by the application of a dye penetrant to detect cracks or laminations in the metal.

PA 3.19.4 Dents in steel pipes or specials of which the depth exceed the above limits and any dents which contain scratches or grooves or which affect the curvature of pipe barrels at welds shall be cut out by cutting of a length of pipe barrel long enough to eliminate the defect. Damaged sections shall be replaced in accordance with the Engineer's instructions. The ends of pipes intended for field welding shall be re chamfered to 30 ° ± 5 ° width of root face 1,6 mm ± 0,8 mm .

PA 3.20 MAINTENANCE OF CLEANLINESS

PA 3.20.1 End covers to pipes and specials shall be kept firmly in position until installation of same in the trench.

PA 3.20.2 The interior surfaces of all pipes, specials, valves and fittings shall at all times be kept free from dust, silt and foreign matter and access for rodents, animals and birds shall be prevented. Pipes and specials shall not be used as shelters by staff or for the storage of garments, tools, materials, food containers or similar goods. Particular care shall be exercised at all times to prevent faecal contamination of pipe interiors by

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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staff, casual visitors, passersby or monkeys and baboons.

PA 4. DESIGN AND SETTING OUT

PA 4.1 DESIGN

PA 4.1.1 General

The detailed design of the pipeline shall be the responsibility of the Engineer.

PA 4.1.2 As-built information by Contractor

PA 4.1.2.1 The Contractor shall be responsible for detailed surveys and the preparation of detailed working drawings comprising the following:

- (i) Detailed profile drawings showing clearly the exact pipeline levels and grades,
- (ii) the exact location of valves, fittings and specials,
- (ii) the location of all roads and/or other service and utility installations crossed by the pipeline,
- (iv) the location of rivers, streams, and other topographical features.

PA 4.1.2.2 Drawings shall be on size A1 standard sheets with 2,0 mm minimum size lettering and shall be to a scale not smaller than that of the Tender drawings. The drawings shall generally conform to the standard and layout of the Tender drawings.

PA 4.1.2.3 Working drawings shall be submitted for the Engineer's approval in quadruplicate and in the following manner:

- (a) Road crossings - 14 working days after construction of crossing is completed.
- (b) All other drawings - 25 working days after construction of works on a specific working drawing.

PA 4.1.2.4 The Engineer shall check all drawings and may instruct any drawings to be altered or corrected and the Contractor shall do so at his own expense and re-submit drawings for approval.

PA 4.1.3 General design criteria

PA 4.1.3.1 Pipelines shall be laid in straight lines or grades between changes of direction or grades. The pipe grade shall follow the general configuration of the ground and shall not be flatter than 1: 500. The following minimum depths of cover to natural ground level over the crown of the pipe shall be maintained:

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LOCATION	MINIMUM DEPTH OF COVER OVER CROWN OF PIPE IN mm
Cultivated ground	1 200
Veld	1 000
Through towns and built-up areas	1 000
Uncultivated ground with shallow rock	1 000

PA 4.1.4 Design by Engineer

PA 4.1.4.1 The Tender drawings show the alignment of the pipeline, the approximate profile of the pipeline, pipe and valve sizes, geological data and pressure classifications, approximate location of valves and fittings. Also included are typical designs for road and river crossings and miscellaneous pipeline structures.

PA 4.1.4.2 At least 7 working days before construction of any part or parts of the Works is due to commence in accordance with the Contractor's detailed Works programme, which are to be submitted in terms of the Contract, the Engineer shall submit duplicate working drawings of such part or parts of the Works to the Contractor and no construction work shall commence before the detailed working drawings are in possession of the Contractor's site staff.

PA 4.1.4.3 No deviation from working drawings shall be allowed without the Engineer's approval. Should the Contractor require deviations or alterations to drawings to suit his construction methods or otherwise, such deviations and alterations shall only be considered by the Engineer on the strength of detailed drawings prepared by the Contractor and submitted to the Engineer in duplicate at least 15 working days before construction involving such deviations or alterations is due to commence. Clauses PA 4.1.2.2 and PA 4.1.2.4 of this specification shall apply where relevant. The cost of surveys, preparation and submission of such drawings and all delays in completion of the Works resulting from such deviations or alterations shall be to the Contractor's account.

PA 4.2 SETTING OUT

PA 4.2.1 The Engineer shall establish the basic reference pegs and benchmarks on Site and give to the Contractor the particulars thereof in sufficient time to enable the Contractor to meet his approved programme. Thereafter the Contractor shall be responsible for the true and proper setting out of the Works and for the correctness of the position, levels, dimensions and alignment of all parts of the Works and for the provision of all necessary instruments appliance and labour in connection therewith.

PA 4.2.2 Setting out of the Works shall be performed by an experienced Engineering Surveyor and shall be to the following limits of accuracy:

- (a) Pipe centreline
Shall be in straight lines between changes of direction and/or grade and shall in its final laid position be within 100 mm of the plan centreline on the approved drawings.
- (b) Pipe invert levels and gradients
In the final laid position, pipe invert levels shall be within ± 25 mm of the invert levels on approved drawings but notwithstanding this tolerance, the same direction of grade as per approved drawings shall be maintained and the grade shall not be flatter than 1:500 (0,2%).

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- (c) Position of fittings, specials and valves
Fittings, specials and valves shall be installed within 5 m of the plan position indicated on the approved drawings.
- (d) Benchmarks and triangulation points
All levels shall be reduced levels above mean sea level and shall be indicated to the nearest 0,005 m. All coordinates shall be based on the applicable Lo system based on the WGS84 datum and shall be indicated to the nearest 0,1 m. Leveling shall be carried out to an accuracy such that the closing error between benchmarks does not exceed 0,007 times the square root of the distance traversed in kilometers.

PA 4.2.3 Setting-out of the Works shall also include the following duties which shall be performed and kept up to date as pipelaying progresses:

- (a) Accurate determination of as-laid invert levels of the pipeline before backfilling commences.
- (b) Accurate fixing by triangulation of all changes in direction before backfilling commences.
- (c) Accurate determination of exact as-laid chainages of all specials, changes in direction and/or grade, valves, off-takes, structures, etc., taken along the pipeline before backfilling commences.
- (d) The establishment of permanent surface benchmarks along the pipeline route at intervals not exceeding two kilometers and accurate levelling of same. Benchmarks to be sited within the pipeline servitude width as indicated on the drawings.
- (e) The establishment of permanent surface triangulation points along the pipeline route at intervals not exceeding 5 kilometers and determination of co-ordinates of same. Triangulation points to be sited within the pipeline servitude width as indicated on the drawings.

PA 4.2.4 Levels and co-ordinates over any section of pipeline backfilled shall be made available to the Engineer on request at no extra costs.

PA 4.2.5 The Contractor shall carefully protect and preserve all benchmarks, sight rails, pegs and other reference marks used in setting out the Works. The checking of any setting out or of any line or level by the Engineer or his representative on site shall not relieve the Contractor of his responsibility for the correctness thereof.

PA 4.2.6 If at any time during the progress of the Works, any error shall appear or arise in the position, levels, dimensions or alignment of the Works, the Contractor, on being required to do so by the Engineer, shall at his own expense rectify such error to the satisfaction of the Engineer.

PA 5. ENTRY AND WORK UPON LAND

PA 5.1 GENERAL

PA 5.1.1 The servitudes available for the construction of pipelines, provides the Employer with a right of way but not ownership of the ground.

PA 5.1.2 Servitudes shall normally not be permanently fenced off except where indicated to the contrary in the Project Specification to the Contract.

PA 5.1.3 The Contractor shall confine his activities to the servitude strip except where otherwise provided for. Trespassing, poaching of game and gathering of firewood on property outside the servitude strip shall be strictly forbidden.

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- PA 5.1.4** All damage caused by the Contractor, his staff or agents outside the servitude strip shall be the responsibility of the Contractor who shall be liable for all claims in this respect.
- PA 5.1.5** Provision has been made for the Contractor and the Employer to gain access from public roads to the pipeline servitudes via separate servitudes of access. These are shown on the drawings. The use of any other private roads to gain access to the pipeline servitude shall only be with the prior written approval of the landowner(s). The Contractor shall be responsible for all claims from the landowner(s) arising out of any such agreement. A Copy of each agreement must be submitted to the Engineer.
- PA 5.1.6** The issue of the Final Certificate in terms of the General Conditions of Contract shall be subject to the Contractor producing to the Engineer a certificate, signed by the landowner or lessee in question that all the Contractor's obligations to him have been completely discharged in terms of any agreements that may have been arranged between the Contractor and the landowner or lessee or in respect of any damage to crops, land or property caused by the Contractor's activities outside the strip of right-of-way. If such certificates are not produced within 12 months after issue of the Completion Certificates in respect of the works or any part of the works, the Employer reserves the right to investigate any agreements entered into between the landowner or lessee in question and the Contractor and any claim made by the landowner or lessee for damage outside the strip of right-of-way. If the Employer is satisfied that the Contractor is in default in terms of the contract and any private agreements which he has made, all justifiable claims shall be paid to the landowner or lessee by the Employer from retention money held and deducted from amount payable to the Contractor.
- PA 5.2 ENTRY UPON PRIVATE LAND**
- PA 5.2.1** At least 7 days written notice shall be given by the Contractor to the Engineer before entering upon any land to commence construction. The Engineer will, as far as possible, arrange a meeting between the Engineer, the Contractor and the landowner or occupier to inform the landowner or occupier of the programme of construction, to make an agreed record of the state of the land and any crops and/or improvements within the required right of way and to consider any special or reasonable requests of the landowner or occupier.
- PA 5.3 WORK IN TOWNS AND ON AREAS UNDER CONTROL OF AUTHORITIES**
- PA 5.3.1** Where the pipeline crosses through towns or areas controlled by the Government, Provincial or local Authorities, Public or Semi-Government Corporations or Mine Owners, the work shall be carried out in accordance with the reasonable requirements of the authorities or owners where these do not contradict the provisions of the contract.
- PA 5.3.2** Before undertaking any work in these areas, the Contractor shall contact the authority or owner concerned at least 14 days before commencement of construction, inspect the route in detail and familiarize himself with the requirements of the authority or owner in respect of working hours and working conditions. No additional payment or relief from his obligations in terms of the contract will be made on account of restriction imposed by the authorities or owners.
- PA 5.3.3** Construction of the pipeline in any controlled area shall not be started without the written advice to the authorities or owners concerned that work is about to commence. No felling of trees, removal of crops or demolishing of buildings or other structures shall be undertaken without the approval of the authorities or owners.
- PA 5.4 ACCESS THROUGH FENCES**

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- PA 5.4.1** Where existing fences cross the pipeline route, the fences within the working area shall be replaced with fences and gates using new material throughout as hereinafter specified.
- PA 5.4.2** Before any fence is cut, the Contractor shall erect straining posts of either 100 mm nominal bore steel tubing or 10 kg/m iron rail or creosote impregnated hardwood of 150 mm minimum diameter in the line of the fence on both sides of the pipeline to the working width required. The post shall be firmly concreted into the ground and shall be properly strutted or stayed to the satisfaction of the Engineer. The type of posts and stays or struts used shall depend on the climatic and soil conditions at the site and the Contractor shall be guided in his choice of materials by the type of fencing material generally in use in the area.
- PA 5.4.3** As soon as the concrete has hardened sufficiently to take the strain, the wire strands of the existing fence shall be cut one by one and each individually secured to the straining posts before proceeding to cut further strands so that the tension in the existing fences is maintained.
- PA 5.4.4** The Contractor shall immediately erect and maintain temporary fences and gates between straining posts to the same general standard as the existing fence and in a manner that will ensure easy access along the pipeline route for the Contractor, the Engineer or his authorised Representatives.
- PA 5.4.5** As soon as construction work has been completed in the vicinity of the temporary fence and gate, a permanent fence and a gate to the standards hereinafter specified shall be erected across the pipeline servitude. Permanent gates shall be provided with a heavy chain and padlock of approved quality. All padlocks shall be similar with duplicate sets of master keys provided. The sets of keys shall be handed over to the Engineer prior to the issue of the Completion Certificate in respect of that section of pipeline.
- PA 5.4.6** From the time of occupancy of the site until the issue of the Completion Certificate the Contractor shall take all measures for the protection and control of livestock etc., which are made necessary by his operations. Livestock shall not be allowed to stray through severed fences or gates provided by the Contractor. If the random movement of stock through any such openings is not effectively prevented at all times, the Engineer shall call upon the Contractor to provide a full time guard at the Contractor's expense.
- PA 5.5** **TEMPORARY FENCING OF WORKING AREAS**
- PA 5.5.1** Where demanded by owners or instructed by the Engineer, the Contractor shall fence one or both sides of the pipeline servitude as may be required to prevent straying of livestock onto the working area during the entire period that excavations are open.
- PA 5.5.2** It shall be incumbent on the Contractor to establish the needs of temporary fencing.
- PA 5.5.3** Temporary fencing shall be of a standard as hereinafter specified and shall be maintained to the satisfaction of the Engineer and shall be removed only when in the opinion of the Engineer, the Site is deemed to be safe for livestock.
- PA 5.5.4** The Contractor shall supply, install and maintain gates of the standard hereinafter specified at such points as instructed by the Engineer or reasonably required by occupiers or owners of property for access across the working area or to parts of the farm severed by temporary fences.
- PA 5.6** **INTERFERENCE WITH AND REINSTATEMENT OF EXISTING SERVICES AND WORKS**
- PA 5.6.1** The Engineer will supply the Contractor with such information as he has, concerning obstructions and services which cross the pipeline route. Whilst such information is given in good faith, it shall not relieve the Contractor of any of his liabilities, obligations and risks under the contract.
- PA 5.6.2** Before commencing any excavation or pipework, the Contractor shall verify the locations and elevations of all known or suspected service and utility installations such as power transmission lines or cables, telephone

lines or cables, water and sewer pipes, access roads, tracks or paths, irrigation or stormwater reticulation, agricultural contours, natural drainage channels, lamps or other posts or pylons and any other service or obstacle, whether those be buried, under water or not. Verification shall be by inspection of the site, examination of drawings, consultation with landowners, occupiers and responsible authorities or, where necessary, by the excavation of trial holes.

- PA 5.6.3** The Contractor shall be responsible for the cost of immediate repair of any damage caused to services or utility installations and for any loss or damages suffered as a result of the interruption of any service so damaged whether or not such damage is attributable to negligence on his part. Any damage caused shall immediately be reported to the Engineer.
- PA 5.6.4** The Contractor shall not interfere with any service or utility installation without written approval of the owner, occupier or responsible authority. The Contractor shall arrange for the temporary continuance of any service or utility installation which must be discontinued, disconnected, deviated or removed for the purpose of construction and for the maintenance of such temporary measures until final restoration of the service or utility installation. The provision of the temporary measures shall be carried out in such a manner as may be required by the authority or owner concerned or as directed by the Engineer.
- PA 5.6.5** The Contractor shall send all requisite notices to the authorities or persons concerned and shall make the necessary arrangements for the maintenance, discontinuance, disconnection or removal of the said installations.
- PA 5.6.6** In the case of temporary discontinuance of services, the Contractor shall warn owners, occupants or responsible authorities of the impending interference with the service and co-operate with them in order to carry out the work with as little disruption of the owners', occupants' or local authority's operations as possible and whatever temporary arrangements are required to maintain the service in operation during alterations shall be carried out by the Contractor.
- PA 5.6.7** As soon as possible, all service and utility installations that have been interfered with, shall be restored to the condition they were in before the start of construction under this contract, or better, but to the satisfaction of the Engineer.

PA 6. SITE PREPARATION

PA 6.1 SITE CLEARING

- PA 6.1.1** Prior to commencing excavation the Contractor shall clear the full width of the permanent pipeline servitude of all bush, trees, scrub, rubble, boulders etc. and shall where specifically indicated in the Schedule of Quantities, demolish permanent structures, huts, houses etc. situated within the permanent pipeline servitude.
- PA 6.1.2** All bush, scrub and trees shall be cut down and all stumps and roots completely removed. Grass however shall not be removed indiscriminately as this would render the servitude liable to erosion. Combustible material removed may be burnt within the servitude, provided care is taken to prevent contamination of trench bottoms or backfill material with charcoal or other products of combustion and safeguards against veldt fires are taken to the satisfaction of the Engineer or landowner.
- PA 6.1.3** The Engineer may direct that certain trees not within 3 meters of the pipeline and which would not interfere with construction, be left standing and the Contractor shall therefore obtain the Engineer's instruction before removing trees which could reasonably be left standing. All timber removed remains the property of the Employer and the Contractor shall dispose of timber in a manner as instructed by the Engineer.

PA 6.2 TOPSOIL

Topsoil shall be carefully stripped over the trench width, set aside for bringing back after backfilling of trenches and replacing over the top of trenches to restore the ground to its near as possible original condition.

PA 6.3 GENERAL LEVELLING

PA 6.3.1 If, owing to excessive cross-falls, the Contractor requires to carry out general leveling within the servitude strip to facilitate use of plant, such leveling may only be carried out after stripping and setting aside of top soil over the full width of the area to be leveled.

PA 6.3.2 After completion of the works, the ground shall, at the discretion of the Engineer be restored to its original contour, topsoil replaced to its original depth and the area protected against erosion to the satisfaction of the Engineer.

PA 7. EARTHWORKS**PA 7.1 EXCAVATIONS****PA 7.1.1 General requirements**

All excavation work shall be subjected to the requirements of the Occupational Health And Safety Act (Act 85 of 1993 and amendments). The Contractor shall ensure that working conditions are safe and that excavations are kept free of water at all times.

The transport, storage, handling and use of explosives shall be in accordance with the Explosives Act and Regulations Act 15 of 2003 and amendments). Blasting shall not be carried out without the approval of the Engineer. Such approval shall not relieve the Contractor of any of his liabilities, obligations or risks under the Act or the Contract. Proper precautions shall be taken to protect persons, the works and the property and the Engineer may instruct the use of blasting mats at the Contractor's expense over any or all sections of excavations, whether in open country or otherwise. The Contractor shall collect fly rock, if any, immediately after each blast. Blasting may be prohibited where, in the opinion of the Engineer, injury to persons and/or damage to property and/or service and utility installations is likely.

When blasting within 500 meters of any permanent structure, above or below ground, including pipelines, buildings etc. described in clause 10.17.1 and 10.17.2 of the Explosives Regulations no. 1604 of the Explosives Act no. 26 of 1956 the peak particle velocity as defined in a technical bulletin "Explosive Today" no. 27, March 1982 of AECl, shall at no stage exceed 25 mm/s adjacent to any of these structures. These peak particle velocities shall be measured by an approved Vibrorecorder and Peak Particle Velocity meter for each blast over the full length of work which falls within the above limits.

PA 7.1.2 Classification of excavated materials**PA 7.1.2.1 General**

Materials shall be classified with sub-classifications of "soft and pickable" and "rock".

PA 7.1.2.2 Classified materials

The Engineer's decision as to in which sub-classification excavated materials fall, shall be final.

PA 7.1.2.2.1 "Soft and Pickable". This sub-classification shall include all top soil, sand, loam, clay, gravel, pickable materials, ouklip (laterite), shattered or loose rock, decomposed or partially decomposed rock and all other materials which can be removed with mechanical equipment or by pick and shovel, whether this be by lifting hard layers from underneath or otherwise. Boulders under 0,3 cubic meter in volume are included. The fact that blasting or pneumatic percussion tools or other rock breaking equipment may be a faster or more convenient method of excavating material under this sub-classification shall not entitle the Contractor to claim payment for "rock" excavation.

PA 7.1.2.2.2 "Rock". This sub-classification shall include all solid undecomposed rock, the practical excavation of which necessitates the use of explosives, rock splitting equipment or pneumatic pavement breakers and rock drills. All boulders larger than 0,15 cubic meter in volume are included.

PA 7.1.3 Trenches**PA 7.1.3.1 Trench widths**

PA 7.1.3.1.1 Minimum trench widths shall generally be as follows:

PIPE NOMINAL BORE IN mm	WIDTH OF TRENCH IN mm
100	700
150	700
200	800
400	1 000
500	1 100
600	1 200

Widths of trenches shall be maintained at the base of the trench and the laid pipeline shall be located centrally in the trench to enable backfill to be effectively rammed below the lower half of the pipe on both sides of the pipe.

PA 7.1.3.1.2 At tie-ins on welded pipelines, trenches shall be excavated to a width of not less than 900 mm in excess of the minimum widths, to a depth of not less than 750 mm below pipe invert level and for a length of not less than 900 mm centred on the joint. For pipelines with flexible joints, sufficient space shall be allowed around joints to permit proper making and inspection of joints.

PA 7.1.3.2 Trench depth**PA 7.1.3.2.1 General**

The contractor shall set out the trench accurately in accordance with the drawings.

Before commencing the setting out the contractor shall clear and roughly grade the surface over the full width of the trench.

The contractor shall provide, erect, set to line and level and maintain approved substantial profiles along the length of the trench at a maximum of 50 m intervals and at changes of grade and direction. Each profile shall be fitted with a horizontal cross-bar set at a predetermined height above the designed bed-level of the pipe and have setting marks which will define the centre-line of the trench. Where required

by the engineer the contractor shall provide a profile with the cross-bar extending across the full width of the trench. A profile shall remain in position during all stages of the trench excavation and the trench floor and pipe bed preparation and until the pipe is laid past the profile.

The contractor shall provide sets of boning rods, templates and piano wire, for the sole use of the engineer, for checking the level, grade and width of the trench relative to the centre-line. The contractor shall also provide, set and level all the pegs required to transfer lines and levels to the pipe bed to control the preparation of the trench floor and pipe bed.

Should the contractor prefer to make use of other setting-out techniques for maintaining the correct line and grade of the trench full details of his proposed technique shall be submitted to the engineer for approval.

Trenches shall be excavated to the grades and levels shown on the approved drawings and depths shall be so controlled that a uniform depth of bedding underneath the pipeline is ensured.

The contractor shall maintain correct line and grade throughout the work. Precise control of the grade of the trench floor and pipe bed is required and the contractor shall compute the pipe bed levels at each pipe joint position and install a level peg at the position of each joint and each change of grade to enable the pipe to be installed in accordance with the levels and grades shown on the relevant longitudinal section. The accuracy of the computation of and transfer of levels from the levelled pegs at the trench side to those installed by the contractor to establish the pipe bed shall be within 3 mm of the correct level. The competent person appointed by the contractor shall be fully experienced and competent in the use of engineering surveying equipment and techniques.

PA 7.1.3.2.2 Trench floor

PA 7.1.3.2.2.1 The trench floor or bottom is defined as the plane at which the bulk excavation is terminated.

The contractor shall apply for and obtain from the engineer instructions regarding the position of the trench floor relative to the pipe bed level stated on the longitudinal section for the pipeline, for each type of material and at each change in material.

Trenches shall be excavated and trimmed to a depth of not less than 100 mm below the underside of pipes in the case of welded or coupled steel pipelines and not less than 200 mm below the underside of pipes in the case of flanged steel pipes in excess of pipe barrel outside diameters. These depths shall be maintained for the full width and length of the trench and all stones, rocks or other projections trimmed accordingly.

The levels and grades of the finished trench floor shall not be more than 0 mm above or more than 50 mm below the prescribed position.

Where, in the opinion of the engineer, the in situ material at the levels and grades of the pipe bed has inadequate bearing capacity, the contractor shall deepen the trench below the stated pipe bed level. The amount of deepening will be prescribed by the engineer after inspection of the trench floor as the excavation proceeds.

The contractor shall terminate the bulk excavation at the stated pipe bed level where the in situ material at the pipe bed level stated on the longitudinal section has adequate bearing capacity, is composed mainly of fine, sandy or clayey-sand material with a plasticity index not exceeding 15, is free from ouklop or substances chemically deleterious to bitumen coated steel pipes and is free from pebbles, stones and fragments of shattered rock with maximum dimensions exceeding 10 mm.

PA 7.1.3.2.2.2 The Contractor shall advise the Engineer whenever trench bottoms have been excavated and trimmed and are ready for inspection. No trench bottoms shall be covered with bedding material or pipes laid until the inspection has been carried out and the trench bottoms passed. Failure of the Contractor to comply with this clause shall render the Contractor liable to re-open, uncover and reinstate trench bottoms for inspection at the Contractor's expense.

PA 7.1.3.2.2.3 The engineer reserves to himself the right to increase the depth of the trench below the pipe bed as shown on the drawings and to pay for such extra depth at tendered rates for excavation.

The contractor shall extend the bulk excavation to a depth of 150 mm below the stated pipe bed level where the in situ material at the levels and grades of the pipe bed has adequate bearing capacity but consists of rock, hard rock, oukclip, clay with a plasticity index exceeding fifteen, coarse broken material with pebbles, stones and fragments of shattered rock with maximum dimensions exceeding 10 mm, or contains oukclip or substances chemically deleterious to bitumen coated steel pipes.

PA 7.1.3.2.2.4 To comply with the regulations promulgated under the Machinery and Occupational Safety Act (Act 6 of 1983) it may be necessary to either batter the trenches to the angle of repose of the in-situ material or to shore the sides of the trench.

PA 7.1.3.3 Overbreak and over excavation

It is to be expected that during the bulk excavation material will be removed from below the prescribed trench floor position. In the cases where the trench floor is formed of materials classified as hard material, the additional depth will for purposes of this contract be termed overbreak and can be expected to vary according to the nature of the rock, the jointing planes, the extent of weathering of the rock, the methods and procedures used in the blasting of the rock and the expertise of the personnel undertaking the blasting. In the case where the trench floor is formed in materials classified as soft material, the additional depth will for purposes of the contract be termed over excavation.

There will be no direct payment for the cost of removing and disposing of the volume of material removed from below the prescribed trench floor position or for the cost of rebuilding overbreak and over excavation to the prescribed trench floor position. The cost of all these operations shall be included in the tendered rates for preparing the trench floor to receive the pipe bed as set out in sub clauses PA 7.1.3.4 and PA 7.1.3.5.

PA 7.1.3.4 Cleaning the trench floor

Before placing a filling layer on the trench floor the contractor shall loosen any disturbed material and shattered rock and shall remove all rubble, mud and standing water. Before a subsequent filling layer is placed the contractor shall remove any loose material, rubble, mud and standing water from the interface between the layers.

PA 7.1.3.5 Rebuilding the trench floor

Rebuilding the trench floor is defined as all operations necessary to replace material removed in overbreak and over excavation and to restore the trench floor to the levels and grades prescribed by the engineer.

In overbreak the exposed surface of the rock at the bottom of the trench shall be cleaned in accordance with subclause PA 7.1.3.4 and the average depth of the overbreak below the prescribed trench floor position shall be assessed in order to determine the number of fill layers needed to rebuild to the prescribed position. Not more than 20% of the area of the trench floor in each 20 m length of trench shall contain unexcavated rock with an upper surface located within 150 mm to 100 mm of the pipe bed level and no material whatever shall project to within less than 100 mm of the pipe bed level.

The overbreak shall be backfilled to the prescribed trench floor position to within the specified tolerances

using cement or lime stabilized fill.

In over excavation the undisturbed surface of the in situ material at the bottom of the trench shall be cleaned in accordance with subclause PA 7.1.3.4 and the average depth of the over excavation below the prescribed trench floor position shall be assessed in order to determine the number of filling layers needed to rebuild to the prescribed position. No undisturbed material shall project above the prescribed position of the trench floor.

The over excavation shall be backfilled to the prescribed trench floor position to within the specified tolerances using cement or lime stabilized fill.

PA 7.1.3.6 Progress of trenching

Trench excavation shall proceed progressively from each working head and the opening of trenches haphazardly at various points along the route will not be permitted without approval of the Engineer. In particular, the Contractor will not be allowed to pass over hard sections of excavations to proceed with soft excavation at further points along the trench. Trench excavations shall not be carried out further ahead of pipe laying than is required for efficient working and in no case shall this exceed 1 kilometer without prior approval of the Engineer. At the discretion of the Engineer this clause may be relaxed insofar as road and stream crossings are concerned. Where rock excavation is continuous, the Contractor may be permitted at the Engineer's discretion to use special rock excavating gangs further ahead of the main excavating gangs.

PA 7.1.4 Valve chambers and thrust blocks

Where instructed or shown on the drawings, excavation which is of a greater width or depth than the prescribed dimensions for the trench excavation or sundry additional excavation of any nature shall be carried out by the contractor to the engineer's instructions. Such additional excavation shall include widening and deepening the normal pipe trench for valve chambers, thrust blocks and other structures and for excavations ordered by the engineer including joint holes and sling slots. Such additional excavations shall be carried out as and when required by the engineer. Only that portion of the authorized excavations in excess of the prescribed dimensions for the trench shall be paid for as additional excavations, inclusive of a maximum working space of 600mm for erecting and removal of shuttering.

Additional excavation will be required to expose existing Magalies Water pipelines to allow the installation of connections to the new pipeline. In exposing existing pipelines the contractor shall excavate by machine, or by hand if necessary, around and under the pipelines taking care to avoid damage to pipe coatings. Any damage caused to the pipe or pipe coatings during excavations shall be made good by the contractor at his own expense.

PA 7.1.5 Joint holes and sling slots

Before the pipes are laid, joint holes and lifting sling slots shall be excavated where required to facilitate efficient welding, inspection and repair of joints and removal of slings. The dimensions of joint holes and sling slots shall be left to the discretion of the Contractor, but the Engineer shall reserve the right to order an increase in the dimensions should the quality of the work suffer as result of inadequate work space. This work shall be carried out as directed and shall be completed well in advance of the pipe-laying. The cost of excavation and subsequent backfill of joint holes and sling slots shall be deemed to be included in the rates tendered for excavation, backfill and placement of bedding.

PA 7.1.6 Spoil dumps

All excavated material shall be dumped along the sides of trenches either separately or in successive layers according to the nature of the material removed in such a way that backfilling in accordance with the specification may be facilitated. Spoil dumps shall not unreasonably obstruct the works, traffic or drainage,

and all surplus spoil not required for backfilling and restoration shall be removed to spoil dumps during the progress of the work.

PA 7.1.7 Safety of trench and other excavations

The contractor shall include in his tendered rates for excavation, the cost of all necessary timbering and shoring of the sides of the trench and the protection and separation of the trench from access by the public, livestock, etc. Timbering shall consist of open planking, walings and substantial struts and shall be carried out in a workmanlike manner and to the satisfaction of the engineer.

The shoring method adopted shall be compatible with the excavating, backfilling and pipe-laying methods and shall cause minimum restrictions to the laying of the pipes. Shores shall be designed to withstand the earth pressures exerted upon them from the trench side, which shall include the superimposed loading of pipe-laying equipment working at the side of the trench with pipes.

The engineer may call upon the contractor to timber the sides of the trench at any point that he may consider in any way dangerous. Such timbering shall be left until after the completion of the pipe-laying at the point affected.

The contractor shall carry out the removal of timbering immediately prior to backfilling or on the instructions of the engineer.

As an alternative to timbering, the contractor may prefer to batter the sides of the trench or form suitable steps to ensure the safety of the excavations in accordance with the regulations promulgated under the Factories, Machinery and Building Works Act, 1941, as amended, and the Machinery and Occupational Safety Act (Act 6 of 1983).

Maintaining the sides of the trench in a safe condition during excavations, preparation of trench floor, delivery of pipes to site, placing of pipe bed, laying of pipes, backfilling and the protection of the trench together with preventing general access to the trench by unauthorized persons, by children and by animals shall be the sole responsibility of the contractor. No undercutting of the sides of the trench will be allowed.

The contractor shall take every precaution to prevent water from any source entering the trench. The engineer may order additional precautions to be taken where he is not satisfied with the contractor's arrangements. Any water, including seepage, entering the trench shall be removed immediately if directed by the engineer.

If required by the engineer, the contractor shall leave unexcavated blocks in the trench to prevent the flow of stormwater down the trench. These blocks shall be at least 1,0 m thick and at spaces as directed by the engineer.

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PA 7.1.8 Maintenance of open trench

After excavation the trench and pipe bed shall be maintained until the pipe is laid. Should the sides fall in or any debris or water accumulate in the trench due to any cause, the trench shall be cleared and the bed made good where so directed by the engineer. After the installation of the pipe, the trench shall be maintained until the backfilling has been completed.

PA 7.2 BACKFILLING**PA 7.2.1 General**

PA 7.2.1.1 The Contractor shall negotiate directly with landowners or lessees in regard to borrow pits for padding or selected backfill material. All such sites shall be subject to the approval of the Engineer.

The Engineer shall be kept fully informed of all negotiations that are in progress between the Contractor and the landowners or lessees. It is essential that the Contractor shall make prompt payment to landowners or lessees for any royalties for borrow pits and for any agreed amounts to be paid to the landowners or lessees for the use of borrow pits, access roads, use of ground outside servitudes etc.

PA 7.2.1.2 It is desirable that trenches shall be backfilled as soon as possible after pipe laying to curtail thermal movements of the pipeline, damage to coatings and flotation of the pipeline should the trench fill with water. At no time shall backfilling lag more than 500 meters behind the last pipe laid. All specified tests on pipe barrels and joints shall therefore be carried out as soon as possible.

PA 7.2.1.3 The Contractor may use his discretion as whether to backfill around joints before the pipeline is hydrostatically tested. The Contractor shall be responsible for the location and repair of any leaks on the pipeline under hydrostatic test and no extra payment will be made for any re-excavation and subsequent reinstatement which may be necessary to locate and remedy leaks or for the installation of cathodic protection equipment. Should the Contractor elect to leave joint holes open until after the hydrostatic test, he shall provide at his own expense effective and approved barricades and fences around each hole for the protection of persons and animals. In built-up areas, barricades shall be clearly marked at night time with warning lights.

PA 7.2.2 Pipe bedding

PA 7.2.2.1 Pipe bedding comprises backfill placed and compacted in trench bottoms up to the level of pipe springing points in a manner such that pipes are uniformly supported over an arc of 120°, centered on the pipe centerline for its full length.

PA 7.2.2.2 Placing and compaction of the pipe bedding shall be regarded as the most critical phase of the backfilling operation. Backfilling beyond this point shall only proceed after inspection and approval of the completed bedding by the Engineer.

PA 7.2.2.3 As soon as possible after trench bottoms have been passed by the Engineer, cross berms of compacted bedding material shall be placed over the full width of the trench and of a size and spacing such that the pipe shall be supported at the required level and grade without interference with the placement and compaction of the balance of the bedding material. This phase of the operation shall be subject to the Engineer's approval and the Contractor shall submit a comprehensive method statement to the Engineer for perusal and approval before pipe laying commences.

PA 7.2.2.4 Bedding material shall be placed and compacted evenly on both sides of the pipe, compaction to be by hand or mechanical tamping or the bedding may be placed by puddling and compaction by means of poker vibrators. The method adopted shall be subject to the Engineer's approval. Whatever method is adopted

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and approved, great care shall be exercised at all times to prevent damage to pipe coatings or disturbance of the pipe level and grade by flotation or otherwise. The top of the completed bedding shall form a level surface completely filling the space between the pipe and trench walls including any cavities that might exist in the trench walls.

PA 7.2.2.5 If compaction is by hand or mechanical tamping, compaction shall be in layers not exceeding 100 mm measured in the loose, watered to optimum moisture content and compacted to densities as per Clause 7.2.6. The material in the "wedges" formed by the curvature of pipe bottoms shall be compacted by hand punning horizontally and obliquely.

PA 7.2.2.6 After completion of a length of pipe bed and its approval by the engineer, the contractor shall carry out the excavation of the joint holes and pipe lifting sling slots and clean the surface of the pipe bed.

The trench shall not be considered complete for pipe-laying purposes until the pipe bed, joint holes and pipe lifting sling slots have been constructed by the contractor and accepted by the engineer.

PA 7.2.3 Soft trench bottoms

PA 7.2.3.1 Where trench bottoms are too soft and waterlogged to permit placement and compaction of bedding material in the normal manner, such trench bottoms shall be excavated to a depth of at least 300 mm below the underside of pipes and specials for the full width and length of the trench affected.

PA 7.2.3.2 The full width and length of the trench bottom and at least 500 mm height of both sides of trench walls shall be covered by "Bidim" or similar approved filter cloth.

PA 7.2.3.3 The full width and length of the trench shall thereupon be covered by a 300 mm thick layer of coarse gravel, coarse sand or 19 mm nominal size crushed stone, fully compacted within the confines of the filter cloth to take the mass of the pipe filled with water and all loads on the pipe without settlement.

PA 7.2.3.4 The free drainage layer shall be covered over the full width of the trench by a single layer of filter cloth with the cloth on trench walls folded over and overlapping to completely seal off the drainage layer against ingress of sand or fine soil particles.

PA 7.2.3.5 Pipes shall be laid directly on the bed prepared as above and pipe bedding and selected backfill completed as specified.

PA 7.2.4 Selected backfill

PA 7.2.4.1 Selected backfill comprises backfill material placed and compacted in trenches from the top level of completed beddings up to a level of 300 mm above the crown of pipes.

PA 7.2.4.2 As soon as possible after completed beddings have been inspected and accepted by the Engineer, selected backfill shall be placed and compacted evenly on both sides of the pipe, compaction to be by pneumatic rammers or vibratory rollers or may be placed as a hydraulic fill and compacted by poker vibrators. The method adopted shall be subject to the Engineer's approval. Whatever method is adopted and approved, great care shall be exercised at all times to prevent damage to pipe coatings or disturbance of the pipe level or grade by flotation or otherwise.

PA 7.2.4.3 If compaction is by pneumatic rammers or vibratory rollers, compaction shall be in layers not exceeding 150 mm in the loose, watered to optimum moisture content and compacted to densities as per Clause PA 7.2.6.

PA 7.2.4.4 The top surface of the completed selected backfill shall be level over the full width and length of the trench. The compacted selected backfill shall completely fill all spaces between the pipe and trench walls, including

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any cavities that might exist in trench walls.

PA 7.2.4.5 If selected backfill of the required properties is not available for coated steel pipelines, approved "blanket-type" rock-shield having a close fit around the pipe shall be used subject to the Engineer's approval. The rock-shield shall at least be 1,0 mm thick and of the Type D wrap specified in SABS 1117. A selected backfill consisting of material passing a 75 mm screen but not less than 60 % by mass passing a 9,5 mm screen, may be utilised in conjunction with the rock-shield, provided the required degree of compaction is maintained.

PA 7.2.4.6 If selected backfill of the required grading is available, but which exceeds the specified requirements in respect of linear shrinkage, coated steel pipes shall with the approval of the Engineer, be protected with a close fitting blanket or a spirally wrapped tape with thirty percent overlap of polyethylene of at least 500 micrometers thickness conforming to the requirements of SABS 1117, Type D wrap.

PA 7.2.5 Common backfill

PA 7.2.5.1 After completion of backfilling with selected backfill material, the remaining trench depth shall be filled with selected "common ground" originally excavated from the trench and with all rocks or boulders exceeding 150 mm nominal size excluded. The backfill shall be placed in the trench in layers not exceeding two hundred (200) mm measured in loose and each layer compacted sufficiently to prevent later settlement. The trench shall be filled to the level to which the topsoil was originally separately removed. The top of the trench shall then be completely filled with the topsoil and compacted up to the original ground level. The top of the trench may be mounded to 150 mm to provide for settlement, provided natural drainage of the ground is not interfered with.

PA 7.2.5.2 Where backfilling is carried out by mechanical plant such as bulldozers, the method of working shall be subject to the Engineer's approval. Heavy plant and equipment shall not be allowed to travel along or across the trench.

Suitable material for backfill shall be moved from any part of the works where there is a surplus to any part where there is deficiency or shall be imported from borrow areas.

PA 7.2.5.3 As soon as trench backfilling has been completed over any portion of the pipeline all surplus materials and rubbish shall be removed from the site to a dumping site, approved by the Engineer.

Where spoil is to be moved outside the free-haul distance, the Engineer's authority in writing must be obtained.

PA 7.2.5.4 Precautions shall be taken to ensure that the natural drainage of the ground is not interfered with, especially where final backfill is left mounded and all necessary cross drains shall be constructed and agricultural drainage berms and contours reinstated as backfilling progresses. Care shall be taken to prevent erosion of backfilling by construction of the necessary diversion banks and drains.

PA 7.2.5.5 The Contractor shall be responsible for settlement of backfill and erosion of the site up to the time the contract maintenance period has expired and he shall fill and level any settlement and/or erosion from time to time, as required by the Engineer and at the Contractor's expense.

PA 7.2.6 Compaction

PA 7.2.6.1 Where compaction of bedding material or selected backfill is specified, such compaction shall be to a density of at least 93 % of the Modified AASHTO maximum dry density. The Contractor shall determine the maximum Modified AASHTO dry density for every type of material used by taking representative samples from borrow areas.

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PA 7.2.6.2 The Contractor shall control the field compaction densities with a fully registered nuclear surface moisture-density gauge which is in a proper working order. This density gauge with operator shall be made available to the Engineer for his use if and when required.

PA 7.2.7 Cleaning of pipeline servitude

PA 7.2.7.1 As soon as possible after the common backfilling has been completed, the Contractor shall clean the pipeline servitude of all surplus materials and rubbish. The cleaning of the servitude shall not lag behind the pipe laying operation more than 3 000 meters. Should this happen the Engineer reserves the right to stop the pipe laying operation.

PA 8. LAYING AND JOINTING OF PIPES AND SPECIALS

PA 8.1 GENERAL

PA 8.1.1 Pipelines shall be laid to straight grades between vertical bends and shall be, within the specified tolerances, to the routes and levels indicated on the approved working drawings.

PA 8.1.2 Pipes shall be laid free from cold stresses. No deflections shall be taken in curvature of pipes, but shall be taken with approved prefabricated bends with exceptions as hereinafter specified.

PA 8.1.3 All deflections under 6° of the axis of pipelines with flexible joints may be made by spreading the deflection over not less than 5 number of joints, provided always that the deflection in any one joint does not exceed those recommended by the manufacturer of the joint after allowance for pipe settlement, heave or other ground or pipe movements.

PA 8.1.4 All deflection in the axis of butt welded steel pipelines of under 15° or less shall be made by scarfing equally the ends of the two pipes to be joined so that the maximum scarf in any one pipe will be 7,5°. Where the total deflection is 4° or less, the scarfing may be made in one pipe end only. Ends to be scarfed shall be carefully and accurately marked and then be either machine cut or machine planed. Hand planing shall not be permitted.

After scarfing, the pipe ends shall be re-chamfered as described in clause 4.15 of SABS 719. The minimum gap between pipe end root faces before welding shall be 1,5 mm and the maximum gap shall be 3,0 mm. After scarfing all pipe ends shall be thoroughly cleaned before the field weld is carried out.

PA 8.1.5 Except where otherwise provided for, the Contractor shall supply all bolts, nuts, washers, gaskets and other jointing materials for complete installation of pipelines including all specials, fittings, valves, meters etc.

PA 8.1.6 The tolerances allowable for the installation of pipes and specials shall be the same as those laid down for the manufacture thereof.

PA 8.2 SPECIALS

PA 8.2.1 Fabrication

PA 8.2.1.1 All specials shall be fabricated, lined and coated where applicable, in the pipe suppliers works with all flanges and openings protected as specified.

PA 8.2.1.2 Except where otherwise approved by the Engineer in writing, the following field welding will be permitted; tie-ins, the attachment of flanges where the exact position and alignment of same are dependent on site conditions e.g. closure pieces and branches for air and access tees. Scour valve tees shall, however, be

manufactured in the factory, pre-aligned to the gradients as indicated on the drawings.

PA 8.2.2 Installation

PA 8.2.2.1 Bends

Bends shall be installed true to line, level and deflection and shall be anchored in concrete where required to counteract thrust. The faces of a thrust block shall be 300mm from the back of the flanges. Bends shall normally be supplied with "centre planes" marked with two small punch marks close to both ends of the bends to facilitate correct positioning of the bends in laying.

PA 8.2.2.2 Tees

Tees for air valves shall be installed with branch barrels vertical. Tees for scour valves shall be installed with branch barrels horizontal or at the gradients as indicated on the drawings. Tees for off-takes shall be installed as shown on the drawings.

PA 8.2.2.3 Flanges

All flanges shall be installed with bolt holes off-centre and symmetrically off-set from the vertical centre line of the flange. Flanges shall be installed truly square to the axis of the pipe.

PA 8.2.2.4 Insulated flanged joints

Insulated joints shall be provided and installed by the Contractor where specified or instructed by the Engineer. The Contractor shall supply all materials, labour and equipment and shall complete and prove that each insulated joint after installation in the pipeline has a resistance well in excess of the resistance to earth of the pipeline on both sides of the insulating joint.

PA 8.2.2.5 Dismantling joints

Dismantling joints shall be installed where indicated on the drawing or instructed by the Engineer. These will normally be provided to facilitate the removal of valves or similar fittings from the pipeline. The Contractor shall supply and install dismantling joints with due regard to their pressure rating and mating flanges. The hydraulic pressure restraining tie-bolts shall be carefully installed to tie the pipework across the dismantling joint. Dismantling joints shall be watertight.

PA 8.2.2.6 Thrust flanges

Where thrust flanges are to be installed on site as for anchoring pipes on steep slopes etc. these flanges shall be supplied by the Contractor split in two equal segments, undrilled with outer perimeter unmachined.

At the point of installation of the thrust flange the pipe coating shall be stripped of the pipe for a distance of 300 mm. The flange segments shall be double fillet welded to the pipe barrel around the full circumference and also along both sides of the split which shall be chamfered for welding. After welding, the coating and lining of the pipe shall be made good.

PA 8.2.2.7 Temporary closure pipes

Temporary closure pieces of the same standard, diameter and wall thickness as the pipeline shall normally be jointed with flanges and/or flexible couplings, except where otherwise specified or instructed by the Engineer.

PA 8.2.2.8 Minor connections and off-takes**PA 8.2.2.8.1 General**

Typical assemblies of complete minor off-takes are shown on the tender drawings and these consist of branches fitted in the pipeline, stop cocks, pressure reducing and relief valves, constant discharge orifices, water meters and strainers and manholes around valves and meters, all in accordance with approved drawings.

PA 8.2.2.8.2 Steel pipelines

The Contractor shall strip an area of pipe coating of 300 x 300 mm. A hole of the required size shall then be cut through the pipe wall in the crown of the pipe and in the centre of the stripped area. A standard boss with female thread of the required size shall be welded over the hole onto the pipe surface using a full fillet weld along the boss perimeter. After removal of welding slag, weld spatter and all foreign matter, the coating and lining shall be made good. The connection shall be off-set from any weld in the pipe barrel. Where the location of the boss in relation to pipe ends or access tees is such that it would be difficult to make good linings, a 200 mm nominal bore off-take tee with flange shall be welded onto the pipe barrel. The standard boss shall be provided on a blank flange and the assembly bolted onto the off-take tee.

PA 8.3 INSTALLATION OF VALVES AND METERS

PA 8.3.1 The mass of valves or meters shall at no time be carried by the pipe, the flange or the coupling and valve chamber floors shall preferably be cast complete with valve stools and supports immediately after the installation of valves and meters. Stools shall not be permitted to carry the mass of a valve until at least 7 days after casting the concrete. Alternatively, prefabrication and welding of pipe and valve supports shall comply with the requirements of SABS 044 Part III and shall be fabricated to the Engineer's approval. Supports shall be welded to pipe only where specified and linings of pipe and specials shall be made good after welding.

PA 8.3.2 Valves and meters requiring special adjustment after installation shall be adjusted and commissioned by the respective suppliers or agents after installation.

PA 8.3.3 Butterfly valves shall be installed with the blade seal retaining ring facing downstream.

PA 8.4 FIELD WELDING

PA 8.4.1 All field welding shall only be done by welders who satisfy the requirements of API 1104 and who have been tested at the Contractor's expense by an independent testing authority for this specific contract.

PA 8.4.2 Before any welding of pipeline materials commences, the qualification of welders shall have been approved, all detailed welding procedure specifications with weld diagrams required for their completion shall have been submitted for approval in a neat form, and the welding procedure qualification tests shall have been successfully concluded all in accordance with the relevant standard specifications.

Sufficient records shall be kept by the Contractor to ensure that all field welds can be subsequently identified with the welder concerned.

PA 8.4.3 No welding shall be carried out during rain or high wind or under dusty conditions unless the welder, the weld area and the weld are adequately protected and sheltered.

PA 8.4.4 Only welding rods which have been kept dry and uncontaminated shall be used.

PA 8.4.5 Welding rods shall be of a grade and quality such that the chemical composition of weld metal and parent metal is similar.

PA 8.5 STEEL PIPELINES

PA 8.5.1 General

The out of roundness at a plane perpendicular to the pipe axis at any point along the pipeline length shall not exceed 4 % the minimum as laid inside diameter (i.e. ± 2 % of the nominal internal diameter) after completion of the backfilling and with atmospheric pressure inside the pipe.

Out of roundness shall be measured as the difference between the minimum and maximum inside diameter of the pipe at a point.

PA 8.5.2 Butt welded pipelines

PA 8.5.2.1 Pipes and specials to be joined by field welding shall be supplied with ends bevelled for welding.

PA 8.5.2.2 Field welding of joints shall conform to API 1104.

PA 8.5.2.3 Before welding of joints shall be proceeded with, pipe ends shall be completely circular and properly mated up by means of an external line-up clamp. At least 4 tack welds equally spaced around the pipe perimeter shall be applied to maintain the root gap and position of the pipe for completion of welding. A protective plastic or rubber sheet shall furthermore be placed over the coating adjacent to the joints to protect same from damage caused by welding spatter.

PA 8.5.2.4 Root welds shall thereafter be carried out followed by successive filler passes, and capper passes, all in accordance with the approved welding procedure. Wherever it is possible to have entry into a pipe, inside welds shall also be applied. The inner weld bead shall not extend more than 1 mm into the bore of a pipe or special.

PA 8.5.2.5 Horizontal weld seams or spiral weld seams at pipe ends shall be placed near the horizontal diameter of the pipe or special and shall be staggered so that the circumferential distance between longitudinal or spiral welds intersecting the same circumferential butt weld, is not less than 90 mm nor more than 130 mm apart.

PA 8.5.2.6 Defects caused by stray welding arc flashes, weld spatter etc. shall be removed by grinding provided that pipe wall thicknesses are not reduced to less than the specified minimum thicknesses, otherwise the portion containing the defect shall be cut out and repaired.

PA 8.5.2.7 During welding of pipes with organic linings, mats of thick rubber felt or other suitable material shall be placed along the pipe invert to protect the pipe lining for the full distance from the point of access up to the point of weld or weld inspection. The mats shall be of sufficient width and shall cover a sufficiently wide area of pipe invert to protect the lining against damage due to access by staff, equipment, and inspectors or fall out from arc weld. Workmen shall wear soft rubber soled shoes before entering lined pipes.

PA 8.5.2.8 Care shall be taken not to stroke arcs on epoxy lined areas and protective tapes, if any, at ends of epoxy lined pipes.

PA 8.5.2.9 Pipes may be welded together alongside the edge of the trench. For factory lined and coated pipes, the maximum length so welded together shall be such that:

(a) The pipe can be subsequently stored, lifted or handled without damage to linings or coatings.

- (b) The out of roundness at a plane perpendicular to the pipe axis at any point along the pipe length during storage, lifting or handling does not exceed 4 % of the minimum inside diameter. Out of roundness is measured as the difference between the minimum and maximum inside diameter of the plane at the point.
- (c) Safe and easy access to internal tie-in welds are assured for staff and inspectors with equipment.
- (d) The maximum length does not exceed 36 meters.

PA 8.5.2.10 Snaking into the trench of butt welded sections of pipe shall be permissible for bare steel pipes, subject to approval by the Engineer of a complete and comprehensive method statement submitted by the Contractor and provided that the out of roundness as defined and measured above during any stage of the snaking operation, does not exceed 4 % of minimum internal diameter.

PA 8.5.2.11 The linings and coatings of pre-lined and coated pipes jointed together outside the trench shall be made good at these joints outside the trench.

PA 8.5.3 Pipelines with flexible couplings

PA 8.5.3.1 Joints by flexible couplings shall be made only in their final laid position. Before assembling the joint, care shall be taken to ensure that pipe ends are clean and free from burrs and ridges. Such burrs and ridges shall be removed if present and linings and/or coatings made good where damaged. Pipe ends shall be mated carefully before joints are made. Pipe ends shall be concentric and perfectly lined up and the coupling shall not be relied upon to line up or to support the pipe.

PA 8.5.3.2 Joints shall be made and couplings assembled to the manufacturer's instructions. Bolts shall be placed with bolt heads pointing in the same direction.

PA 8.5.3.3 Two-thirds of the number of coupling bolts, equally spaced, shall first be partially tightened up in a regular sequence, using a short spanner. The remaining bolts shall then be similarly tightened. After checking the coupling alignment, the bolts shall then be finally tightened evenly and in a regular sequence by means of a torque wrench.

PA 8.5.3.4 Where couplings without central registers are used, precautions shall be taken to ensure that the pipe ends are apart by the same distance as if a coupling with central register had been used and the couplings shall carefully be centered over the pipe ends.

PA 8.5.4 Flanged joints

PA 8.5.4.1 Flanges shall be truly parallel with all bolts evenly firm before being finally drawn up with torque wrenches to watertightness. Taper gauges shall be used to check that there is a uniform gap before and after final tightening up of bolts. Bolts shall be tightened in an approved sequence with bolts equally spaced and at opposite ends tightened equally first.

PA 8.5.4.2 The Contractor shall ensure that the correct jointing materials, i.e. gaskets, bolts and nuts are available when required. Only correct diameter and lengths of bolts and studs shall be used. Flat washers shall be used under all nuts. The length of bolts and studs shall be such that at least two and maximum of four threads protrude from the nut when fully tightened. The threads of bolts, studs and nuts shall be thoroughly cleaned and then coated with a Mobil Tag E immediately prior to assembly.

PA 8.5.4.3 All flange faces shall have a gramophone finish and shall be protected against rust by an approved coating.

PA 8.5.4.4 Flanged fittings shall be so installed that there are no stresses induced into the pipework, specials or fittings by forcing ill-fitting units into position or by bolting up flanges with faces not uniformly in contact with their gaskets over their whole faces.

PA 8.7 MAINTENANCE OF CLEANLINESS DURING LAYING

PA 8.7.1 The interior of pipes shall be perfectly clean before being laid and the Engineer may instruct pipe interiors to be cleaned or washed before the pipes are lowered into the trench. All brushes, trowels, welding rod stumps, pieces of mortar, dust and all foreign matter shall be removed from pipes immediately after laying. Once a section of pipeline has been cleaned, it shall be sealed off and shall not be entered again unless permitted by the Engineer in writing.

PA 8.7.2 The Contractor shall at his own expense make good any damage to valves and fittings or clogging of off-takes or mal-functioning of fittings which result from his failure to keep the pipeline in a thoroughly clean condition.

PA 8.8 NIGHT-CAPS

PA 8.8.1 Metal night-caps shall be used to close off all ends of each laid section of pipework when work is stopped at the end of the day or for longer periods and shall be left on the ends of sections of completed pipework until such sections are tied-in with the remainder of the completed pipeline. The night-caps shall consist of a steel plate welded into a half coupling which must be provided with a sufficient number of lugs to secure the ring and gasket and shall be strong enough to withstand external water and earth pressure in the event of flooding or collapse of earth and the joint shall be watertight.

PA 8.8.2 The Contractor shall also, at his own expense blank-off all air valves, scour valves and off-takes with 6 mm thick steel blank flanges which shall be bolted with at least four bolts to tee flanges or shall be fixed to plain ended tee branches by half couplings welded to the blank flanges. These shall be watertight and shall not be removed until the valves or other fittings are about to be fitted.

PA 8.8.3 Notwithstanding the use of night-caps the Contractor shall at his own expense make good all damage to pipe linings and fittings caused by the ingress of dirty water, silt, sand, debris, vermin, insects and other foreign matter. The Contractor shall at his own expense and to the satisfaction of the Engineer clean the interior of the pipeline of such contaminants.

PA 8.9 PREVENTATION OF FLOTATION

PA 8.9.1 Pipes to be encased in concrete shall be prevented from flotation during concreting operations. Apart from this special case during concreting operations, the Contractor shall prevent the flotation of pipework due to stormwater or groundwater entering the trench before backfilling has been completed.

PA 8.9.2 Methods adopted to prevent flotation shall not damage coatings or linings and shall be approved by the Engineer. Notwithstanding this the Contractor shall at his own expenses repair all damage to pipework caused by flotation and/or by the methods adopted to prevent it.

PA 9. REPAIRS TO LININGS, COATINGS AND PROTECTION OF JOINTS

PA 9.1 GENERAL

PA 9.1.1 All damaged linings and coatings of pipes, specials and fittings shall be made good to the satisfaction of the

Engineer before installation, provided always that damage, which in the opinion of the Engineer is extensive, might subject such pipe, special or fitting to rejection.

PA 9.1.2 The materials used for the repairs to linings and coatings shall be the same as that used for the pipes, unless otherwise approved by the Engineer in writing.

PA 9.1.3 The linings and coatings of butt welded steel pipes shall be made continuous over joints as soon as possible after approval and acceptance by the Engineer of the welded joint.

PA 9.1.4 Flexible couplings shall be provided with external protection as soon as the pipeline has been hydrostatically tested and electrically bonded, where applicable.

PA 9.2 FUSION BONDED POLYETHYLENE COATINGS

PA 9.2.1 General

The coating shall be made continuous over butt welded joints by applying a butyl tape wrapping system such as Denso S43/R23 which shall comprise of a cold applied inner and outer wrap of 0.5mm and 0.75mm thickness respectively which shall be applied onto the pipe after the pipe surface has been properly cleaned and primed with a butyl primer.

PA 9.2.2 Surface preparation

Before surface preparation can commence it is essential to remove all dirt and grease from the pipe surface.

The minimum surface preparation standard acceptable shall be St2 (Swedish Standard SIS 055900 1967, Mechanical wire brushing). Circumferential surface preparation shall be carried out to a distance of 200mm each side of the weld bead.

PA 9.2.2 Priming

Priming shall not be carried out further ahead of physical tape wrapping than a maximum of 8 hours.

Prime the prepared surface with Denso Butyl Primer to 150mm each side of the weld.

Ensure the primer is dust free prior to application of a tape wrap system. If the primer has become severely contaminated with dust, a re-prime shall be carried out.

Approximately 30 minutes drying time shall be allowed or until the primer is tacky to the touch.

PA 9.2.2 Inner Wrap

The area to be taped shall include the total primed surfaces of the pipe joints and shall include the 50mm widths of primed shop applied coating.

Peel back approx. 0,5m of interleaving and centre 100mm wide inner tape over the edge of the primer on one side of the joint. Press down firmly. Before spiral wrapping commences, a full circumferential wrap of tape is applied by hand with sufficient tension to narrow the width of tape between 1 and 2mm. Whilst maintaining tape tension as described, the tape shall be applied spirally. Interleaving shall be removed as wrapping proceeds. The tape shall be applied to ensure that a minimum 55% overlap shall be achieved. The tape shall be applied to a minimum width of 50mm beyond the primed area onto the shop applied coating.

PA 9.2.2 Outer Wrap

The area to be taped shall include the total wrapped surfaces of the pipe joints and shall include the 50mm widths of primed shop applied coating on both sides of the inner wrap.

The 100mm wide tape shall be centred over the edge of the applied inner wrap on one side of the joint and pressed down firmly. Before spiral wrapping commences, a full circumferential wrap of tape shall be applied by hand with sufficient tension to narrow the width of tape between 1 and 2mm. Whilst maintaining tape tension as described above, the tape shall be applied spirally. The tape shall be applied in such manner that a minimum 55% overlap shall be achieved. The tape shall be applied to a minimum width of 50mm beyond the applied inner wrap area onto the primed shop applied coating.

PA 9.2 BITUMEN COATINGS**PA 9.2.1 Surface preparation**

PA 9.2.1.1 Unprotected steel surfaces shall be wire brushed to standard St 3 of SIS 055900 and all dust and foreign matter carefully removed. All weld spatter shall be removed by scraping and/or grinding.

PA 9.2.1.2 Damaged bitumen prime coats shall be removed by scraping to bare metal, extending back into areas of sound prime coat.

PA 9.2.1.3 Bitumen surfaces showing chalking or other forms of degradation shall be wire brushed down to sound bitumen for a distance of not less than 100 mm from or around the point of repair.

PA 9.2.1.4 Limewash to coatings shall be removed down to sound uncontaminated bitumen for a distance of at least 100 mm from or around the point of repair.

PA 9.2.1.5 Cold applied bitumen primer shall be applied to both steel and exposed bitumen surfaces and be allowed to dry for not less than 4 hours, but not longer than 4 days, care being taken to prevent of primed surfaces.

PA 9.2.2 Application of bitumen

PA 9.2.2.1 A flood coat of hot applied bitumen shall be applied to primed repair areas of coatings to give a coating thickness not less than 1,5 mm at any point.

PA 9.2.2.2 A single wrap of glass fibre tissue, saturated with hot bitumen shall then be applied around the whole circumference of the joint or over the whole area of repair, whichever is applicable in a manner such that the tissue abuts the edge of the existing coating. The applied glass fibre shall be ironed with hot irons to ensure complete bonding, exclusion of air and complete impregnation with bitumen.

PA 9.2.2.3 A second single wrap of glass fibre tissue, saturated with hot bitumen, shall then be applied such that the two wraps of tissue overlap by at least 50 % of the width of the tissue and at least one wrap of tissue abuts the edges of the existing coating. The second wrap of glass fibre tissue shall be ironed with hot irons to ensure complete bonding, exclusion of air and complete impregnation of bitumen.

PA 9.2.2.4 A flood coat of hot applied bitumen shall then be applied to give a coating thickness above the last wrap of glass fibre tissue of at least 1,0 mm .

PA 9.2.2.5 Two further wraps of glass fibre tissue, saturated with hot bitumen shall then be applied in succession, each wrap as above, but such that at least one layer of tissue overlaps the existing coating by not less than 50 mm . Overlap of successive layers of tissue to be at least 50 % of tissue width.

- PA 9.2.2.6** A further flood coat of hot applied bitumen shall be applied over the repair to give a minimum coating thickness of 1mm over the last glass fibre tissue layer and to overlap the existing coating by at least 100mm.
- PA 9.2.2.7** In the case of armoured coatings, a single wrap of bitumen saturated glass fibre woven wrap shall be applied at 50 % overlap over the last bitumen flood coat and be ironed with hot irons to ensure complete impregnation of bitumen and bonding. The woven wrap shall then be followed by a further flood coat of hot applied bitumen to give a minimum thickness of not less than 1 mm over the woven wrap.
- PA 9.2.2.8** The repaired surface shall then be ironed smooth, neatly feathered into the existing coating.
- PA 9.2.2.9** A heavy lime-wash coat shall be applied over the repaired areas of coatings immediately after inspection and acceptance of the repair by the Engineer.
- PA 9.2.2.10** When heating bitumen, the temperature shall never exceed 235°C. Bitumen shall only be heated in totally enclosed kettles, equipped with stirrers to keep the molten bitumen agitated and at an even temperature and to prevent localized overheating and scorching of bitumen. The kettle shall be fitted with a thermometer.

PA 9.3 CEMENT MORTAR (CONCRETE) LININGS**PA 9.3.1 Surface preparation**

- PA 9.3.1.1** Unprotected steel surfaces shall be wire brushed to standard St 2 of SIS 055900 and all dust and foreign matter shall be removed.
- PA 9.3.1.2** The edges of the existing lining shall then be brushed to remove all dust and a neat cement/water slurry applied to the pipe wall and the edges of existing lining.

PA 9.3.2 Application of lining

- PA 9.3.2.1** A mortar mix equal to the mix used in the existing lining and having a mix proportion of 1 part of cement to 2 parts of clean concrete sand by mass, shall then be troweled into the joint, while the slurry is still wet, taking care to work the mortar well into the tapered edges of the existing lining.
- PA 9.3.2.2** The mortar shall be as dry as possible with a water content by mass of not more than 50 % of cement content. Mortar shall be freshly mixed and shall not be re-wetted after original mixing. All mortar older than 1 hour after addition of water shall be discarded.
- PA 9.3.2.3** The lining shall be finished smooth with the existing lining.

PA 9.4 SHOP APPLIED EPOXY LININGS AND COATINGS

- PA 9.4.1** The maximum allowable number and sizes of repairs to epoxy lined and/or coated pipes on the site by each, the supply and laying contractors, will be as follows:

Linings

No large repairs, i.e. an area greater than 25 mm diameter, will be allowed whilst a maximum of 1 small repair, i.e. an area smaller than 25 mm diameter, per 6 meters length of pipeline.

Coatings

Only one large and one smaller repair, as defined above.

PA 9.4.2 Surface preparation**PA 9.4.2.1 Welded joints and larger repairs i.e. area in excess of 25 mm diameter**

The complete area of the weld, unlined sections and heat affected lined sections shall be chipped, scraped and wire brushed to remove all slag, oil, grease, bitumen and oxidation deposits. The weld bead shall be ground down so that the height of the upset metal and flash on the inner surface shall not exceed 1,0 mm. All weld spatter shall be removed by scraping and/or grinding. The entire surface, including the weld seam, shall be entirely smooth and free from jagged or sharp protuberances.

The complete surface to be lined and/or coated shall then be grit blasted to produce a bright steel finish in accordance with SIS 055900, Grade Sa 2.5. Where this degree of cleanliness does not accurately match the steel colour, use a standard of 95 % average, obtained by photo electric reflectance meter which is calibrated for the steel and type of grit being used, taking 100 percent as the degree of finish obtained when no further increase in reflectance is obtained by extended blasting. All air used for grit blasting shall be free of all oil and moisture. Grit of which 50 % shall not be round, shall be dry and free of foreign matter such as saline or clay contents, bitumen or bituminous type contaminants, oil or other deleterious substances. Particle size shall be such as to produce an anchor pattern profile exceeding 50 micrometers in depth, but not exceeding 75 micrometers in depth as determined by micrometer gauge or portable microscope fitted with a calibrated focusing knob.

After blasting, all dust and debris shall be removed by vacuum cleaning, dry brushing or dry air blast to a degree such that a piece of clear adhesive tape pressed to the grit blasted surface and thereupon transferred to a white tile, shall show no dust or debris up, when compared with a standard pattern.

Thereafter the grit blasted surface including 25 mm wide strip of sound epoxy lining or coating shall be coated within 2 hours.

PA 9.4.2.2 Smaller repairs i.e. area smaller than 25 mm diameter

The area of repair, including at least 25 mm of sound epoxy lining around the area of repair, shall then be rubbed with a medium grade emery paper. Only Aluminium Oxide abrasives shall be used. Steel surfaces and heat affected epoxy lined surface shall be rubbed down to a bright steel finish, standard Sa 3 of SIS 055900. The 25 mm minimum width of sound epoxy surrounding the area of repair shall be rubbed to remove the lining gloss or all signs of chalking, whichever is applicable.

The complete surface to be repaired including the emery papered edge of the existing lining or coating shall be wiped with a solvent recommended by the supplier of the epoxy and coated within 2 hours of the surface being prepared as described above.

PA 9.4.3 Application of epoxy

PA 9.4.3.1 Each coat is to overlap the existing lining or coating by at least 25 mm.

PA 9.4.3.2 The minimum thickness of the applied lining or coating shall be 300 micrometers dry film thickness.

PA 9.4.3.3 Solvent-free epoxies

The above Clause 9.1.2 shall apply in the case of fusion bonded epoxies which must be applied strictly in accordance with the manufacturer's requirements.

For other solvent-free epoxies however, the area shall receive one coat of a solvent-free repair kit recommended by the same manufacturer and compatible with the epoxy used in the pipes, applied by soft brush, spray or roller to ensure the correct coat coverage. The maximum dry film thickness shall be 500 micrometers.

A large range of epoxy repair materials have been tested to date and only the following materials may be used for temperatures ranging from 10° to 55° and humidities as specified by the suppliers:

(a) Under dry conditions:

- (i) Colturiet Submarine supplied by Messrs AECI
- (ii) Valspar Patching Compound (Canada)

(b) Wet and underwater conditions:

- (i) Hycote 151 by UTC for film thicknesses preferably not greater than 250 and definitely not greater than 500 micrometers.

PA 9.4.3.4 Solvent-borne epoxies

The materials specified above in Clause 9.4.3.3 should be used.

Alternatively, but only with specific written approval of the Engineer, a solvent-borne epoxy may be applied over the area to be repaired in 3 coats by soft brush, spray or roller with each coat in a distinctly different colour to ensure correct inter coat coverage. The drying time and application for each coat shall be strictly in accordance with the manufacturer's instruction with respect to temperature, humidity etc. The maximum dry film thickness of the applied coating shall be 350 micrometers.

PA 9.4.4 On completion of repairs, the repaired lining shall be tested with a wet sponge holiday detector and thickness of repair checked by an eddy current or magnetic instrument. These tests shall be carried out by the Inspectorate on all repairs.

PA 9.4.5 All repairs, including the joint repairs to the lining, shall be completed, tested and approved by the Engineer prior to backfilling the trench as stated in Clause 7.2.1.2.

PA 9.4.6 Adequate ventilation (and heating if required), shall be provided for the proper curing of the repaired epoxy lining over the internal welded joint.

PA 9.5 IN-SITU APPLIED EPOXY LININGS

PA 9.5.1 Linings shall only be applied after all welding on the pipeline is complete.

PA 9.5.2 No further welding will be permissible on any lined pipes and repairs shall therefore not normally be necessary.

PA 9.6 PLASTIC TAPE WRAPPING

PA 9.6.1 Over the trench wrapping operations shall normally follow completion of site welding and repairs to individual welded joints shall therefore not be a routine operation.

PA 9.6.2 Surface preparation

PA 9.6.2.1 Where protection of welded joints or repairs to damaged tape wrappings are necessary, damaged tape shall be carefully cut away to expose at least a 30 mm wide strip of undamaged, un-degraded and sound primed surface.

PA 9.6.2.2 Unprotected steel surfaces, damaged or degraded primed surfaces shall be cleaned by scraping, grinding and wire brushing to remove all primer, rust, oil, grease, welding slag, weld spatter and dust.

PA 9.6.2.3 Welds, where applicable, shall be allowed to cool before application of approved cold primer over the area of repair. The primer to overlap sound exposed primer by at least 30 mm.

PA 9.6.3 Application

PA 9.6.3.1 The complete system of repairs shall be approved by the Engineer in writing prior to affecting any repairs. In general, however, the plastic tape, of the type, grade and quality used in existing wrapping or other approved system shall be applied spirally around the pipe to cover the repair and adjacent sound wrapping by at least 50 mm. The tape shall be applied in at least two wraps, each wrap overlapping by at least 50 % of the width of the tape. (i.e. four layers of tape)

PA 9.7 PROTECTION OF FLEXIBLE COUPLINGS AND FLANGES**PA 9.7.1 Moulded bitumen encasing**

PA 9.7.1.1 The coupling or flange shall be protected by covering with moulded bitumen.

PA 9.7.1.2 The coating of the pipe shall project at least 100 mm into the mould over which length of coating the reflective finish shall be carefully removed.

PA 9.7.1.3 The uncoated portions of the pipe and the exposed portions of the couplings shall then be cleaned of rust, oil, dust and grease and painted with 2 coats of an approved cold applied bituminous primer.

PA 9.7.1.4 The mould shall then be treated internally with thick white-wash to prevent the adhesion of bitumen to the mould, and the mould shall then be clamped around the pipe coupling, ensuring that the ends of the pipe coating are covered by the mould.

PA 9.7.1.5 The bitumen shall be suitably heated and shall be poured into the mould so as to encase the coupling components, uncoated pipe ends, bonding thermo-welds and bond conductors entirely with a minimum cover of bitumen of 10 mm and to complete the external protection. The mould shall then be stripped and cleaned ready for use elsewhere.

PA 9.7.1.6 Heating of bitumen shall conform to Clause PA 9.2.2.10.

PA 9.7.2 Polyurethane and tape wrapping

PA 9.7.2.1 Couplings shall be protected by covering with polyurethane foamed in-situ and wrapped with polyethylene tape.

PA 9.7.2.2 The coating of the pipe shall project at least 100 mm into the mould over which length of coating reflective finish shall be carefully removed.

PA 9.7.2.3 The uncoated portions of the pipe and the exposed portions of the coupling shall be cleaned of all dust, rust, oil and grease and given 2 coats of an approved cold applied bituminous primer that shall be compatible

with coating and with polyurethane.

- PA 9.7.2.4** The 2 coats of primer applied to the pipe ends and coupling components shall be completely dry before the foam is applied and shall be capable of withstanding the chemical and thermal effects of the foaming process without degradation either of the primer or of the foam.
- PA 9.7.2.5** The foam filler shall be formed by a sheet metal mould providing a minimum of 25 mm cover of foam to all uncoated areas of pipe ends, coupling components, bonding welds and bond conductors. The external surface of the moulded foam shall be in the form of a smooth central cylinder surrounding the coupling with smooth conical extension overlapping the pipe coating by 100 mm at each end. The tangent of the angle between the conical surface and the axis of the pipe shall not be greater than 0,25.
- PA 9.7.2.6** The foam shall be produced in-situ by the "Caradol C2/Caradate 30" systems as described in Preliminary Information Pamphlet Res/P/U4 published by Shell Chemicals UK Limited or equivalent system and all the manufacturer's instructions with regard to storage, handling, mixing, safety precautions and other procedures necessary for the production of best quality polyurethane foam shall be strictly complied with. The foam shall be homogenous and free of cracks, laminations and discontinuities or weakness of any kind.
- PA 9.7.2.7** After completion of the foam filler the external surfaces of the pipe coating within 300 mm of the foam shall be thoroughly cleaned and smoothed exposing bitumen coating free of all dirt, grease, oil and white-wash. Thereafter a 200 mm wide band of an approved cold applied primer, compatible with bitumen, foam and tape adhesive shall be applied at each end of the foam filler to bring the surfaces near the conical ends to a smooth, uniform condition. Each band of primer shall straddle equally the exposed foam/bitumen interface.
- The tape wrapping shall be approved 300 micrometers thick plasticizer free, polyethylene pressure sensitive tape, 150 mm wide, of low density and with good conforming characteristics and di-electric properties. The entire joint is to be wrapped with 2 layers of tape, each layer applied smoothly and finishing 2 complete turns over the coating beyond the foam filler at either side of the joint, the last quarter turn at each end being applied in a relaxed state without tension. Each layer of tape is to be wrapped helically with a continuous helical overlap 40 mm wide in each layer.
- PA 9.7.2.8** The Contractor shall exercise proper control to ensure that the chemical solutions used in the foaming system are correctly stored at temperatures not exceeding 20°C and for periods not exceeding 6 months or under any other special conditions recommended by the manufacturers. Similarly, the Contractor shall provide such dry-warming equipment as may be necessary to keep the tape warm enough to maintain a degree of conformity adequate for smooth, wrinkle free wrapping over the cone/cylinder transitions in the surface shape of the foam filler.
- PA 9.7.2.9** Particular care must be taken to prevent contact of isocyanate foaming material with the skin and eyes and inhalation of the vapour.
- PA 9.7.3 Polyethylene sleeves**
- PA 9.7.3.1** Couplings or flanges shall be protected by covering with polyethylene sleeves.
- PA 9.7.3.2** The sleeve shall consist of a continuous sheath of polyethylene at least 250 micrometers thick and 600 mm long and of diameter to suit the coupling and which shall be taped to the pipe on either side of the coupling. The polyethylene shall be black in colour and contain an ultraviolet ray inhibitor. The coated portion of the pipe shall project at least 150 mm into the sleeve.
- PA 9.7.3.3** The uncoated portions of the pipe and the exposed portions of the coupling shall be cleaned of all dust, rust, oil and grease and given 2 coats of an approved cold applied bituminous primer.

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PA 9.7.3.4 After shaping the sleeve to coupling contours and allowing sufficient slack to prevent stretching of polyethylene across coupling components it shall be taped using pressure sensitive tapes onto the pipe with the tapes extending at least 150 mm on to the sleeve and on to the coated pipe from which reflective finish has been carefully removed for the width of tape wrap. The pressure sensitive tape shall be applied spirally at a tension sufficient to close off the polyethylene sleeves tightly against the pipe barrel and to prevent ingress of water. The tape shall be applied with an overlap of 50 % of width.

PA 9.7.3.5 The polyethylene sleeves shall be slipped over the pipe barrel during laying and before pipes are coupled. The sleeves will however only be applied over couplings on completion of hydrostatic tests. In the interim period, the sleeves shall be protected from sunlight.

PA 9.7.4 Petroleum mastic and tape wrappings

PA 9.7.4.1 Couplings or flanges shall be protected by moulding with a petroleum jelly mastic and wrapped with tape. The coating of the pipe shall project at least 100 mm into the moulded portion over which length of coating the reflective finish shall be carefully removed.

PA 9.7.4.2 The unprotected portion of the pipe and coupling components shall first be cleaned of dust, rust and other foreign matter. "Denso" priming solution or equivalent shall then be applied to the coupling, leaving a thin film on the surface of the sleeve and a liberal amount on bolt heads and nuts, bolt threads, narrow cavities, etc. at a nominal coverage rate of .8m²/litre.

Where excessive surface corrosion has occurred and where continuous moisture is present, Denso S105 Paste or approved equivalent shall be applied.

PA 9.7.4.3 "Denso Mastic Plast" or equivalent is then applied to cover bolt heads and nuts, flanges and sleeve to a thickness of 12 mm. Moulding shall be up to but not over the bolts. Apply Denso Profiling Mastic or Denso Triangular Strips to cover all bolt heads and nuts, built up to form an elliptical sphere section for the entire circumference against each side of the flange.

PA 9.7.4.4 "Denso" tape or equivalent is then wrapped spirally around the unprotected portions of the pipe and the coupling, including at least 100 mm of pipe coating on both sides, care being taken to exclude air pockets by moulding into all depressions. The tape shall not be stretched and shall be applied with a minimum overlap of 100 mm at ends.

100mm wide Denso Tape is applied to the circumference of the pipe barrel either side of the pipe flange and to overlap weatherboard fashion the edges of the previously applied tape by not less than 30mm to reinforce and seal the wrapping procedure. Eliminate air pockets, wrinkles, creases and overlaps as before.

PA 9.7.4.5 Finally polyethylene tape of 300 micrometers minimum thickness shall then be applied spirally over the mould overlapping the pipe coating by at least 100 mm. The ends shall be secured onto the barrel by means of pressure sensitive tapes, tightly taped around the pipe barrel and centred 150 mm over the ends, providing at least 75 mm of pressure sensitive tape on both, the pipe barrel and the exterior mould wrap. The joint shall be watertight.

PA 9.7.4.6 Care shall be taken at all times to prevent contamination of petroleum pastes and tapes by sand, soil or other foreign matter.

PA 10. CROSSING OF ROADS AND STREAMS**PA 10.1 GENERAL**

PA 10.1.1 The Employer shall obtain permission for the crossing of roads from the responsible authorities. All conditions and requirements imposed and/or prescribed by the authorities concerned shall be conveyed to the Contractor who shall be responsible for meeting all such conditions and requirements in carrying out the crossing.

PA 10.1.2 All crossings shall be constructed strictly in accordance with approved drawings.

PA 10.2 ROAD CROSSINGS

PA 10.2.1 Crossings of National, Provincial, District, Divisional, Special roads (hereinafter called major roads) or such other roads as authorities might dictate, shall be made in flanged or butt welded steel pipes within a steel or reinforced concrete sleeve or a reinforced concrete culvert. Steel pipes to extend over the full width of road reserve plus 5 m on each side.

PA 10.2.2 Crossing of farm roads, unnumbered public roads and minor roads shall, except where otherwise dictated by authorities, be made by maintaining a one thousand (1 000) mm minimum compacted cover over the crown of the pipe at any point along the pipe centreline for the full width of the carriageway plus shoulders. The Engineer might instruct a 150 mm minimum thickness concrete surround to be placed around the pipe along any length of pipeline at such crossings.

PA 10.2.3 Steel sleeve pipes shall have a 12 mm minimum wall thickness, be lined with a bitumen prime coat and shall be armour coated. Wherever possible reinforced concrete sleeve pipes shall be installed by pushboring underneath carriageways unless otherwise specified.

PA 10.2.4 Steel pipes at major road crossings shall have:

PA 10.2.4.1 Wall thicknesses increased by at least 20 % above the required structural thickness or shall be equal to the specified minimum thickness for the size of pipe whichever is the greater. The required structural thickness shall be that pipe wall thickness which shall limit steel stresses to a maximum of 60 % of the minimum yield stress of the steel when the pipe is subjected to design pressure. The pipe of increased wall thickness shall extend for the full width of the road reserve up to points at least 5 m beyond reserve boundaries on each side.

PA 10.2.4.2 Either armour coating of a bitumen glass fibre or a 400 micrometers thick fusion-bonded epoxy coating for the length of sleeves or culverts, including manholes plus a distance of 1 m on each side of the sleeve or culvert.

PA 10.2.4.3 All field applied butt welds falling within reserves 100 % radiographically inspected.

PA 10.2.4.4 All flanged joints moulded as per specification.

PA 10.2.5 Backfilling and reinstatement of road surfaces shall be to the requirements of the Roads Authority. Should the Roads Authority prefer to carry out reinstatement of surfaces by direct labour or otherwise, the Contractor shall pay all charges in connection therewith.

PA 10.2.6 Where no method of reinstatement is specified or requested by the Roads Authority, the following shall apply:

Backfilling around and over sleeves or culverts shall be placed in layers not exceeding 150 mm,

measured in the loose, using a selected sandy material. Each layer shall be dampened to optimum moisture content and be compacted to a density not less than 90 % Modified AASHTO before succeeding layers are placed. For surfaced roads, backfilling shall proceed to the underside of the sub-base level when 150 mm of approved sub-base gravel shall be placed and compacted to a density of at least 95 % Modified AASHTO. On top of the sub-base layer, a 200 mm layer of crushed stone base course consisting of material passing a 40 mm square screen and mixed with an approved binder shall be compacted in two 100 mm layers, compacted to a density of at least 98 % Modified AASHTO, each layer to be dampened and thoroughly compacted before placing the succeeding layer. The top layer shall be swept with a hard broom to remove all laitance from stone surfaces but without under pinning the individual crushed stone particles. The upper surface shall then be covered with a light application of primer or emulsion before placing a 32 mm to 40 mm bituminous premix wearing course which should be rolled to a solid layer.

PA 10.2.7 All underground telephone cables or overhead telephone and power lines within or adjacent to road reserves shall be properly supported and protected against damage during all phases of construction.

PA 10.3 STREAM CROSSINGS

PA 10.3.1 Stream crossings comprise all crossings of defined water courses in which water flows or might flow as a result of surface run-off or otherwise.

PA 10.3.2 Stream crossings shall be constructed in steel pipe encased in reinforced concrete, all in accordance with approved drawings.

PA 10.3.3 Steel pipes at stream crossings shall have:

PA 10.3.3.1 Wall thickness increased by at least 20 % above the required structural thickness or shall be equal to the specified minimum wall thickness for the size of pipe, whichever is the greater. The structural wall thickness required shall be that pipe wall thickness which shall limit steel stresses to a maximum of 60% of the minimum yield stress of the steel when the pipe is subjected to design pressure. The pipe of increased wall thickness shall extend for the full length of concrete encased zones plus 2m on both sides.

PA 10.3.3.2 An armoured bitumen-glass fibre coating or a 400 micrometers thick fusion-bonded epoxy coating as specified or as indicated on the drawings or in the Schedule of Quantities whenever encased in concrete.

PA 10.3.3.3 All field applied butt welds within concrete encasements 100 % radiographically inspected.

PA 10.3.4 The top surface of concrete encasements or adjacent pipes shall not protrude above natural bed level of streams, nor shall it in any way interfere with water flow or be the cause of bed erosion.

PA 10.3.5 The Contractor shall be responsible for diversion of flow, if any, over or away from the trench and shall dewater the trench immediately before pipe laying and keep it dewatered until completion of backfilling. He shall be responsible for and shall repair at his own expense, damage to foundations, structures or other parts of the Works caused by flooding due to failure of any part of the diversion or protective works or due to any other cause.

PA 10.3.6 The Contractor shall remove cofferdams, other protective works and surplus spoil immediately after having served its purpose and shall reinstate the site to its original condition. Flooding of adjacent land, bed erosion or changes in location of water courses due to the Contractor's failure to comply with this clause shall be made good at his own expense.

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PA 11. HYDROSTATIC TESTING**PA 11.1 GENERAL**

- PA 11.1.1** Pipelines shall be hydrostatically tested as pipelaying proceeds and after installation of all valves, specials and fittings.
- PA 11.1.2** The Contractor shall be responsible for providing all water required for testing, the source of which shall be subject to approval by the Engineer.
- PA 11.1.3** The length of pipeline to be tested in one operation shall be as approved by the Engineer.
- PA 11.1.4** Where the method of test is in any way in variance to this specification, the Contractor shall submit a detailed method statement to the Engineer and no test shall proceed before approval of such method statement by the Engineer.

PA 11.2 TEST PRESSURES

- PA 11.2.1** Test pressures shall be as indicated on the tender drawings. Test pressures shall generally be 1,25 times the pipeline design pressure for design pressures up to and including 3,2 MPa and 1,1 times the design pressure for higher pressures. Design pressure shall be taken as the maximum pressure to which pipelines might be subjected under all conditions of operation and shall include allowance for transient pressures.
- PA 11.2.2** Test pressures over any length or section of pipeline under test, taking possible differences in elevation along the pipeline into account, shall be such that the test pressure at any point along the section is not less than 1,1 times nor greater than 1,40 times the design pressure at these points.

PA 11.3 LEAKAGE RATES

- PA 11.3.1** Leakage of a pipeline under test, taken as the aggregate quantity of water added over a 24 hour period to reinstate required test pressure, shall not exceed quantities equivalent to the following:
- PA 11.3.1.1** Steel pipelines with flexible joints - 1/3 300 (0,030%) of the volume of water in the section under test.
- PA 11.3.1.2** Steel pipelines with welded joints - 1/4 000 (0,025%) of the volume of water in the section under test.
- PA 11.3.2** The leakage rate at any one joint in the section under test shall not exceed the following:

$$Q = \frac{\text{Allowable leakage in 24 h of pipeline under test in liters}}{20N}$$

Where Q = Leakage rate in liters/hour
 N = Number of joints in section under test

PA 11.4 STATE OF VALVES DURING TEST

- PA 11.4.1** The state of valves during the test shall be as follows :
- PA 11.4.1.1** In-line isolating valves open, except where used to isolate a test length.
- PA 11.4.1.2** Scour isolating valves closed.
- PA 11.4.1.3** Off-take isolating valves closed.

PA 11.4.1.4 Scour sleeve valves open unless no scour isolating valve is provided.

PA 11.4.1.5 Air valve isolating valves open.

PA 11.4.1.6 By-pass isolating valves to in-line isolating valves and reflux-valves closed.

PA 11.4.2 The Contractor shall be permitted to test against a closed in-line isolating valve. He should bear in mind however that valve gates and seals are not expected to close drop tight at differential pressures exceeding the design pressure of the valve. Design pressures of valves shall be equivalent to a pipelines field test pressure. No relaxation of specified leakage rates shall be permitted due to leaks past gates, blades or seals of isolating valves.

PA 11.5 METHOD OF TESTING

PA 11.5.1 The Contractor shall provide an approved test pump, an accurate water meter, sealed pressure gauge and autographic pressure recorder, tested and certified by an independent testing organisation, and all other equipment, materials and labour required for the test.

PA 11.5.2 The section of pipeline to be tested shall be clean and closed off at the ends by isolating valves, and caps or approved end-closure pieces. Free ends shall be firmly strutted against solid supports or thrust blocks designed to withstand safely 2 times the calculated end thrust under maximum test pressure. It shall be incumbent on the Contractor to establish the need for blank flanges or isolating valve flanges in order to limit leakage rates past gates, blades and seals.

PA 11.5.3 Testing water may be introduced at any air valve within the portion of the pipeline under test. A test manifold shall be placed between the selected air valve and its isolating valve. The manifold shall be provided with three branches, each fitted with drop-tight valves. The main branch shall be sized to suit the Contractor's test pump connection. The two smaller branches shall not be less than 12 mm nominal bore fitted with heavy duty needle valves and reducers to suit pressure gauge connections. A pressure gauge and an autographic pressure gauge respectively shall be connected to each of the smaller branches. A water meter carrying a valid calibration certificate shall be installed between the pump and test manifold. The Contractor shall accurately determine the reduced level at the autographic pressure gauges and enter this level on the recorder chart. The Contractor shall also enter the reduced level of the highest and lowest invert of the section under test on the recorder chart.

PA 11.5.4 The section of pipeline to be tested shall be slowly filled with clean water of quality to the Engineer's approval, great care being exercised to remove all air from the pipeline. The section of pipeline under test shall be completely filled with water and kept full for not less than 3 days in the case of fibre-cement pipelines or steel pipelines with concrete linings and not less than 1 hour in the case of unlined steel pipelines or steel pipelines with linings other than concrete.

PA 11.5.5 During this initial filling stage, the pipeline joints and all specials, fittings and valves shall be visually inspected for visible leaks and same rectified before proceeding with the test.

PA 11.5.6 After the specified absorption period and with the pipeline full of water, the autographic recorder shall be put into operation at least 15 minutes before pressurisation of the pipeline commences. Water shall be added until the required test pressure is reached whereupon the valve on the test manifold shall be closed and sealed. The reading on the water meter shall be recorded.

PA 11.5.7 The pressure shall be maintained for one hour and if a pressure drop occurs, more water shall be added to reinstate the test pressure and the valve closed again. The quantity of water added shall be measured by recording the readings before and after pumping. This procedure shall be repeated for a period of 24 hours,

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with water added at hourly intervals where necessary to reinstate pressure and water meter readings recorded. At the end of the 24 hours period, the aggregate quantity of water required to reinstate pressure over 24 hours shall be determined.

- PA 11.5.8** The Contractor shall give the Engineer 48 hours written notice of his intention to commence pressure testing and the Engineer may attend and supervise all or any part of tests. All records and recording charts shall be handed to the Engineer as soon as tests over any section have been completed.
- PA 11.5.9** All valves, specials, fittings and exposed joints, shall be inspected visually during the 24 hours pipeline test and all visible signs of leaks, sweating and distress shall be reported and attended to without delay.
- PA 11.5.10** Immediately after completion of the prescribed 24 hours hydrostatic test, all air valves shall be tested in turn before test pressure in the pipeline is released. Each air valve shall be isolated and the drain plug removed. The air valve balls and any actuating linkage shall work freely without restraint. The isolating valve shall be checked for leakage before replacing the plug. Finally, the automatic resealing of the air valves shall be checked by re-opening the isolating valve.
- PA 11.5.11** After completion of the tests on air valves, the section of pipeline under test shall be completely refilled with water, if necessary, and pressurised to the static head shown on the drawings. Each scour valve shall be checked by opening isolating valves and sleeve valves where applicable for a duration sufficient to check the complete opening and closing cycles. If necessary, the pipeline shall be refilled after each individual test and re-pressurised to static pipeline head in order to test all scours within the section under test.

PA 11.6 REMEDIAL MEASURES

- PA 11.6.1** Should the maximum leakage limits as specified be exceeded, the Contractor shall determine the position and cause of the leaks and shall take remedial measures at his own expense and to the satisfaction of the Engineer to stop such leaks and ensure the specified degree of water tightness. Under no circumstances shall peening be permitted as a means for stopping leaks, nor shall the pipeline be allowed to remain under extended period of pressure to allow self-sealing with or without sealing aids in the test water. Any leakages from valves not supplied under this contract and which cannot be easily stopped by gland adjustment will be the responsibility of the Employer. The Contractor shall in the case of latter event occurring provide and install blank flanges to seal off leaks and to allow testing operations to proceed or to be speeded-up. The supply and installation of these blank flanges shall be covered by a variation to the contract at the rates indicated in the Schedule of Quantities.
- PA 11.6.2** If during the contract period of maintenance, the number of leaks and other defects is considered by the Engineer to be more than could reasonably be expected from a well laid pipeline operating under normal conditions, he may order the Contractor to re-test parts or the whole of the pipeline at the Contractor's own expense and no claims for escalation in costs or for whatever other reasons the Contractor might consider to submit claims be considered, except where such re-tests are the result from damages caused to the pipeline by the Employer.

PA 12. STERILISATION

- PA 12.1** All pipelines for the conveyance of potable water shall be sterilized.
- PA 12.2** As soon as the whole pipeline has passed a hydrostatic test, test water shall be scoured to ensure a flushing velocity of not less than 1 m/sec. over the entire length of the pipeline.
- PA 12.3** Potable water treated with sodium hydrochloride or calcium hypo chloride or chlorine gas to a chlorine concentration of not less than 5 mg/l free available chlorine, shall be introduced into the pipeline or section

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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of pipeline to be sterilized. On completion of filling with chlorinated water the chlorine concentration in water sampled at any point along the section of pipeline filled, shall not be less than 3 mg/l free available chlorine.

- PA 12.4** In determining chlorine concentrations the Contractor shall satisfy the Engineer that the method adopted does measure free available chlorine concentration and not total chlorine residuals, the latter being the easier to determine by means of simple comparators.
- PA 12.5** Chlorinated water shall be retained for at least 2 hours during which all air valves, in-line isolating valves, by-pass valves, branch isolating valves and scours shall be operated in order to expose all interior surfaces of these appurtenances to the chlorinated water.
- PA 12.6** After 2 hours retention of chlorinated water in the pipeline, samples drawn at any point along the pipeline shall contain not less than 0,5 mg/l free residual chlorine. Where necessary, additional chlorine shall be injected to maintain chlorine residuals, provided always that the 2 hours minimum retention time with water containing an initial free chlorine residual of at least 3 mg/l and a final free residual of not less than 0,5 mg/l is maintained.
- PA 12.7** On completion of sterilization of any section of pipeline, the water in that section may be retained or may be passed along the pipeline to other sections to be sterilized.
- PA 12.8** Provided cleanliness of pipelines has been maintained during transport, storage and laying and provided furthermore that testing water is of potable quality, the Engineer may allow the introduction of chlorine gas or compounds into water during hydrostatic testing of pipelines. Should in these instances entry into the pipeline be necessary at any stage to repair leaks or shall the interior surfaces of any pipe, fitting, valve or similar appurtenance be touched by humans, equipment etc. portions so affected shall be re-sterilized.
- PA 12.9** Provided the pH of water used for the sterilization of pipelines can be proved to be less than 7,5 before introduction of chlorine, the retention period of chlorinated water in the pipeline may be reduced from 2 hours minimum to 1 hour minimum.

PA 13. DRAINAGE OF PIPELINE

- PA 13.1** Standing water in a pipeline can lead to anaerobic conditions where sulphate reducing bacteria can cause corrosion.

After a pipeline has been hydrostatically tested and sterilized, if required, it shall be completely drained of all water, including pumping out of all low laying areas such as at scours, etc. Sections that will not need refilling for testing or sterilization should be drained sooner.

This will generally apply unless otherwise instructed by the Engineer.

PA 14. MISCELLANEOUS CONSTRUCTION WORKS AND WORKMANSHIP

PA 14.1 FENCING

PA 14.1.1 Temporary fences

- PA 14.1.1.1** Temporary fences shall be stockproof.

- PA 14.1.1.2** Where used to fence off the pipeline working area across properties or camps protected by vermin-proof fencing, "jackal proof" netting wire shall be provided.

PA 14.1.1.3 The minimum standard shall be five strands of 2,5 mm thick galvanized wire, sufficiently spaced.

PA 14.1.1.4 The Contractor shall supply, install and maintain temporary gates of the standard as specified hereunder at such points as instructed by the Engineer for access across the temporarily fenced off working area or to parts of properties severed by temporary fences.

PA 14.1.2 Permanent stock-proof fences

PA 14.1.2.1 Plain stock fencing shall be 1,2 meter high and shall have at least 6 strands of double barbed, 2,5 mm thick galvanized wire or single barbed, 2,95 mm thick galvanized wire. Spacing of wire strands shall be in accordance with the general practice for fencing in the particular area.

PA 14.1.2.2 Fencing standards at least 1,8 meter long either of 3 kg/m iron I-section or creosote impregnated hardwood of 70 to 100 mm minimum diameter shall be erected vertically and be spaced at 12 meter intervals with at least 2 droppers of length minimum 75 mm more than fence height, between standards.

PA 14.1.2.3 Droppers shall either be ridged T-section iron droppers or creosote impregnated hardwood of 30 mm minimum diameter or twisted galvanized wire droppers of double 4 mm thick wire.

PA 14.1.2.4 At each change of direction and at intervals not exceeding 400 meters on straights, straining or corner posts shall be provided. Straining or corner posts shall be 2,1 meters long, buried to a depth of at least 750 mm into the ground and properly stayed in the direction of direct pull of the wire. Backfilling in all post holes shall be thoroughly consolidated to give adequate support. Where necessary or instructed by the Engineer, straining or corner posts shall be concreted-in. Straining and/or corner posts shall either be rail section of 10 kg/m mass or steel tubing of 100 mm minimum nominal bore or creosote impregnated hardwood of 150 mm minimum diameter. Each steel post shall have a base plate of size at least 230 x 230 x 5 mm and in the case of tubular posts, a pressed steel or cast iron cap at the top.

PA 14.1.2.5 Materials for posts, struts, droppers etc., shall suit climatic and soil conditions and the Contractor shall be guided in his choice of materials by existing fencing practices in the area concerned.

PA 14.1.2.6 Steel and iron straining posts and struts shall be hot dipped galvanized in accordance with SABS 763 to a final thickness of 75 micron and a weight of 600 grams per square meter.

PA 14.1.3 Permanent vermin-proof fencing

Vermin-proof fencing shall be constructed as for plain stock fencing with at least 3 supporting strands of 2,8 mm thick high strain steel wire, $\pm$ 1 meter high covered with 75 mm x 1,8 mm thick "jackall proof" netting wire. A further single strand of double barbed 2,5 mm thick galvanized wire shall be placed $\geq$ 200 mm above the netted area. Netting wire shall be placed so as to prevent vermin from creeping under.

PA 14.1.4 Gates

PA 14.1.4.1 Gates shall be single leaf approximately 4 300 mm opening and 1 200 mm high. They shall be of welded tubular construction braced diagonally in both directions. The gates shall be of approved design but in any case the frame shall be of medium quality galvanized tubing of 40 mm minimum bore and the braces shall be of galvanized tubing of 32 mm minimum bore. All gates shall be hot dipped galvanized in accordance with SABS 763 to a final thickness of 75 micron and a weight of 600 grams per square meter.

PA 14.1.4.2 Frames shall be covered with horizontal galvanized wires at 220 mm centers where gates are to be installed in stockproof fences. Gates for installation in vermin-proof fences shall be covered with galvanized 50 mm diamond wire mesh of 2,50 mm thick wire.

PA 14.1.4.3 All gates shall be hung horizontally in an approved manner on boxed stays consisting of pairs of cross braced and strutted 10 kg/m iron rails or creosote impregnated hardwood of 150 mm minimum diameter, all posts firmly concreted in. Boxed stays shall be provided on both sides of the gate.

PA 14.1.4.4 All gates shall be placed in line with existing fences.

PA 14.1.4.5 All gates shall be provided with a galvanized locking chain welded to the gate post.

PA 14.2 CONCRETE WORK

PA 14.2.1 General

PA 14.2.1.1 All concrete work shall be finished to the lines, levels slopes and outlines shown on the drawings or as otherwise directed.

PA 14.2.1.2 All exposed concrete surfaces shall be finished such that surface irregularities shall not exceed a tolerance of ± 8 mm and shall be rubbed down with a carborundum stone to present a surface of even colour and a smooth and pleasing appearance. All exposed edges shall be chamfered by 40 mm chamfers fixed to shuttering. Unless otherwise specified all floors shall have a wood-float finish.

PA 14.2.1.3 Surfaces shall be free from honeycombing and protrusions. Honeycombing to the extent that in the opinion of the Engineer the strength of the structure is impaired or the reinforcement is subject to corrosion or lack of bond, shall be removed and replaced with satisfactory concrete at the Contractor's expense within 72 hours of the concrete originally being placed.

PA 14.2.1.4 The minimum concrete cover to reinforcement of concrete surfaces permanently in contact with ground shall be 50 mm and for all other surfaces shall be 40 mm.

PA 14.2.1.5 All pre-cast units shall be steel-trowelled on upper surfaces to present a dense, homogenous surface.

PA 14.2.1.6 Slight spalling of top edges of manholes to be covered by pre-cast or cast-in-situ cover slabs shall be permitted provided the maximum dimension of the spall measured along any face shall not exceed 25 mm and provided further that no reinforcement is exposed. The maximum permissible difference in any of the two measurements taken to opposite corners diagonally across rectangular or square structures shall not exceed 2 % of that measurement calculated from the drawing. The tolerance in thickness of walls or cover slabs shall be ± 15 mm.

PA 14.2.2 Thrust blocks

PA 14.2.2.1 Before any thrust block is cast, the pipe special or fitting shall be supported and secured in its correct alignment and shall be jointed to the adjacent pipework.

PA 14.2.2.2 The width of any thrust block shall be limited to 1 500 mm either side of pipe or special centre line to ensure space for future pipelines in the same servitude. Concrete faces of thrust blocks shall be a minimum of 300 mm from flanges and from flexible coupling centers. The bearing face of thrust blocks shall be cast against undisturbed soil or rock.

PA 14.2.3 Valve chambers

PA 14.2.3.1 Chambers for isolating valves, air valves, meters, access manholes etc shall be constructed in accordance with approved drawings.

PA 14.2.3.2 Care shall be taken that the elevation of air bricks and tops is such that no ingress of surfaces run-off or

ground water into chambers can occur.

PA 14.2.4 Encased pipework

PA 14.2.4.1 Where steel pipes and/or specials are permanently encased in concrete, e.g. in thrust blocks, walls of concrete valve chambers, stream crossings, etc, the coating over the portion to be so encased shall be to the same standard as the rest of the pipeline, except where indicated to the contrary in the Schedule of Quantities or on the drawings.

PA 14.2.4.2 Whenever it is necessary to encase fibre-cement pipes in concrete, the flexible joints shall not be encased and the concrete shall terminate 300 mm from the flexible joint.

PA 14.2.4.3 Thrust/puddle flanges of pipes or specials encased in concrete shall be painted with one coat of bitumen primer and two coats of bitumastic paint to a dry film thickness of 180 micrometers except where indicated to the contrary in the Schedule of Quantities or on the drawings.

PA 14.3 BRICKWORK

PA 14.3.1 Brickwork is to be built to the dimensions, thicknesses and heights as shown on the drawings.

PA 14.3.2 All joints shall be completely filled with mortar. Joints to face brickwork shall be neatly rounded with a 10 mm diameter grooving tool while faces of common brickwork which are to be plastered, shall have joints raked out to a depth of 12 mm to ensure good plaster bond.

PA 14.3.3 Mortar shall consist of one part cement to four parts approved sand by volume and shall be used within one hour of mixing.

PA 14.3.4 Brickwork shall be built in stretcher bond and all common bricks shall be well wetted before being laid.

PA 14.4 FABRICATED STEELWORK AND STEEL PIPE SPECIALS

PA 14.4.1 All fabricated steelwork for covers, locking bars, keep plates, hinge plates, grids, etc, shall be manufactured from mild steel plate, chequer plate and/or bar as detailed on the drawings. All the steelwork shall be heavy duty hot dipped galvanized in accordance with SABS 763.

PA 14.4.2 All welding shall be carried out in accordance with SABS 044 - "Code of Practice for Welding".

PA 14.4.3 Manhole locking bars, hinges, holding down straps, etc, shall be heavy duty hot-dip galvanized after fabrication and site welding, drilling and cutting if unavoidable, shall be chipped to remove slag, wire brushed and painted with at least three coats of approved cold galvanizing solution.

PA 14.4.4 The galvanizer must be a member of the Hot-dipped Galvanizing Association of South Africa (HDGASA) and must be a SABS accredited galvanizer. The galvanizer must supply a SABS certificate with all items delivered to site.

PA 14.5 SERVITUDE ROAD

PA 14.5.1 The Contractor shall build a servitude road 3 meters wide along as much of the length of the pipeline as is practicable for the use of the Employer's vehicles for patrolling and maintaining the completed pipeline. The road shall be built as shown on the drawings or in the specification unless otherwise instructed by the Engineer in writing. It shall be built to conform closely to the shape of the natural ground to prevent interference with the surface drainage.

PA 14.5.2 After the pipeline servitude has been cleared of all boulders, trees, bush and other vegetation and prior to trenching operations; the Contractor shall mark out the area of the roadway to the Engineer's approval. Thereafter all topsoil and grass shall be removed over the width of the road to an approximate depth of 200 mm by means of a motor grader or scraper, the excavated material being placed in windrows parallel to and clear of the edges of the roadway on one or both sides.

The windrows may be flattened so as not to restrict pipelaying operations. The Engineer may order a greater or lesser depth of topsoil to be thus removed to expose subsoil or to remove unsuitable material depending on site conditions.

PA 14.5.3 When trenching operations commence, material surplus to backfilling requirements and suitable for surfacing the servitude road shall be dumped on the roadway and spread by motorgrader or bulldozer as work proceeds. Laterite, shales, decomposed tillite, dolerite gravels and the like in suitable form, and materials containing rock fragments which will break down under a grid roller to provide well graded material will be suitable for the road formation. Soils with a high content of clay and similar fine materials shall not be used for road surfacing. Any shortfall of surfacing material shall be imported from approved borrow pits.

PA 14.5.4 The Contractor may construct the servitude road immediately after the trench has been completed or after the pipeline has been backfilled and while the servitude area and working area are being reinstated. When the 3 meters width of surfaced servitude road has been completed, the topsoil shall be bladed up to both edges of the roadway and compacted to form a smooth surface free of cuts or banks except where the Engineer may direct otherwise.

PA 14.5.5 A grid roller shall be used and water applied for binding as required. Compaction of the servitude road formation shall be achieved by the careful routing of construction vehicles along the roadway, supplemented by the use of a grid roller. The final operations of grading and the surface of the road and adjoining areas with the servitude shall be performed with a motor grader.

PA 14.5.6 In areas where the topography precludes the building of the servitude road as described above, the Engineer may direct such benching and earthworks as he may consider necessary to establish access for the Employer's supervisory vehicles. However, such works will be of a minor nature and Tenderers shall understand that they are not intended for pipeline construction purposes.

PA 14.5.7 Material excavated from the pipeline trench surplus to pipeline backfilling or road surfacing requirements shall, if considered suitable by the Engineer and without extra cost be used for road formation at swamp crossings and the approaches to stream crossings instead of being spoiled to waste. Concrete aprons at stream crossings shall be constructed as shown on the drawings or instructed by the Engineer.

PA 15. FINAL PAINTING

PA 15.1 After successful hydrostatic testing of the pipeline and after completion of all construction work under this contract all external surfaces of uncoated or ungalvanized steelwork and surfaces of all valves and fittings shall be prepared and painted as hereinafter specified. In addition, all surfaces of materials which has received first coat of paint in the course of the contract in accordance with this specification, shall receive final coats of paint of the same colour or such other colour as may be specified or instructed by the Engineer.

PA 15.2 SURFACE PREPARATION

PA 15.2.1 Bare steel surfaces

All bare steel or cast-iron surfaces and all steel or cast-iron surfaces previously primed or painted and of which prime or paint coats show signs of deterioration shall be sand blasted to bare steel to standard St 2 of

SIS 055900. Where necessary, a combination of hand tools, mechanical grinders and a chemical cleaner such a "Prolux Ferrokleen" or equivalent shall be used to obtain the specified degree of cleaning. After cleaning, all dust and debris shall be removed by brushing with a clean stiff-bristle which shall be kept clean by frequent rinsing in white spirits or equivalent solvent.

PA 15.2.2 Previously painted surfaces

Previously primed or painted surfaces in sound condition shall be wiped with a rag soaked in white spirits to remove all signs of dust, debris, bitumen, oil and grease. Where necessary, chalked or slightly weathered surfaces shall be given a light sanding to expose fresh paint layers.

PA 15.3 PAINTING

PA 15.3.1 Prime coat and second coat

PA 15.3.1.1 Bare steel or cast-iron surfaces

Immediately after cleaning and not more than 2 hours after cleaning, provided surfaces are kept dry and free dust, a coat of approved cold applied bituminous primer shall be applied by brush or roller to a minimum dry film thickness of 100 micrometers. As soon as the prime coat is dry to the touch a second coat of an approved bituminous paint shall be applied by brush to a minimum dry film thickness of 150 micrometers. All coats shall be applied evenly and shall be free from tears and runs. The coats shall be kept dry and free of dust and debris.

PA 15.3.1.2 Previously painted or primed surfaces

Immediately after cleaning and not more than 2 hours after cleaning, provided surfaces are kept dry and free of dust and debris, a coat of an approved bituminous paint shall be applied by brush to a dry film thickness of not less than 150 micrometers. The coat shall be applied evenly and shall be free from tears and runs. The coats shall be kept dry and free of dust and debris.

PA 15.3.2 Final coat

As soon as second coats are dry to the touch, one coat of bituminous based aluminium paint shall be applied by brush to a dry film thickness of not less than 150 micrometers. The coat shall be applied evenly and shall be free from tears and runs. Paint coats shall overlap coated portions of pipes and specials by at least 75 mm.

PA 15.4 All painting shall be carried out under the supervision of a skilled, experienced and competent painter. No painting shall be done in wet weather and all coats shall be applied to clean dry surfaces.

PA 15.5 All paint shall be used from the original containers of the manufacturer and such containers are to be brought onto the site unopened. No adulteration will be permitted and paints shall be used strictly in accordance with the manufacturer's instructions.

PA 15.6 The Engineer shall instruct any painted steel or cast-iron surface to be inspected with a holiday instrument with copper bristle detector and operating at 5 kV. Single holidays may be repaired by overcoating, but if more than 2 holidays are detected over any area of 0,5 m the Engineer may reject the paintwork. Rejected paint surfaces shall be re-cleaned to bare steel surface to the standard specified and shall be repainted at the Contractor's expense.

PA 15.7 The following parts and/or surfaces shall not be painted over:

- PA 15.7.1** All working parts of valve actuators which will result in the malfunctioning of the valve.
- PA 15.7.2** All indicators, makers plates, instruction plates, hard stamping etc.
- PA 15.7.3** All stainless steel, chromium plated parts and non-ferrous work.
- PA 15.7.4** Grease nipples, grease cups, valve indicators, exposed spindles.
- PA 15.7.5** Hot dipped galvanized surfaces. If cutting of galvanized parts cannot be prevented, exposed steel shall be thoroughly cleaned and painted with at least 3 coats of an approved cold galvanizing solution or "Prolux Zinc Galv 6" or equivalent.
- PA 15.8** All working parts of valves and fittings shall be checked to ensure that they operate freely and correctly and shall be lubricated after all paintwork has dried out.

PA 16. MARKER BEACONS, BENCH MARKS, TRIANGULATION BEACONS AND MARKING OF VALVE CHAMBERS

- PA 16.1** Precast concrete marker beacons as detailed on the drawings shall be placed exactly above the centre line of the completed pipeline and concreted-in at all changes of direction, on reserve boundaries, on both sides of road crossings, on both sides of river crossings, at farm boundary crossings and at one kilometer intervals generally on straight sections of the pipeline.
- PA 16.2** Combined triangulation-benchmark beacons as detailed on the drawings shall be placed exactly above the centre line of the completed pipeline at all changes of direction, on reserve boundaries, on both sides of river crossings and at farm boundary crossings. The exact chainage measured along the pipeline at each benchmark shall be punched clearly into the plate on the benchmark beacon and a serial number to easily identify a benchmark beacon or to detect loss of a beacon. Wherever possible and approved by the Engineer these triangulation pins with benchmark and marking plates with data shall be incorporated on the outside of chambers founded on undisturbed ground i.e. reflux valves, isolating valves, one of the road crossing access chambers, etc.

The beacons shall all be accurately numbered, levelled and triangulated with the following data to the specified accuracy hard stamped on it:

- (i) Beacon number.
- (ii) Measured chainage.
- (iii) Reduced level above MSL to an accuracy of $\pm(0,01+0,005 \times \text{length of pipeline in km})$.
- (iv) "X", "Y" and "Z" co-ordinates in meters to the applicable "Lo" system according to the Survey Act, 1927 for Class accuracy.

On completion of triangulation the threaded portion of the triangulation pins shall be covered with a graphite/grease compound and the end covers firmly screwed back by hand.

- PA 16.3** All chambers constructed on the pipeline shall be clearly marked on the outside to denote the appurtenances housed in each and the chainages thereof. Marking shall be by stenciling in road marking paint in letters not smaller than seventy five (75) mm.

All markings shall face the upstream direction. Abbreviations to be used shall be as follows:

(i) Air valves	AV
(ii) Isolating valves	IV
(iii) Scour valves	SV
(iv) Access only	AX
(v) Air valve in conjunction with access	AV
(vi) Reflux valves	RV
(vii) Insulating flanges	IF
(viii) Water meters	WM
(ix) All farm off-takes	FO
(x) All bulk off-takes	BO
(xi) Surge tank	ST

PA 17. COMPLETION DRAWINGS

The Contractor shall submit acceptable complete "As-built" drawings before the issue of the Completion Certificates. Failing this the penalty as stated in the "Appendix to Form of Tender" shall apply. The "As-built" drawings shall conform to the requirements described below:

One complete set of paper prints of the drawings supplied to the Contractor shall be marked "As-built" with all changes shown in red.

PA 18. SUPERVISION AND INSPECTION**PA 18.1 GENERAL**

PA 18.1.1 The Works will be supervised and inspected by the Engineer and/or his authorised Representatives. Such supervision and inspection shall in no way relieve the Contractor of his obligation and responsibility for performing the Works in accordance with the contract.

PA 18.1.2 The Contractor shall institute his own inspection of the Works and shall conduct tests to ensure that the materials supplied and quality of workmanship comply with the requirements of the contract. The Contractor must therefore be in possession of his own testing equipment.

PA 18.1.3 The Employer may appoint an independent Inspectorate who shall act on behalf of the Engineer to conduct any test to ensure that materials and workmanship comply with the requirements of the contract.

PA 18.1.4 The Contractor shall provide access at all times and shall be responsible for the opening and closing of access covers for inspection purposes and for providing sufficient labour and equipment such as ladders, rubber-tired trolleys, rubber mats or other suitable protection for linings, lighting etc, all to the approval of

the Engineer, to enable the Engineer, his authorised Representative or the Inspectorate to inspect the Works efficiently. The Engineer and the Inspectorate shall be afforded every facility to enable inspection to be carried out effectively.

PA 18.2 WELD INSPECTION**PA 18.2.1 Radiographic examination**

PA 18.2.1.1 Butt welds shall be examined radiographically, processed and adjudicated by the Contractor on site in accordance with API 1104. Cracks, lack of complete penetration or lack of complete fusion shall be considered injurious defects. The standard for acceptance of minor imperfections such as slag inclusions or gas pockets shall be that specified in clauses 9.2 to 9.13 inclusive of API Standard 5L.

All radiographs shall be adjudicated and approved by the Inspectorate.

PA 18.2.1.2 10 % of the total length of all manual field welds, 2 % of the total length of field welds done by an approved automatic process and 100 % of the length of all welds at miters shall be examined radiographically with particular reference to weld intersections, using equipment supplied and staffed by the Contractor.

PA 18.2.1.3 The Engineer reserves the right to decrease the length of welds radiographed to a minimum of 4 % of manual welds and 1 % of automatic welds if the standard of welding is consistently high and justifies the reduction.

PA 18.2.1.4 The Engineer however also reserves the right to increase the length of welds to be radiographed to 100 % of length of weld on the following basis and any increase above 10 % of length of manual welds or 2 % of length of automatic welds, shall be to the Contractor's account.

PA 18.2.1.4.1 If in 10 % of length of manual welds or 2 % of length of automatic welds radiographed, more than 1 out of every 5 butt welded joints successively examined shows defects, length of weld to be radiographed shall be increased to 20 % of manual welds and 5 % of automatic welds.

PA 18.2.1.4.2 If in 20 % of length of manual welds or 5 % of length of automatic welds radiographed, more than 3 butt welded joints in any 10 joints successively examined shows defects, the length of weld to be examined shall be increased to 50 % of manual welds and 10 % of automatic welds.

PA 18.2.1.4.3 If in the length of welds so radiographed, more than 5 in any 20 joints successively radiographed shows defects, the Engineer may increase the length of weld to be examined at his own discretion up to 100 % of manual and automatic welds.

PA 18.2.1.4.4 All defects shall be repaired and re-radiographed at the Contractor's cost and such radiography of repairs shall not be deemed to be included in the required percentage of radiography.

PA 18.2.1.4.5 Claims arising from delays in construction caused by justifiable additional radiography which may be ordered by the Engineer or necessitated by weld repairs, shall not be considered.

PA 18.2.2 Visual examination

PA 18.2.2.1 All field welds shall be examined visually.

PA 18.2.3 Fillet welds

PA 18.2.3.1 Apart from visual examination, fillet welds shall be subjected to dye penetrant or magnetic particle tests at the Inspectorate's discretion.

PA 18.2.4 Repair of welds

PA 18.2.4.1 The repair procedure and performance, and welders employed on repairs shall be as stated in Appendix B of API Standard 5L. Each repair weld shall be marked with the welder's identifying stamp.

PA 18.2.4.2 All costs related to the repair of defective welds shall be borne by the Contractor. When the repair has been made the full length of the repair shall be examined radiographically.

On discovery of reject welds the engineer may, at his discretion, call for additional radiographic examination until it is shown that the necessary standard is being maintained.

PA 18.2.4.3 Defective welds shall be repaired immediately they are found to be so. The Engineer has the right to stop the Contractor proceeding with further pipe laying in the event of the Contractor delaying the rectification of defective welds. Furthermore, no consideration will be given to any claims arising from delays in construction resulting from such action.

PA 18.3 INSPECTION OF LININGS AND COATINGS

PA 18.3.1 All linings and coatings, whether having passed a factory inspection or not, shall be inspected on site and shall be subject to rejection.

PA 18.3.2 All repairs to linings and coatings shall be subject to inspection.

PA 18.3.3 All materials used on site for lining and coating or for repairs to linings and coatings shall be subjected to tests. The number of samples tested and the sampling points shall be at the Engineer's or the Inspectorate's discretion. The Contractor shall provide all samples free of charge.

PA 18.3.4 Materials rejected shall be removed from site without delay, whether such materials have already been applied to pipes, specials and appurtenances, or not.

PA 19. MEASUREMENT AND PAYMENT**PA 19.1 GENERAL**

PA 19.1.1 All rates, lump sums and prices shall be held to include all labour, plant, equipment, materials, supervision, overheads, profits and maintenance as per contract.

PA 19.2 SURVEYS, SETTING OUT, DRAWINGS (INCLUDING "AS-BUILT")

PA 19.2.1 Shall be priced as lump sums in the section for "Fixed Charge and Value Related Items" under the relevant Preliminary and General items in the Schedule of Quantities.

PA 19.2.2 Payment shall be in equal monthly installments over the approved contract period.

PA 19.2.3 Sums shall be held to include for re-drawing and/or correction of drawings not approved by or acceptable to the Engineer.

PA 19.3 SITE CLEARING

PA 19.3.1 Shall be measured per linear meter of pipeline centerline cleared over the width of the permanent servitude.

PA 19.3.2 Rates shall be held to include for clearing of wider areas where required by the Contractor, for removal of

trees, de-stumping, de-rooting, for disposal of vegetable matter by burning and safeguarding against veld or bush fires related thereto, for disposal of vegetable matter, timber, stumps, rubble, debris etc to approved dumping sites within 5 km radius from point of loading.

PA 19.3.3 Wherever deemed necessary in the opinion of the Engineer, extra over rates will be provided in the Schedule of Quantities for clearance of trees and stumps not covered by rates in clause PA 19.3.1.

PA 19.4 DEMOLISHING

PA 19.4.1 Demolishing of huts, houses and similar structures falling within the width of the permanent servitude shall be priced as a lump sum payable on completion of the item.

PA 19.4.2 The sum shall be held to include for demolishing the entire structure and foundations and all services and facilities related thereto and for disposal of all materials, rubble and debris to approved dumping sites within 5 km radius from point of loading.

PA 19.5 TRENCH EXCAVATIONS

PA 19.5.1 Shall be measured per linear meter length along the centre line of the trench. The depth will be measured from the surface of the ground to the bottom of the specified bedding layer.

PA 19.5.2 Rates shall be held to include general leveling to facilitate use of plant, all work in connection with access through existing fences and reinstatement of same with new materials and gates as specified, all expenses in entry upon properties, the crossing, deviation, maintenance and reinstatement of services and utility installation, shoring, battering, overbreak, dewatering, trimming of trench bottoms, repairs and/or reinstatement of trenches after flooding or any other reasons, and all additional work and limitations to work due to blasting or other restrictions imposed by statutory authorities, other than the Engineer, for provision and maintenance of access at required points across trench.

PA 19.5.3 Extra over rates for stripping and setting aside of top soil to stockpile, and later reinstatement shall be scheduled.

PA 19.5.3.1 Excavate topsoil from pipeline trenches and stockpile cubic metre (m³)

The unit of measurement shall be the cubic metre of topsoil excavated within the specified widths over the lengths and depths authorized by the engineer for each pipeline and stockpiled. Excavation in excess of the authorized dimensions will not be measured for payment.

The tendered rate shall include full compensation for excavating, loading, transporting, off-loading and stockpiling the topsoil.

PA 19.5.3.1 Remove topsoil from stockpile and reinstate within the servitude cubic metre (m³)

The unit of measurement shall be the cubic metre of topsoil removed from stockpile and placed above the backfill in pipeline trenches as and where instructed by the engineer. The authorized dimensions of the pipeline trench widths times the authorized depth of topsoil shall be used to calculate the volume of topsoil replaced.

The tendered rate shall include full compensation for removing the topsoil from stockpile, irrespective of distance, for loading, transporting, off-loading, placing and spreading the topsoil to the required thickness, for levelling it off to a smooth surface, for removing any stones from the top surface and for lightly compacting the topsoil.

- PA 19.5.3** Extra over rates for excavations at road crossings shall be held to include for traffic control, deviations, warning signs, safeguarding and all precautions demanded of works dictated or required by roads authorities and/or the GPO.
- PA 19.5.4** Extra over rates for excavations at stream crossings shall be held to include for flow diversion, repair of flood damage to work, dewatering of trenches.
- PA 19.5.5** The excavation and trimming of joint holes to facilitate all activities necessary to make and complete pipe joints shall be deemed to be included in the tendered rates for trench excavations.
- PA 19.6 EXCAVATIONS FOR VALVE CHAMBERS, THRUST BLOCKS, CULVERTS, CONCRETE ENCASEMENTS AND SIMILAR STRUCTURES.**
- PA 19.6.1** Shall be measured in cubic meters (m³) nett to the outside dimensions of the structure for all excavations outside trench payment lines. The cross sectional area of trench payment lines shall be defined by the minimum specified trench width and the depth of cut from ground level up to 150 mm or 200 mm as the case may be for a particular type of pipe, below the underside of the pipes.
- PA 19.6.2** Rates shall be held to include for widening to allow working space around structure, shoring, battering, overbreak, trimming, dewatering and all additional work and limitations to work due to blasting or other restrictions imposed by statutory authorities other than the Engineer.
- PA 19.6.3** Extra over rates for excavations at road and river crossings shall be held to include for all the aspects as per sub-clauses PA 19.5.3 and PA 19.5.4.
- PA 19.7 PREPARATION OF TRENCH FLOOR AFTER COMPLETION OF BULK EXCAVATIONS**
- PA 19.7.1** Shall be measured per cubic meter (m³) of material ordered or per square meter of trench floor compacted.
- (a) Using class I selected fill cubic metre (m³)
- (b) Using cement or lime stabilized fill cubic metre (m³)
- (c) By compaction only, to 90% of mod AASHTO density square metre (m²)
- PA 19.7.2** The unit of measurement for subitems (a) and (b) shall be the cubic metre of material (measured in place after compaction) of each type as ordered by the engineer and as specified. Only material placed within the authorized dimensions shall be measured for payment.
- PA 19.7.3** The unit of measurement for subitem (c) shall be the square metre of trench floor/pipe bed foundation compacted as specified where no pipe bedding material is required. Only material compacted within the authorized dimensions shall be measured for payment.
- PA 19.7.4** The tendered rates for subitems (a) and (b) shall include full compensation for procuring, furnishing, placing and compacting all materials, for storage of materials, for transport and for provision of all labour and constructional plant required to carry out the work.
- PA 19.7.5** The tendered rate for subitem (c) shall include full compensation for the provision of all labour and constructional plant required to carry out the work.
- PA 19.8 PIPE BEDDING (BEDDING CRADLE)**
- PA 19.8.1** Shall be measured per cubic meter (m³) of pipeline laid on completed bedding.

- PA 19.8.2** Rates shall be held to include for bringing in approved bedding material within a 10km radius from point of application, for all costs of opening up borrow areas where required, royalties to owners, reinstatement of borrow areas and access roads on completion, bulking, placing into trench, spreading, levelling, compaction and testing of materials.
- PA 19.8.3** Extra over rates for use of "Bidim" or similar approved filter cloth and 19 mm crushed stone in waterlogged ground shall be held to include for all materials, placing, compaction, deepening of trench bottoms and everything additionally required to complete the bedding in terms of the specification.
- PA 19.8.4** Extra over rates for Class A concrete bedding conforming to SABS 102 shall be held to include for everything additionally required to complete the bedding.
- PA 19.8.5** Extra over rates for Class A concrete bedding conforming to SABS 102 shall be held to include for everything additionally required to complete the bedding.
- PA 19.8.6** Excavation of sling slots and subsequent backfill and compaction thereof shall be deemed to be included in the tendered rates for placing and completing the pipe bedding.
- PA 19.9 SELECTED BACKFILL (FILL BLANKET)**
- PA 19.9.1** Shall be measured per cubic meter (m³) of pipeline laid and completely backfilled.
- PA 19.9.2** Rates shall be held to include for bringing in selected backfill within 10km radius from point of application, for all costs and royalties in opening up borrow areas, reinstatement of borrow areas and access roads on completion, bulking, placing into trench, spreading, leveling, compaction and testing of materials.
- PA 19.9.3** Extra over rates for the use of polyethylene sheets or blankets in conjunction with selected backfill of required fineness but with high clay content, shall be indicated as either a plus (+) or minus (-) value. Rates shall be held to include for everything necessary to complete selected backfill up to 300 mm above crown of pipe as per specification.
- PA 19.9.4** Extra over rates for the use of approved rock shield in conjunction with backfill which do not meet specified requirements in respect of fineness and clay content shall be indicated as either a plus(+) or minus (-) value. Rates shall be held to include for all expenses in getting rock shield materials approved, its application to approval of the Engineer and everything necessary to complete selected backfill up to 300 mm above crown of pipe as per specification.
- PA 19.10 COMMON BACKFILL (MAIN FILL)**
- PA 19.10.1** Shall be measured per linear meter (m) of pipeline completely backfilled.
- PA 19.10.2** Rates shall be held to include for moving of suitable trench spoil from areas where there is a surplus to areas where there is a shortage over a free-haul distance of 10 km, for placing, spreading, leveling and compaction, for bringing back top soil and reinstatement thereof over the trench, for reinstatement of agricultural drains and contours across servitude, for all works required in safeguarding against and prevention of erosion along the servitude, for backfilling around all chambers and other pipeline structures excavated outside the trench payment line.
- PA 19.10.3** Extra over rates for common backfill at road crossings shall be held to include for complete reinstatement of road formations and road surfaces in conformity to the specification or the requirements of the roads authority.

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PA 19.10.4 Extra over rates for common backfill at stream crossings shall be held to include for complete reinstatement of the natural stream bed and removal of all obstructions created by pipeline construction and which may obstruct or interfere with the natural flow regime of the stream.

PA 19.11 CLEANING OF SERVITUDE

PA 19.11.1 Shall be measured per linear meter (m) of pipeline servitude cleaned on completion of backfilling.

PA 19.11.2 Rates shall be held to include for clearing of the permanent and temporary servitude widths of surplus spoil i.e. excavated materials including rock, debris, rubble, rejected or surplus piping, specials and fittings and transport of same to approved dumping sites or acquired servitudes, within 5 km radius from point where loaded, for reinstatement of ground surface in temporary servitude strip by ripping or otherwise to facilitate re-establishment of vegetation. The spoil dumps should be neatly trimmed and, if required, covered with top soil 100 mm thick, and grassed.

PA 19.12 LAYING AND JOINTING OF PIPING AND SPECIALS

PA 19.12.1 Shall be measured per linear meter (m) of pipeline laid and jointed.

PA 19.12.2 Rates shall be held to include for site storage, transport and handling of pipes and specials, for all jointing materials, for Contractor's inspection services, for radiography exceeding specified limits and at repairs, for repairs to piping and specials, repairs to linings and coatings, for moulding of flanges and couplings, for prevention of flotation and provision, installation and maintenance of night caps to all open ends of pipes in trenches, for installation of thrust and puddle flanges where required, for maintaining the pipeline, piping and specials, clean and free from contamination, for final painting as specified and for the provision of suitable plant, labour and supervision to transport pipes, specials and fittings up or down very steep inclines along the pipeline route.

PA 19.12.3 Extra over rates for pipe laying and jointing at road and stream crossings shall be held to include for all additional labour, materials, plant, supervision and inspection required for installation of the piping and specials as per specification and approved drawings and for all limitations imposed on operations and methods of work due to restricted working space or due to restrictions imposed by authorities, high water level etc.

PA 19.12.4 Extra over rates for pipe laying and jointing on steep slopes shall be held to include for all restrictions and limitations imposed by the site for the provision and installation of all anchors and holding down straps, flexible supports.

PA 19.13 RADIOGRAPHIC TESTING OF WELDED JOINTS

PA 19.13.1 The unit of measurement shall be the number of each size of welded joint to be radiographically tested.

PA 19.13.2 The tendered rates shall include full compensation for all personnel, materials and equipment required to carry out the radiographic tests for the full length of each joint.

PA 19.13.3 Payment shall be done for the radiographic testing of welds as specified in Clause PA 18.2. Any increase in tests as result of poor workmanship of the Contractor or retesting of failed tests shall be for the Contractor's account.

PA 19.14 INSTALLATION OF IN-LINE VALVES, METERS AND FITTINGS

PA 19.14.1 Shall be measured per unit of complete assembly.

PA 19.14.2 Rates shall be held to include for site storage, handling and transport, for all jointing materials and installation as specified or as per drawings, for oiling and greasing of moving parts, tightening up to of leaking glands and final painting after installation, and for everything necessary to complete installation as per specification or drawings except for construction of chambers which is measured separately.

PA 19.15 PIPELINE OFF-TAKES AND FITTINGS

PA 19.15.1 Shall be measured per unit of complete assembly.

PA 19.15.2 Rates shall be held to include for site storage, handling and transport, for all jointing materials, for installation of all valves, meters and fittings as per Clause PA 19.12 and for everything necessary to complete the off-take as per specification or drawing, except for construction of chambers which is measured separately.

PA 19.16 CHAMBERS, CULVERTS AND PIPELINE STRUCTURES

PA 19.16.1 Concrete shall be measured in accordance with SABS 1200GA Clause 8.1.4 - Concrete complete with formwork.

PA 19.16.2 Reinforcement shall be measured in tons nett and rates shall be held to include for cutting, bending, placing and all brackets, stools and supporting steel.

PA 19.16.3 Miscellaneous built-in steel and iron work like chequer plate covers, cast iron manhole covers and frames, grating, tread irons, locking bars and padlocks, holding down bolts and anchorages bearing finger and pinjoints, louvres, ventilators, bar and mesh screens, steel valve supports, ladders etc, shall be measured per unit of complete assembly. Rates shall be held to include for fabrication, corrosion proofing, supply and delivery to site and complete installation.

PA 19.16.4 Manhole covers shall be measured per unit of complete assembly and rates shall be held to include for fabrication, supply, and delivery and complete installation.

PA 19.16.5 Precast concrete paving blocks or slabs shall be measured per square meter area covered and rates shall be held to include for manufacture, supply, laying, finishing off, all foundation preparation and work, concrete or mortar or soil surround or fills and all cut-off walls for erosion protection.

PA 19.16.6 Thrust blocks and anchor blocks shall be measured per cubic meter concrete poured of the class as specified and rates shall be held to include for additional excavation required to meet the required dimensions of each block, for ensuring that the thrust area is undisturbed and sound and meets with the minimum required thrust area, for procuring all materials needed, for mixing, placing and curing the concrete and any other activities required to complete the thrust block or anchor block.

PA 19.17 CONSTRUCTION AND MAINTENANCE OF SERVITUDE ROAD

PA 19.17.1 The unit of measurement shall be the km of servitude road constructed and maintained for the duration of the construction period and during the twelve month maintenance period. The tendered rate shall include full compensation for all labour and constructional plant required to construct the access road in accordance with the PA 14.5.

PA 19.18 CONNECTING TO EXISTING PRESSURE PIPES

- PA 19.18.1** Shall be priced as a lump sum payable for each connection as detailed on the drawings or described in the Schedule of Quantities which must be made and commissioned.
- PA 19.18.2** Prices shall be held to include all effort required to locate, expose by hand, removal of end caps, other fittings, or cutting into the existing pipeline, draining the pipeline and dewatering operations, additional excavations, installing the valves and other required specials, repair of damaged coatings and linings, temporary and permanent thrust blocks, testing, subsequent backfill and compaction, and refilling and bringing to pressure of the existing pipeline and any other actions that may be required to complete and commission the connection. The prices shall also include for liaison with the service owner and other affected local authorities and to comply with their requirements and regulations.
- PA 19.18.3** New materials, such as valves, bends, tees, shall be measured and paid for separately.
- PA 19.19 FENCING**
- PA 19.19.1** All fencing, including temporary fencing, palisade fencing and permanent fencing, except reinstatement of existing fences across servitudes with new materials which shall be included in rates for trench excavation, shall be measured in linear meters of fence erected and rates shall be held to include for maintenance, breaking down and removal on completion where applicable.
- PA 19.19.2** Gates other than those provided in temporary fences to maintain access for owners and which shall be included in rates for temporary fencing, shall be measured per unit of complete installation.
- PA 19.19.3** Rates shall be held to include for painting as specified.
- PA 19.20 HYDROSTATIC TESTING AND DRAINING**
- PA 19.20.1** Shall be priced as a lump sum payable in proportion to the length of pipeline tested.
- PA 19.20.2** Prices shall be held to include for the supply of water, all gauges, recorders, watermeters, detection and repair of leaks, supply, installation and removal of bulkheads, blank flanges, thrust blocks and anchors and everything necessary to conduct and complete the test as well as the draining of the pipeline as specified.
- PA 19.21 STERILISATION**
- PA 19.21.1** Shall be priced as a lump sum payable in proportion to length of pipeline completely sterilised.
- PA 19.21.2** Prices shall be held to include for the supply of water, chemicals, free residual chlorine indicators, instruments, equipment, re-sterilisation after entry and everything necessary to conduct and complete sterilisation as specified.
- PA 19.22 MARKER BEACONS, BENCH MARKS, TRIANGULATION POINTS AND MARKING**
- PA 19.22.1** Shall be priced as a lump sum payable on completion of services required in terms of the specification.
- PA 19.22.2** Price shall be held to include for hardstamping of brass plates, coding, numbering, lettering and everything necessary to complete as specified.

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PARTICULAR SPECIFICATION**PB : MANUFACTURE OF STEEL PIPES AND FITTINGS****CONTENTS**

PB1 SCOPE

PB2 MANUFACTURE OF PIPES AND FITTINGS

PB 1 : SCOPE

This specification covers the manufacture and if applicable the delivery of pipes and specials such as bends, tees, etc, inclusive of coatings and linings of the diameters listed below.

The work involved will entail the manufacture, coating and lining as well as delivery to and off-loading on site of cement-mortar lined and fusion bonded medium density polyethylene (FBMDPE) coated plain-ended steel pipes and specials with ends prepared for butt-welding, as listed below.

PB 2 : MANUFACTURE OF PIPES AND FITTINGS**PB 2.1 Material requirements**

- (i) The steel plate or strip for the fabrication of the pipes shall be manufactured in accordance with American Petroleum Institute (API) Standard 5L and be of the grade as stated in the table below and in the schedule of quantities.

External diameter mm	Wall thickness mm	Steel plate or strip	Approximate total length m	Preferred length of individual pipes m
356	4.5	API 5L - Grade X42	500	12.144

- (ii) The place of manufacture of the steel plate and strip shall be subject to the approval of the engineer.
- (iii) All steel plates and strip shall be free from seams, cracks, laminations and other injurious defects.
- (iv) The pipe manufacturer shall submit to the engineer the steel maker's certificates covering all steel used. These certificates shall indicate the process of manufacture, the chemical analysis and the physical properties of the steel except that, at the option of the pipe manufacturer, the physical properties of the steel may be determined from specimens taken from finished pipe.

PB 2.2 Dimensional requirements

- (i) Length and mass

The length of individual pipes offered shall be 12 144mm, or as approved by the engineer. The length of pipe supplied shall not vary by more than plus or minus 40 mm.

The mass of the shell shall be calculated on the basis that the mass of steel is 7,843 kg per square metre per mm of thickness.

- (ii) Diameter and circumference

The internal and outside diameters and the circumference of the pipes shall conform to the relevant dimensions and tolerances listed in table 1.

Table 1 : Diameter and circumference of steel pipe shells

Internal diameter (shell without lining)	: 347mm
Outside diameter	: 356mm
Diametral tolerance	: ± 2 mm
Length of ends subject to diametral tolerance	: 100mm
Circumference	: 1 118mm
Circumferential tolerance	: ± 3 mm
Wall thickness	: 4.5mm
Nominal wall thickness tolerance	: +10% or -8%.
Straightness	: < 2 mm for each 3 m in length from a line parallel to the axis of the pipe section

The diametral tolerance is only applicable over the end length given in table 1 measured from each end of the pipe and over the remainder of the pipe out of roundness shall be limited. The maximum outside diameter shall not be more than 1% larger than tabulated and the minimum outside diameter shall not be more than 1% smaller than tabulated.

Forming of the pipe shall be such as to avoid peaks, flats and re-entrants.

(iii) Wall thickness

The nominal wall thickness shall be subject to a tolerance of +10% or -8%.

(iv) Straightness

Finished pipe sections shall be truly straight with walls parallel to the axis of the pipe. Any pipe section with a fault in alignment exceeding 2 mm for each 3 m in length from a line parallel to the axis of the pipe section shall be rejected.

Where two pipe lengths are welded together in the pipe fabrication works, the finished pipe shall be truly straight. Any such pipe with a fault in alignment exceeding 12 mm from a line parallel to the axis of the pipe shall be rejected.

(v) Pipe ends

Pipe ends shall be square to the axis of the pipe, cleanly cut and be free from burrs.

(vi) Pipe ends prepared for field welding

Where pipes are to be joined by field welding, eg for sets, bends and special pipes, the ends shall be bevelled to an angle of $30^\circ \pm 5^\circ$ measured from a plane perpendicular to the axis of the pipe, and shall include a root face of 2 mm $\pm$ 1 mm. The root face of all pipe ends measured across the full diameter of the pipe shall not deviate more than 1,5 mm from squareness to the axis of the pipe.

(vii) Trueness and finish of pipes

All pipes shall be truly cylindrical and free from injurious surface defects, laminations and dents. Any pipe that has flattened areas in the steel wall shall be rejected. Helical forming of strip at the beginning and end of coils and across butt-welds joining coils shall be accurate and true. Flat areas, re-entrants, bamboo effects or dents etc will not be accepted. Special precautions shall be taken to avoid lack of trueness resulting from variations in width of steel strip.

All weld spatters shall be removed by chipping or grinding.

(viii) General

Non-compliance with any of the material or dimensional requirements shall be a cause for rejection of the pipe by the engineer.

PB 2.3 Fabrication requirements

(i) General

The pipes shall be manufactured exclusively by such makers as are approved by the engineer and at only one works unless otherwise agreed to by the engineer in writing.

Pipe sections shall be consecutively numbered from the commencement of fabrication. Each pipe section number shall be punched on the inside of the pipe approximately 20 mm from a longitudinal weld at each end of the pipe and each circumferential weld made at the pipe fabrication works to join pipes shall be marked with the welder's identifying stamp.

The method of manufacture of the pipes shall be submitted for approval by the Engineer. All welding procedures shall be approved by the engineer. All welders and welding operators employed on the work shall have passed an approved qualification test. The contractor shall maintain a record of the procedure, performance and qualification tests.

Full details of welding electrodes and fluxes, where applicable, shall be submitted to the Engineer for approval.

(ii) Forming

Pipes shall be fabricated from plates or strip formed, rolled or pressed to a cylindrical form and with one or more longitudinal or circumferential seam(s), or from strip formed or rolled to a cylindrical form with a helical seam. Circumferential joints shall be at least 1,5 m apart, and the longitudinal welds of mating sections shall be spaced at least 30° apart.

Coil jointing welds in the strip used in the forming of spiral-weld pipes shall be not less than 300 mm from a pipe end.

There shall be no perceptible radial offset (misalignment) of the plate edges in the weld seams.

(iii) Welding

All welding shall be electric fusion welding acceptable to the engineer and shall comply with the following requirements:

1. Uniformity of appearance: All welds shall be substantially uniform in appearance and shall show full fusion and penetration throughout their lengths.
2. Undercut: Welds shall be substantially free from undercut and, if present, the depth of the undercut shall not exceed 12,5% of the nominal wall thickness or 1 mm, whichever is the lesser in depth, and the aggregate length of undercut in any 1 m length of welding shall not exceed 50 mm.
3. Weld bead tolerances: The outer weld bead shall not exceed a height of 3 mm for a nominal wall thickness of 10 mm and under, and shall not exceed a height of 5 mm in pipes having thicker walls. The inner weld bead shall not project more than 1 mm and all excess weld metal shall be removed by grinding to the satisfaction of the engineer. The inner weld beads of a pipe that is to receive an epoxy coating shall have a smooth profile

free from grooves, pin holes, pits, sharp edges, etc and shall merge smoothly into the parent metal. In butt welds made from one side only, a root groove may be present provided that it has a rounded outline and does not penetrate below the level of the adjacent surfaces of the parent plate.

4. Freedom from defects: The weld, heat affected zone and surrounding parent metal shall be free from cracks, porosity cavities and trapped slag.
5. Transverse tensile strength of welded joint: The welded joint shall have an ultimate tensile strength equal to at least 95% of the minimum tensile strength of the parent plate.
6. Resistance to bending: Test specimens prepared and tested in accordance with subclause PB2.4 except at the arisises, shall show no crack (on the outer surface) greater in length than 5 mm in any direction.

PB 2.4 Welding tests

(i) Examinations and testing of welds shall comprise the following:

1. Transverse tensile and guided bend tests carried out on test pieces cut from the welded seam : The tests shall be carried out in accordance with clauses 4.4, 4.5, 4.11, 4.12 and 4.16 of API Standard 5L. Should one of these test samples fail to comply with the relevant requirements, two further specimens of the same type shall be prepared and subjected to the relevant test. If one or both of the retest specimens fail to comply with the relevant requirements further retests shall be carried out until ten consecutive specimens comply with the relevant requirements.
2. Radiographic examination of longitudinal and circumferential welds: Cracks, lack of complete penetration or lack of complete fusion shall be considered injurious defects. The standard for acceptance of minor imperfections such as slag inclusions or gas pockets shall be that specified in clauses 9.2 to 9.13 inclusive of API Standard 5L.

Any weld rejected as a result of radiographic examination may be repaired at the option of the contractor, and such repair shall be carried out in accordance with subclause PB2.6. The repaired weld shall be re-examined. Radiographic re-examination shall extend for the full length of the weld on the plate in which the repair has been carried out.

(ii) General

The facilities and equipment for testing and examining welds that are available at the pipe fabrication works shall be subject to approval by the Engineer. The cost of all tests and repairs to a pipe cut to obtain test strips shall be borne by the contractor.

PB 2.5 Number and type of welding test

The following welding tests shall be carried out:

- (i) Transverse tensile and guided bend test on the first pipe section of each item then on one pipe section in each 500 m of each item.
- (ii) Radiographic examination of the full length (100%) of the longitudinal and circumferential welded seams of the first pipe to prove the procedures. If unsatisfactory results are obtained the successive pipe(s) shall be radiographically examined as detailed above until such procedures are acceptable. Thereafter the full length of all welds on one pipe from each lot of fifty pipes shall be radiographically examined. Should the quality at any time fall below the standard required by the contract then successive pipes shall be radiographically examined until a satisfactory procedure has been re-established.

- (iii) Radiographic examination of full width (100%) of each coil-joining butt weld for helically formed pipe.
- (iv) Radiographic inspection for a length of 400 mm from each end of every longitudinal welded seam and the full length (100%) of every circumferential welded seam made to join pipes into a double length.

PB 2.6 Repair of injurious defects

Repairs of a welded seam shall be permitted during the process of manufacture.

Where repairs are required the defective weld metal shall be cut out, and the parent metal prepared by grinding and re-welded to the satisfaction of the engineer.

The repair procedure and performance, and welders employed on repairs shall be as stated in Appendix B of API Standard 5L. Each repair weld shall be marked with the welder's identifying stamp.

When the repair has been made the full length of the repair shall be examined radiographically.

On discovery of reject welds the engineer may, at his discretion, call for additional radiographic examination until it is shown that the necessary standard is being maintained.

Should a weld repair be required on a pipe subsequent to hydrostatic testing the pipe shall be retested to the test pressure specified.

PB 2.7 Hydrostatic testing of pipes at the factory

Prior to the application of protective coatings and linings, all pipes shall be subject to an approved hydrostatic test to a test pressure determined as follows:

$$P = \frac{2\,000\,t\,f}{D}$$

where

P	=	the test pressure in kPa,
t	=	wall thickness in mm,
f	=	85% of the guaranteed minimum yield strength in MPa for the steel plate, and
D	=	outside diameter of the pipe in mm.

Hydrostatic testing shall not be carried out until all aspects of fabrication have been completed.

The pressure shall be applied steadily by approved means and maintained without variation sufficiently long for proof and inspection. While under the test pressure the pipe shall be struck smartly and repeatedly along its length with a hammer of a mass of not less than 1 kg. The description of the testing apparatus shall be subject to approval by the Engineer.

Should water sweat or ooze from any part or any defects of any nature be discovered the pipe shall be emptied and the defects made good. The pipe shall then be tested again. Should a pipe, after repair, fail to pass the second hydrostatic test the engineer may order its rejection.

The fact that any pipe may have passed the hydrostatic test at the works shall not exempt the contractor from his liabilities under the general conditions of contract.

If a pipe fails to pass any of the above tests it shall be rejected but the engineer may permit repairs or alterations to be made to enable the pipe to pass the test.

The engineer may require one or more pipes to be tested to destruction. If practicable the engineer may require the contractor to repair the pipes and retest them. The cost of repairs will be paid by the employer as an extra to the contract.

PB 2.8 Protective coatings

Protective coatings shall comprise -

- (i) A coherent lining bonded to the inside surface of each pipe in order to prevent corrosion of the inner pipe surface and reduce wall friction,
- (ii) A coherent layer bonded to the outside surface of each pipe in order to prevent corrosion of the outer pipe surface.

Before being placed in the pipe trench and filled with water the pipes may be subjected to temperatures ranging from a minimum of approximately -7°C in winter to a maximum of 35°C in summer.

The materials for the internal coating shall be suitable for the lining of steel pipes, shall provide protection against corrosion and shall not impair the quality of the water passing through the pipeline.

Epoxy coating material shall have the approval of the Department of Health Services and Welfare and shall comply with the requirements of section 3 and column 2 of table 1 of SABS 1217 including the requirements of column 6 of table 1. The contractor shall undertake to ensure that samples of each batch of material used for the internal coating of pipes, specials, sets and bends to be supplied under the contract, are submitted to the South African Bureau of Standards for "chemical fingerprinting". The contractor shall further undertake that should the supplier of the epoxy material contemplate a change in the formulation of the material, further samples of the proposed formulation shall be submitted to the South African Bureau of Standards and the Department of Health Services and Welfare for re-certification and approval. A copy of each "chemical fingerprint" statement and each certificate of approval issued, during the course of the contract, by the South African Bureau of Standards and/or the Department of Health Services and Welfare shall be submitted to Vhembe DM for its approval. A copy of the Board's written approval shall subsequently be handed to the engineer and no pipes shall be approved unless this approval has been accepted by the engineer.

PB 2.9 Surface preparation

Oil and grease shall be removed before shot blasting or wire brushing by scraping, by washing and flushing with an approved solvent such as white spirit and wiping with clean cloths.

Welds shall be ground to a smooth profile with a radius contour of not less than 1 mm. No metal shall be removed below the depth of the surrounding steel plate. Weld spatter shall be removed by chipping or grinding.

The interior of pipes, specials, sets and bends that will receive the epoxy lining system shall be cleaned by steel shot blasting and will not be accepted unless the operation provides a roughened surface with a degree of cleanliness equivalent to BSa 2½ of Swedish Standard SIS 05 59 00. The surface profile amplitude shall have an average which does not exceed 0,1 mm and no individual reading shall exceed 0,15 mm.

All surfaces of pipes, specials, sets and bends that will receive the bituminous coating system shall be cleaned by steel shot blasting and will not be accepted unless the operation provides a roughened surface with a degree of cleanliness equivalent to BSa 2½ of Swedish Standard SIS 05 59 00. The surface profile amplitude shall have a

minimum value of 0,05 mm and shall not exceed 0,2 mm.

The method of preparation and cleaning of the steel pipe shell prior to applying the protective coatings shall be approved by the engineer.

PB 2.10 Internal epoxy lining

The internal surface shall be lined with an approved solvent free epoxy coating (material) applied by a machine designed for the hot application of such material. The machine shall be equipped to heat the two components to the temperature recommended by the coating manufacturer and control the temperature thermostatically within 5°C or better and to accurately meter the components to the mixing head in the prescribed proportions. The components shall be completely mixed and hydraulically sprayed on to the surface. The design shall be such as to prevent gelation of the material in the equipment. The film thickness shall have an average of not less than 300 µm and the minimum thickness at any point shall be 250 µm. Particular care shall be taken to adequately coat weld seams and edges.

PB 2.11 Internal cement-mortar lining**(i) Specification**

The internal surface shall be lined with a cement-mortar lining, which shall be applied in accordance with the American Water Works Association Specification C205-80 or as amended except where the Specification C205-80 is at variance with the requirements of this specification.

(ii) Thickness

The thickness of the cement-mortar lining shall be 12 mm, subject to a tolerance of ± 2 mm.

(iii) Roundness of pipe ends

The pipe ends shall be held truly round during placing and setting of the cement-mortar lining.

(iv) Materials

Cement shall be freshly manufactured ordinary Portland cement in compliance with SABS ENV 197-1.

Sand shall consist of inert granular material and the grains shall be durable and uncoated. The sand shall be well graded and pass a 1.5 mm mesh screen. Sand shall be free from injurious amounts of clay, lumps, shale, soft or flaky particles, mica, loam, oil, alkali or other deleterious substances. The total mass of such substances shall not exceed 3%. The source of the sand shall be approved by the engineer.

Water shall be clean and free from injurious amounts of mud, oil, organic materials or other deleterious substances. Admixtures may be used provided the additive will not injuriously affect the water quality and written approval has been obtained from the engineer. The contractor shall submit test data to substantiate admixture performance.

The proportions shall be determined from the characteristics of the aggregate. Measurement of the materials shall be by mass and the water:cement ratio shall be controlled and kept to a minimum, with an allowance being made as necessary for the most effective machine operation and adhesion of mortar to the pipe.

PB 2.12 External fusion bonded medium density polyethylene coating

The external surface shall be coated with an approved fusion bonded medium density polyethylene coating, such as

Sintakote II or approved equivalent. The coating shall be applied in accordance with AS 4321: "Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings".

The pipe shall be placed into a preheat oven where the temperature of the steel is raised to processing temperature, after which it shall then be picked up and dipped into a fluidised bath of polyethylene powder. On contact the powder shall melt and fuse to the pipe's external surface. The pipe shall be rotated and held in the bath until the required coating thickness is reached.

The coating thickness shall not be less than stated below:

Pipe OD (mm)	Minimum thickness (mm)
Up to and including 273mm diameter	: 1.6mm
Over 273mm diameter up to and including 508mm diameter	: 1.8mm
Over 508mm diameter up to and including 762mm diameter	: 2.0mm
Over 762mm diameter	: 2.3mm

PB 2.13 Extent of coating

The coatings shall be cut back cleanly from the ends of the pipe for a distance of 100mm. The engineer reserves to himself the right to modify the extent of the coating if required.

PB 2.14 Welding into double lengths

Two pipes may be welded into a double length by setting and lining up the pipes on rollers and jointing the pipes by butt welding. The welding shall comply with subclause PB2.3(iii) and the completed weld shall be tested over its full length in accordance with subclauses PB2.4 and PB2.5.

When the jointing weld has been accepted by the engineer the internal and external coatings shall be made good after cleaning off all slag, weld spatter and damaged coating material.

PB 2.15 Completing coatings at double length joint

FBMDPE coating

Following the completion of welding the weld area shall be cleaned in accordance with subclause PB 2.9. A radiation-cross-linked polyethylene modified wrap-around heat-shrinkable sleeve not less than 425mm in width shall then be applied in accordance with ANSI/AWWA C216 and the sleeve manufacturer's recommendations.

After preheating, a thin film of Denso WPC primer shall be applied to any visible bare steel and onto the FBMDPE coating for a distance of 100 mm. The sleeve shall overlap the FBMDPE coating for a minimum length of 100 mm on either side of the coating.

The specified preheat and postheat is necessary to ensure satisfactory bonding of the sleeve. A roller shall be used to eliminate voids from under the sleeve. The repair shall be visually inspected to ensure that it is in intimate contact with the pipe and that a bead of mastic has exuded from each end of the sleeve for the full pipe circumference. If this is not in evidence additional heating shall be required.

PB 2.16 Examination of coatings

After the application of the coatings each pipe shall be examined by the contractor in the presence of the engineer both visually and by means of a thickness meter and a Holiday detector of the correct type and rating for the particular coating system. Insufficient coating thickness and Holidays revealed shall be marked with chalk and repaired to the

satisfaction of the engineer. The equipment that will be available to carry out Holiday detection shall be subject to approval by the engineer.

On one pipe in each batch of fifty pipes the contractor shall carry out, in the presence of the engineer, the following tests in accordance with the test methods set out in SABS 1178:

Section 7.3.2 : Peel test

Section 7.3.3 : Condition of bitumen

PB 2.17 Repair of external coating

(i) FBMDPE coating:

Small areas of damage to a FBMDPE coating can be repaired by the application of a patch whereas larger areas may be repaired by the application of a heat shrinkable polyethylene sleeve. Oxygen and acetylene shall not be used to heat the coating as heating in this way can degrade the MDPE material.

PB 2.18 Specials

Specials, such as tees, bends, tapers, etc, shall comply with the requirements of clause PB2 insofar as they are applicable. They shall be reinforced such that the stress in the fitting under the prescribed test pressure does not exceed 55% of the yield stress of the steel. They shall be protected in accordance with sub-clauses PB2.8 to PB2.17 inclusive except that manual application may be carried out where application by machine is not possible.

Specials shall where practicable be submitted to the hydraulic test specified. Where the hydraulic test is not practicable, the paraffin test laid down in clause 17 of BS 534 shall be applied. In addition to the paraffin test, a radiographic examination of the full length of all welds shall be carried out. The results of all such examinations must meet with approval of the inspector.

PB 2.19 Pipe records

The contractor shall maintain a record, in an approved form, showing the pipe serial and delivery numbers, the steel cast number for the plate used in each pipe section, the date of fabrication and hydrostatic testing together with the actual test pressure and details of defects and subsequent repairs. Each record shall be signed by the engineer and shall be available for reference by the engineer during all working hours. At the end of the contract, all records shall be delivered to the engineer.

PB 2.20 Marking

The contractor shall ascertain the category of steel plate from which the pipe is fabricated from the internal stamped identifying marks and apply a 100mm wide painted band of the relevant identifying colour around the end of the pipe. In addition a second band, 50mm wide, denoting the wall thickness of the steel plate shall be painted around the end of the pipe. The details of the painted identifying bands shall be in accordance with the standard colour code for marking steel pipes.

The diameter in mm, overall length in m, mass in kg and the words "VHEMBE DM" shall be painted on the outside of each pipe. The reference number on the delivery schedule, which need not be the same as the pipe number, shall be painted at each end and in the middle of the pipe on the outside. All lettering shall be not less than 100 mm high.

PB 2.21 Delivery of pipes

The contractor responsible for the supply and delivery of the pipes shall make all arrangements for transporting the pipes from the place of manufacture to the site. The tendered rates for pipes shall include for the transport from the

Contractor's Paraph

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Client Paraph

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place of manufacture.

The contractor shall ensure that the work is not delayed due to lack of pipes and fittings by placing orders with the suppliers as soon as possible after the acceptance of his tender. The contractor shall immediately notify the engineer in writing should the actual time of delivery exceed the time of delivery as tendered. No extension of time shall be considered should the contractor fail to comply with any of the two requirements as stated.

PB 2.22 Storage of pipe at place of application of protective coatings

A pipe that has been completed and has passed the final inspection shall be stored at the place of coating until it can be accepted on the site. The pipe shall be placed on approved supports in a demarcated area which has been cleared of all vegetation and treated with an effective weed killer. The support shall be arranged so that the bearing area is adequate to prevent damage to the external coating. Bags filled with sawdust shall not be used to support pipes.

Each pipe end shall be enclosed with a white polyethylene sheet cover secured to the pipe by a metal strap. The cover shall be perforated to allow flow of a small quantity of air through the pipe.

During inclement weather or for any other reason that may prevent acceptance of pipe deliveries at the site, the engineer may instruct that pipes be stored at the place of coating.

PB 2.23 Protection of pipe during transporting

The pipe shall be protected against damage at all stages during its transport from the works to the site of delivery. The pipe shall be lifted by means of broad band slings and the use of chains, wire ropes, etc will not be permitted. Wooden chock blocks at least 150mm wide and suitably padded for the pipes to rest on shall be provided on each transport vehicle.

The manufacturer shall ensure that the ends of the pipes are properly protected from damage during all stages of handling and transporting of the pipes. The cost of such protection shall be included in the tendered rates.

PB 2.24 Repair of damaged pipes

When pipes are delivered to site the contractor shall inspect the pipes for damage before off-loading commences. Once the contractor has satisfied himself that pipes are undamaged and suitable for installation, he shall arrange for off-loading of the pipes and take, on behalf of the Employer, ownership of the off-loaded pipes. All damage to a pipe and/or its internal and external coating that may subsequently occur shall be repaired at the expense of the Contractor.

PARTICULAR SPECIFICATION**PC SUPPLY OF VALVES****CONTENTS**

PC 1	SCOPE
PC 2	GENERAL REQUIREMENTS
PC 3	GATE VALVES
PC 4	BUTTERFLY VALVES
PC 5	REFLUX VALVES
PC 6	MEASUREMENT AND PAYMENT

PC 1 SCOPE

This specification covers the design, manufacture and supply of gate valves, butterfly valves, air valves and reflux valves for use in pressure pipelines.

PC 2 GENERAL REQUIREMENTS**PC 2.1 Design Pressure**

Each valve is assigned a design pressure elsewhere in these documents and shall be tested in relation to these pressures as specified. The design pressure shall be hard stamped on the edge of a flange of each valve.

PC 2.2 Test Pressures

Valve bodies shall be subjected to closed-end tests at pressures of 1,5 times the design pressure. Test pressures shall be maintained for not less than 5 minutes duration and valve bodies shall be watertight in all respects.

Complete valves shall be subjected to open-end tests at pressures of 1,5 times the design pressure for material strength and soundness. Drop tightness is not a requirement for this test.

Complete valves shall be subjected to open-end tests for drop tightness at pressures from zero (0) to 1,0 times the design pressure. Valves shall be drip tight over the complete range of pressures.

PC 2.3 Other tests

The integrity of the bodies of all valves to be supplied under this contract shall be subjected to ultrasonic testing and a certificate shall accompany each valve or batch of valves to certify that the valve has been tested and found to be sound.

PC 2.4 Design Life

All valves and appurtenant fittings shall be designed for a useful life of 45 years under the operating conditions indicated elsewhere in the documents.

PC 2.5 Flanges

Valves shall be flanged and drilled off-centre to B.S. 4504 or SANS 1123, unless otherwise stated elsewhere. Flanges shall have flat joint faces machined in accordance with B.S. 4504 or SANS 1123. All flange faces to have a gramophone finish.

Sufficient clearance shall be allowed between the body and the flange to enable flange bolts to be tightened.

Tapped holes shall only be permissible where stiffening ribs interfere with bolting.

PC 2.6 Jointing Materials

Valves shall be supplied complete with bolts, nuts, washers and gaskets for joining up to adjacent mating flanges. Bolts shall be of sufficient length for at least 2 and maximum 4 screw threads to protrude outside nuts when assemblies are fully tightened.

PC 2.7 Contact between Dissimilar Metals

Suitable insulation materials shall be used on the contact faces between dissimilar metals of which the potential difference exceeds 0,3 volts.

PC 2.8 Painting of Valves

A pipe lining epoxy shall be used to coat all internal and external cast-iron, cast-steel and mild steel components of valves in accordance with SANS 1217 with the following provisions:

- (a) Only non-metallic abrasives shall be used for surface preparation. It shall not be recycled after the first use. All blow/deep holes in cast iron surfaces shall be drilled out and filled with solvent free epoxy filler before applying the epoxy coating(s).
- (b) Minimum dry film thicknesses:
Internal 300 micrometers.
External 300 micrometers.
Flange faces 125 micrometers.
- (c) All internal surfaces shall be pinhole free.

PC 2.9 Inspection

The inspection of valves shall be carried out by the Engineer or his representative in the manufacturer's works. The Supplier or Manufacturer shall give at least 2 weeks prior notification to the Engineer of the dates of inspection.

The Manufacturer or Supplier shall provide all labour, materials and facilities required for inspection free of charge.

The Engineer's inspection shall in no way relieve the Supplier or Manufacturer from any of his obligations to design, manufacture and supply valves of superior quality and workmanship in accordance with the specification.

PC 3 GATE VALVES**PC 3.1 Type**

Valves shall be double flanged, wedge gate or RSV, internal (non-rising) spindle types of which gates shall be completely clear of the waterway in the fully open position.

PC 3.2 Standards

SANS 664 and SANS 191 shall apply as and where applicable and where not in contradiction to this specification.

PC 3.3 Opening and Closing

Closure of valves shall be by clock wise rotation of spindles or hand wheels.

All gate valves shall be capable of being opened or closed under an unbalanced pressure equal to design pressure.

The effort required on hand wheels to open or close valves under these conditions shall not exceed 250 N in the case of valves up to 300 mm NB and shall not exceed 400 N in the case of larger valves.

PC 3.4 Materials**PC 3.4.1 Valve Bodies and Gates**

Valve bodies and gates shall be of cast-iron or cast-steel. Cast-iron shall conform to SANS 936 grade SG38/SG42 or SANS1034 grade 300 minimum. Cast-steel shall conform to BS3100. Test specimens shall be submitted on request free of charge.

PC 3.4.2 Other Valve Components

Spindles shall be of high strength stainless steel.

Body and gate sealing rings shall be of stainless steel, bronze or zinc-free gunmetal, unless otherwise specified because of the nature of the water.

Gate position indicators, i.e. marking plates and needles shall be of cast aluminium or cast brass.

Channel guides and shoes shall be in bronze or zinc-free gunmetal or stainless steel as specified in the Schedule of Quantities.

PC 3.5 Construction**PC 3.5.1 Body**

The body shall be of rugged design with substantial ribs to minimize distortion under pressure where necessary.

Where gearing is provided, bodies shall be designed and manufactured to withstand any additional stresses with an ample margin of safety.

PC 3.5.2 Gate

One face of the gate shall be marked, corresponding to a similar mark on the body, to ensure correct replacement after removal.

The gate shall operate satisfactorily under the conditions specified.

PC 3.5.3 Sealing faces

Body and gate seals shall be of design and construction such that would prevent seals becoming loose or water passing behind seals under all conditions of operation and test. This feature must be proved at tendering stage by suitable drawings and documentation.

The leading edges of sealing rings shall be slightly chamfered.

PC 3.5.4 Spindles and hand wheels

The spindle thrust collar shall bear against a ball thrust bearing of approved design, details of which shall be furnished at tendering stage.

Provision shall be made for glands to be repackable under pressure without shutting off the water.

Unless otherwise specified all valves shall be fitted with caps complying with SANS 664.

PC 3.5.5 Gearing

Gears shall be robust and machine cut and mountings shall be of substantial design and manufacture.

All gears with ratios 1:3 and lower shall be provided with easily replaceable shear pins to prevent damage to the valves if excessive force is applied. A spare pin shall be attached to each valve.

All lubricating points shall be fitted with nipples for grease-gun lubrication.

PC 4. BUTTERFLY VALVES**PC 4.1 Type**

Valves shall be double flanged, full bore types. Wafer types shall not be acceptable. Valves shall be capable of operating at any opening without variation of disc position and there shall be no flutter of the disc.

PC 4.2 Standards

B.S. 5155 shall apply as and where applicable and where not in contradiction to this specification.

PC 4.3 Opening or Closing

Closure of valves shall be by clock wise rotation of hand wheels.

All valves shall be capable of being opened or closed under an unbalanced pressure equal to design pressure.

The effort required on hand wheels to open or close valves under these conditions shall not exceed 400 N.

Discs shall close with a positive action with no possibility of slamming shut during any stage of the closing operation.

Bottom part of disc shall open in downstream direction.

PC 4.4 Materials

Valve bodies shall be cast-iron or cast-steel or may be of fabricated steel construction. Cast-iron shall conform to SANS 936 grade SG38/SG42 or SANS 1034 grade 300 minimum. Cast steel shall conform to BS3100. Steel shall conform to BS4360 grade 43A

Discs shall be of cast-iron or cast-steel to the above requirements.

Test specimens shall be submitted on request free of charge.

Disc shafts or stub-shafts shall be of high strength stainless steel conforming to A.I.S.I. 431 or equivalent and shall be attached to valve discs by means of stainless steel securing elements.

Resilient seals shall have non-weathering, non-sticking, long life properties and shall be compatible with the quality of water to be conveyed.

Resilient seal securing elements and seal seats and its securing elements shall be of stainless steel.

PC 4.5 Construction

PC 4.5.1 Body

Hubs for shaft-bearing housings shall be integral with the valve body.

Valve bodies shall have adjustable mechanical stops to prevent over-travel of the valve disc in the open or closed position. These stops may be incorporated in the actuator.

PC 4.5.2 Disc

Discs shall be a single casting of approved hydrofoil section and smooth continuous surfaces. The maximum combined stresses in the disc shall not exceed 20 % of the minimum yield stress of the material used when the specified unbalanced pressure is applied on any of the two sides.

PC 4.5.3 Seals and seats

Valve water seals shall be one of the following types:

- (a) A resilient seal fixed to the edge of the disc by securing elements and a stainless steel seat non resilient seal fixed onto the body,
- (b) a resilient seal fixed to the body of the valve and the edge of the disc protected by a stainless steel insert fixed in the edge of the disc to act as seat (non-resilient seal).

The profiles of seats shall be smooth and continuous and shall provide adequate "lead-in" for the resilient seal during closure of the disc.

Seals and seats shall be of a design which would prevent same of becoming loose or would permit passage of water under seals or seats during all conditions of operation and test.

PC 4.6.4 Shafts

Shafts shall be continuous or may be of the stub-shaft type. If of the stub-shaft type, each stub shaft shall extend into the disc hub for a distance of at least 1,5 shaft diameters.

Shafts shall be attached to discs by means of keys, dowel pins, taper pins or any combination of the three and the connection shall be designed to transmit shaft torque equivalent to at least 75 % of the torsional strength of the shaft. Dowel and taper pins shall be mechanically secured.

PC 4.6.5 Bearings

Sleeve type bearings shall be fitted in the hubs in the valve body.

These bearings shall be self-lubricating with a proven record of dependable operation of not less than 5 years.

Each valve shall be fitted with at least one adjustable thrust bearing set to hold the disc securely concentric with the body seat or seal.

PC 4.6.6 Stuffing boxes

Stuffing box assemblies shall be such that the packing can be adjusted or replaced without disturbing any part of the valve or operator assembly.

PC 4.6.7 Position indicators

Each actuator shall be equipped with accurate indicators to show clearly the fully open or closed positions and the 1/4, 1/2 and 3/4 intermediate open positions.
Indicators shall be of robust, rigid and corrosion resistant design with all markings embossed.

PC 5. REFLUX VALVES**PC 5.1 Type**

Valves shall be double flanged for horizontal installation in pipelines to minimize reflux action and to reduce water hammer in rising mains and shall be one of the following types as specified in the Schedule of Quantities.

- (a) Single sloping swing door for sizes up to 400 mm N.B.

PC 5.2 General Requirements

The valves shall have minimum hydraulic resistance, shall not be subject to gate or disc flutter and shall give rapid non-slam closure on reversal of flow. Preference shall be given to design which allows removal of doors or discs for inspection of doors or discs and seals without removal of the valve assembly from line. Valves shall be free from external moving parts.

PC 5.3 Materials

Valve bodies shall be of cast-iron or cast-steel. Cast iron shall conform to SANS 936 grade SG38/SG42 or SANS grade 300 minimum. Cast-steel shall conform to BS 3100.

Doors and discs shall be of zinc-free gunmetal or cast-steel to the above requirements.
Test specimens shall be submitted on request, free of charge.

Swing door or disc hinge spindles shall be of high strength stainless steel conforming to A.I.S.I. 431 or equivalent.

Valve body seats and sealing faces on doors or discs shall be of stainless steel, zinc-free gunmetal or bronze or nickel.

PC 5.4 Construction**PC 5.4.1 Body**

Bodies shall be of sound and robust design and shall be shaped to give the minimum change in waterway.

Designs of bodies and body seals shall be free from pockets to cause eddies or to accumulate debris.

Special care shall be taken that foreign objects like bolts cannot lodge themselves in pockets on the downstream side of body seats and thereby prevent doors from closing fully.

Access openings and covers shall be well designed and creation of stress raisers shall be prevented.

PC 5.4.2 Doors and discs

Doors and discs shall be cast as a unit with integral cast hinge lugs.

Doors and discs shall operate freely, but shall be restricted in its travel by the provision of substantial stops fitted with approved rubber facings to prevent wear due to metal contact. The rubber facings shall be vulcanised onto the metal and secured by corrosion resistant countersunk screws. Details shall be submitted with tenders.

The doors or discs shall have continuous hinge spindles which shall be supported at their ends in substantial bearings.

Each spindle is to be extended through a stuffing box on one side of the body only and a pointer is to be fitted to the extended spindle so that the open and closed positions of doors or discs are indicated on an embossed brass or cast-aluminium indicator plate.

PC 5.4.3 Sealing faces

Sealing faces shall be securely fixed with corrosion resistant elements or shall be deposit welded with stainless steel.

Faces shall be accurately machined and finished to meet the requirements of Sub-clause 2.2.

PC 5.4.4 Bearings

Main bearings shall be external and accessible without emptying or removal from line of the valve body.

Bearings shall be of substantial design and shall be designed to take the unbalanced thrust on doors or discs in the open-ended test for material strength and soundness.

Bearings shall have a long life and retain a low coefficient of friction. Any possibility of bearings becoming tight during service or due to ageing shall be eliminated.

Where possible, bearings shall be water lubricated. Full particulars of type and construction of bearings shall be submitted at tendering stage.

PC 6 MEASUREMENT AND PAYMENT

Valves shall be measured and paid for as per payment references included in Particular Specification PA – Construction of Steel Pipelines

PARTICULAR SPECIFICATION**PD ENVIRONMENTAL PROTECTION AND CONTROL SPECIFICATIONS****CONTENTS**

PD1	PLANS
PD2	USE OF LAND
PD3	VEGETATION CLEARANCE
PD4	PROTECTION OF VEGETATION
PD5	PROTECTION OF FAUNA
PD6	ARCHAEOLOGICAL ARTEFACTS
PD7	SCENIC QUALITY
PD8	WORKING AREA
PD9	ACCESS ROADS
PD10	FIRES
PD11	FENCING
PD12	TOPSOIL
PD13	BORROW PITS AND QUARRIES
PD14	EROSION PREVENTION
PD15	EARTHWORKS
PD16	SPOIL AND WASTE MATERIAL
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PD19	REFUSE DISPOSAL
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PD22	ENVIRONMENTAL AWARENESS OF EMPLOYEES
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PD24	SUBCONTRACTED WORK
PD25	MEASUREMENT AND PAYMENT

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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PD1 PLANS

Prior to establishment of the site camp(s), the Contractor shall produce a plan showing the positions of all buildings, laydown yards, vehicle wash areas, fuel storage areas, batching areas and other infrastructure for approval by the Engineer or the Environmental Officer.

PD2 USE OF LAND

The Contractor shall not use the land forming the Site of, or connected with the Works, for any purpose whatsoever other than for the proper carrying out of the Works under the Contract and shall place any camps that may be required for himself and his employees only on sites approved by the Engineer. No trees or bushes shall be damaged or cut down by the Contractor or by any of his employees whether for use on the Works or otherwise without the written consent of the Engineer or the Environmental Officer and then only where and in the manner as they may direct.

PD3 VEGETATION CLEARANCE**PD3.1 Woody vegetation**

Prior to the start of construction, woody vegetative matter shall be stripped. This material shall either be spread randomly throughout the surrounding veld so as to provide biomass for other micro organisms and habitats for small mammals and birds, or it may be stockpiled for later redistribution over the reinstated topsoiled surface.

No vegetative matter shall be burnt or removed for firewood.

PD3.2 Herbaceous vegetation

During clearing of woody vegetation no basal cover or grass and topsoil shall be removed and damage to this layer shall be minimised as far as possible.

PD4 PROTECTION OF VEGETATION

The Contractor shall ensure that all works are undertaken in such a manner that vegetation outside the Works area is not damaged under any circumstances.

PD4.1 Vegetation outside the Works area

The following provisions shall apply with respect to the protection of areas of vegetation adjacent to the marked Works areas:

No tree or shrub outside of the Works area shall be felled, lopped, cut or pruned without the prior written approval of the Engineer or the Environmental Officer.

No tree or shrub outside the Works area shall be felled, lopped, cut or pruned until it has been clearly marked for this purpose by the Engineer or the Environmental Officer. The method of marking will be specified by the Engineer or the Environmental Officer, and the Contractor will be informed in writing.

No tree outside the Works area shall be burned for any reason.

For every tree protected by these specifications which is removed or, in the opinion of the Engineer or

Environmental Officer, is unduly damaged by the Contractor, the Contractor shall pay a penalty of R5 000.00 per tree to the client.

PD4.2 Vegetation within or adjacent to the Works area

No tree or shrub within the works area shall be felled, lopped, cut or pruned without the prior written approval of the Engineer or the Environmental Officer.

Trees which have been selected for preservation by the Engineer or the Environmental Officer within or adjacent to the Works areas shall be fenced around their drip line. The fence shall be clearly marked with danger tape. No open fires shall be allowed within this fenced area, nor shall vehicles be parked underneath these trees.

If trees are located within the working width of the pipeline, the pipeline shall be aligned to avoid these trees wherever possible.

PD4.3 Transplantation of rare and endangered plant species

Prior to vegetation clearing any rare or endangered plant species which have been identified by the Environmental Officer or Engineer must be removed and transplanted as instructed by these persons.

PD4.3.1 Transplanting of small trees (1 to 1,5 m height) and small shrubs (0,5 to 1 m height).

- a) Trees and shrubs shall only be transplanted between the months April and September. Deciduous trees and shrubs shall be transplanted only when they are in a leafless condition.
- b) Holes for transplanting trees and shrubs shall be dug before these plants are dug out. Trees shall be planted in holes of 1 m x 1 m x 1 m and shrubs shall be transplanted in holes of 600 mm x 600 mm x 600 mm.
- c) Trees and shrubs shall be planted so that their stems or trunks are at the same depth as in their original location. The orientation of the transplanted plants must be the same as in their original location (i.e. the north-facing side must remain north-facing).
- d) Transplanted plants shall be pruned to limit transpiration. Plants shall also be sprayed with an evapotranspiration retardant liquid if they are evergreen.
- e) Transplanted plants shall be watered once a week for 5 weeks and thereafter once every 2 weeks.

PD4.3.2 Transplanting of Aloes, succulents and bulbous plants

- a) Aloes, succulents and evergreen bulbous plants may be transplanted at any time of the year. Deciduous bulbous plants shall be transplanted when they are leafless.
- b) Aloes and bulbous plants shall be planted in similar soil conditions and to the same depth as they were before removal.
- c) Transplanted aloes and bulbs shall be watered once directly after transplanting to settle the soil.

PD4.4 Alien vegetation

The Contractor shall remove all alien vegetation from the works area for the duration of construction. Such vegetation will be identified by the Environmental Officer and the method of eradication will be specified by him.

PD5 PROTECTION OF FAUNA

The Contractor shall ensure that all Works are undertaken in a manner which minimizes the impact on the local fauna and shall apply the following specifications with respect to fauna management and protection:

Under no circumstances shall any animals be handled, removed, killed or interfered with by the Contractor, his employees, his subcontractors or his subcontractors' employees.

The Contractor and his employees shall not bring any domestic animals onto the site.

The Contractor shall ensure that the work site is kept clean and tidy and free from rubbish which would attract animal pest species.

There shall be no feeding of animals.

The Contractor shall ensure that domestic and native animals belonging to the local community are kept away from unprotected works.

PD6 ARCHAEOLOGICAL ARTEFACTS

The Contractor shall engage an archaeologist to demarcate archaeological sites identified during the impact study.

Archaeological sites shall be protected by a three strand fence which will be at least 2 m outside the extremities of the site. The fence shall be clearly marked with danger tape.

Should the Contractor expose any archaeological artefacts during excavation, work on the area where the artifacts were found shall cease immediately and the Engineer or the Environmental Officer shall be notified as soon as possible.

Upon receipt of such notification, the Engineer or the Environmental Officer will arrange for the excavation to be examined by an Archaeologist as soon as practicable. Acting upon advice from the Archaeologist, the Engineer will advise the Contractor of necessary actions to be taken. The Engineer will take all necessary actions to ensure that delays are minimized.

Under no circumstances shall archaeological artifacts be removed, destroyed or interfered with by the Contractor, his employees, his subcontractors or his subcontractors' employees.

The Contractor shall ensure that none of his employees gain access to any archaeological areas (whether fenced or unfenced), except when authorised to do so by the Engineer or the Environmental Officer.

PD7 SCENIC QUALITY

The Contractor shall not establish or undertake any activities which, in the opinion of the Resident Engineer or Environmental Officer, are likely to adversely affect the scenic quality of the area. The Engineer may direct the Contractor to refrain from such activities or to take ameliorative actions to reduce the adverse effect of such activities on the scenic quality of the environment.

No painting or marking of natural features shall be done. Marking for surveying and other purposes shall only be done with pegs and beacons.

All cut and fill forms shall be rounded at the edges to blend them with the surrounding landforms.

All packed rock and exposed rock cuttings shall be treated in order to blend their colour with the colours of the natural weathered rocks of the adjacent environment.

PD8 WORKING AREA

The area of construction along the pipeline shall be contained within a 15 m servitude.

The servitude shall be temporarily fenced for the portion under construction at anyone time. The fence shall be progressively erected and removed as the work proceeds. The location and extent of the fence shall be determined by the Engineer or the Environmental Officer.

PD9 ACCESS ROADS

No new permanent access roads shall be developed by the Contractor other than those determined or approved by the Engineer.

Existing roads shall be used as far as possible for inspection purposes.

Topsoil shall be stripped as described under item PD12 "Topsoil" prior to construction and reinstated on completion of use of the road.

The temporary access road shall form part of the 15 m working width servitude.

Horse and trailer vehicles transporting pipes may not turn in areas of cultivated lands but shall turn in areas specifically identified by the Engineer or the Environmental Officer.

PD10 FIRES

No open fires shall be permitted except in areas specifically prepared and controlled for this purpose.

PD11 FENCING

Fencing shall be erected around sensitive natural or cultural elements to protect them from damage. No pedestrian or vehicular access shall be allowed to such fenced areas.

In places where temporary fencing is required, the Contractor shall erect such fencing when and where required by the Site Engineer, and re-erect and maintain temporary fencing as necessary. Temporary fencing shall remain in position either until it is replaced by permanent fencing or until completion of the whole of the Works, unless the Contractor requires, or the Engineer or the Environmental Officer directs, its earlier removal. The Contractor shall erect and maintain the aforementioned temporary fencing in the locations and for the period described in the Contract.

If temporary fencing is removed temporarily for the execution of any part of the Works it shall be reinstated as soon as practicable by the Contractor.

The clearing for permanent fencing shall be limited to the removal of trees and shrubs within 1m of the fence line. There shall be no removal of the grass cover or topsoil within this width.

Any fences damaged by the Contractor shall be repaired as soon as practicable at his cost.

PD12 TOPSOIL**PD12.1 Source of topsoil**

Topsoil shall be stripped from all areas that are to be utilized during the construction period and where permanent structures and access is required. These areas will include all areas to be excavated, temporary and permanent access roads, construction camps and borrow pits. Topsoil shall be stripped after clearing of woody vegetation and before excavation or construction commences.

The topsoil is regarded as the top 300 mm of the soil profile irrespective of the fertility and composition of the soil.

PD12.2 Topsoil stripping

Soil shall be stripped to a minimum depth of 150 mm or to the depth of bedrock where soil is shallower than 150 mm. Herbaceous vegetation, overlying grass and other fine organic matter shall not be removed from the stripped soil.

No topsoil which has been stripped shall be buried or in any other way be rendered unsuitable for further use.

Topsoil shall only be stripped when it is in a dry condition in order to prevent compaction.

PD12.3 Topsoil stockpiling

Stripped topsoil shall be stockpiled on sites adjacent to where it has been stripped which have been approved by the Engineer. Soil stockpiles shall not take the form of windrows, unless this can be placed far enough away from the working area. This is to prevent the soil from being spread out or mixed with the other spoil during construction.

Topsoil stripped from different soil zones shall be stockpiled separately and clearly identified as such. Topsoil obtained from different sites shall not be mixed.

Soil stockpiles shall not be higher than 2,5 m, and the slopes of soil stockpiles shall not have a vertical: horizontal gradient exceeding 1:2,5.

No vehicles shall be allowed access onto the stockpiles after they have been placed. Topsoil stockpiles shall be clearly demarcated in order to prevent vehicle access and later identification as the resource for rehabilitation and vegetation establishment.

Soil stockpiles shall not be allowed to become contaminated with oil, diesel, petrol, garbage or any other material which may inhibit the later growth of vegetation in the soil.

After topsoil stockpiling has been completed, the Contractor shall apply soil conservation measures to the stockpiles to the approval of the Engineer or Environmental Officer.

PD12.4 Topsoil placement

Topsoil shall be placed to a minimum depth of 150 mm over all areas where it has been stripped and over disused borrow pits after construction in those areas has ceased. Topsoil placement shall be done concurrent with construction as soon as construction in an area has ceased.

All areas onto which topsoil is to be spread shall be graded to the approximate original landform with maximum slopes of 1:2,5 and shall be ripped prior to topsoil placement. The entire area to be topsoiled shall be ripped parallel to the contours to a minimum depth of 150 mm.

Topsoil shall be placed in the same soil zone from which it had been stripped. However, if there is insufficient topsoil available from a particular soil zone to produce the minimum specified depth, topsoil of similar quality may be brought from other reservoir sites.

Where insufficient topsoil that has been stripped by the Contractor to provide the minimum specified depth, the Contractor shall obtain suitable substitute material from other sources at no cost to the employer. The suitability of the substitute material shall be determined by means of a soil analysis which is acceptable to the Engineer or the Environmental Officer.

No vehicles shall be allowed access onto topsoil after it has been placed.

After topsoil placement is complete, cleared and stockpiled vegetation matter shall be spread randomly by hand over the topsoiled area as instructed by the Environmental Officer.

PD13 BORROW PITS AND QUARRIES

If a borrow pit is to be developed or an existing one is to be extended, all topsoil from the area that is to be quarried must be stripped and stored for later rehabilitation of the pit.

Stripping and excavation actions shall be progressive in such manner that those parts of a borrow pit or quarry where work is complete can be rehabilitated while other areas are still being quarried.

Cut slopes of borrow pits and quarries shall not have a vertical: horizontal gradient of not steeper than 1 :3, preferably 1 :5.

Borrow pits shall be used as dump sites for excess rock spoil. On completion of spoiling the pits shall be reshaped and covered with a layer of topsoil. On no account may spoil or rock be placed in drainage ways without prior consent being obtained from the Engineer.

Stormwater cut off drains shall be provided at the top of the cut slope, where identified as necessary by the Engineer, to prevent erosion of the rehabilitated surface of the borrow pit or quarry.

No borrow pit shall be used as a dump site for refuse material or for toxic material ego cement, oil, diesel, rubber and similar materials.

PD14 EROSION PREVENTION

The Contractor shall take measures, to the approval of the Engineer, to ensure that there is no undue stormwater damage and soil erosion resulting from the construction activities inside and outside the construction camp and Works areas.

Surface stormwater shall, where possible, not be allowed to be concentrated and to flow down cut or fill slopes without erosion protection measures being in place.

Overflow and/or scour channels shall be lined with stone pitching along their length and at their points of discharge to prevent soil erosion. The point of discharge shall be at a point where there is dense natural grass cover. These channels shall not discharge straight down the contours but shall be aligned at such an angle to the

contours that they have the least possible gradient.

PD15 EARTHWORKS

All cut and fill forms should be rounded on the edges to allow them to blend with the surrounding landforms.

PD16 SPOIL AND WASTE MATERIAL

The Contractor shall load and haul excess spoil to fill in the borrow pits or to dump sites approved by the Engineer. The dumped material must be finally rounded off to have slopes not steeper than 1 :3.

The Contractor shall remove all foundations and similar waste and transport all such waste material off site to dump areas which have been approved by the Engineer.

PD17 BLASTING

Contractor shall take measures to limit flying rock during blasting operations.

Fly rock 150 mm and larger which falls beyond the cleared working area shall be collected and removed together with the rock spill.

When blasting under power lines the Contractor shall arrange for power to be temporarily switched off or have the lines moved or comply with the requirements of ESCOM who will be advised in reasonable time of the intention to blast.

PD18 PREVENTION OF OIL POLLUTION

Waste run-off water from the vehicle wash bays, workshops and diesel/fuel tank areas shall be collected in a series of covered conservancy tanks with oil baffles/oil traps. The oil sludge thus collected shall be disposed of at an approved toxic waste disposal site. Water from conservancy tanks shall be drained to retention areas to allow silt settlement.

Above mentioned areas should be dished concrete floor slabs which drain into the conservancy tanks.

All spillage of oil onto concrete surfaces shall be controlled by the use of an approved absorbent material such as Oclansorb or Drizit.

All old oils shall be retained for re-cycling by the supplier.

All soil contaminated by oil, fuel, etc. shall be collected immediately and disposed of at an acceptable disposal site to the approval of the Engineer or the Environmental Officer .

PD19 REFUSE DISPOSAL

The Contractor shall dispose of all refuse generated by him or his subcontractor on a weekly basis at an approved refuse disposal site.

PD20 ABLUTION FACILITIES

Portable toilets shall be placed within easy access of the Contractor's employees. These shall be moved to follow the progression of the Works.

PD21 CLEARANCE OF SITE ON COMPLETION

On completion of the Works the Contractor shall clear away and remove from the works area all constructional plant, surplus rock and other materials, foundations, plumbing and other fixtures, rubbish and temporary works of every kind. Areas thus cleared shall be graded and scarified to restore the ground to its original profile as near as practicable before topsoil placement.

PD22 ENVIRONMENTAL AWARENESS OF EMPLOYEES

The Contractor shall arrange that all his employees and those of his subcontractors receive environmental training before the commencement of construction to the satisfaction of the Engineer or Environmental Officer, in order that these employees:

- a) acquire a basic understanding of the key environmental features of the work site and environs;
- b) are thoroughly familiar with the requirements of the Environmental Protection and Control Specifications as they apply to the Works;
- c) receive basic training in the identification of archaeological artifacts, and rare and endangered flora and fauna that may be encountered along the route;
- d) are made aware of any other environmental matters which are deemed to be necessary by the Engineer or the Environmental Officer.

PD23 COMPLIANCE WITH ENVIRONMENTAL PROTECTION SPECIFICATIONS

All persons employed by the Contractor or his subcontractors shall abide by the requirements of these Specifications as they apply to the works.

Any employees of the Contractor or his subcontractors found to be in breach of any of the Environmental Protection Specifications may be ordered by the Engineer to leave the site forthwith. The order may be given orally or in writing. Confirmation of an oral order will be given as soon as practicable but lack of confirmation in writing shall not be a cause for the offender to remain on site. No extension of time will be granted for any delay or impediment to the ". Contractor brought about by a person ordered to leave the site.

Supervisory staff of the Contractor or his subcontractors shall not direct any person to undertake any activities which would place such person in contravention of the Environmental Protection and Control Specifications.

For every tree protected by these specifications which is removed or, in the opinion of the Engineer or the Environmental Officer, is unduly damaged by the Contractor, the Contractor shall pay a penalty of R5 000.00 per tree.

PD24 SUBCONTRACTED WORK

Subcontractors and their employees shall comply with all the requirements of the Environmental Protection and Control Specifications that apply to the Contractor. Absence of specific reference to the subcontractor in any specification does not imply that the subcontractor is not bound by that specification.

PD25 MEASUREMENT AND PAYMENT

The reinstatement of borrow pits, pipe trenches and work areas shall be included in the contractor's rates for

earthworks and excavations. Erosion protection such as construction of berms for stormwater drainage shall be included in the rates for pipe trenches and excavations of earthworks. Only gabions, where instructed by the Engineer will be paid separately.

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PARTICULAR SPECIFICATION**PAB LABOUR INTENSIVE CONSTRUCTION METHODS****PAB-1 SCOPE**

The execution of a Contract through the utilization of Labour Intensive Construction methods entails the economically efficient employment of as great a number unskilled and skilled labour from the local community as is technically feasible throughout the construction process to achieve the standard demanded by the specification; the result being a significant increase in employment being generated per unit of expenditure by comparison with conventional equipment intensive methods. It also includes the training of local labour as a step to self-support and development of the community.

PAB-2 INTERPRETATIONS**PAB-2.1 Definitions**

"Labour Intensive Construction" means the economically efficient employment of as great a portion of the local community as is technically feasible to produce as high a standard of construction as demanded by the specifications and allowed by the funding available, thus effectively substituting labour with equipment. The employment of people from the community will be at different levels of skills considering the available skills of the unemployed members of the community.

"Steering Committee" means a committee established in the project area representing all interested and affected parties in the project area.

"Labour Desk Officer (LDO)" means a person appointed by the steering committee for liaison between the Contractor and the local community on labour issues only".

"Liaison officer", wherever it is used, shall have the same meaning as "Labour Desk Officer".

The following definitions shall also apply to labour-intensive work:

Task	:	A quantified activity or operation.
Daily Task	:	A task that is required to be completed within the time constraints of a normal working day
Task work	:	Work paid for on the completion of a predetermined task.
Daily rate	:	The remuneration of a day's work, regardless of output.
Daily wage	:	See daily rate.
Task rate	:	The remuneration for a completed task
Daily task rate	:	The remuneration for a completed daily task.

Refer to the "New Framework Agreement for Labour Intensive Construction in Civil Engineering – Criteria and Guidelines."

PAB-3 LIAISON WITH COMMUNITY

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PAB-3.1 Community Liaison

In order to ensure that the use of local skills and employment of local labour proceeds smoothly, the Contractor shall liaise with the local community through the LDO. All decisions regarding identification and hiring of labour, relieving labour of their duties, local problems and other matters of local importance shall be made in consultation with the LDO. A monthly meeting with the community representatives shall be arranged by the Contractor to be attended also by the Engineer's and Employer's representatives and the Project Steering Committee

PAB-3.2 Employment of Labour

The actual persons to be employed shall be agreed upon in consultation with the community representatives through the LDO. In order to ensure that the project is economically viable and the employment of labour is not merely a "hand-out" to the local community, it is important that payment of the labour force is linked to productivity by utilising the "task-work" principle, i.e. the labour force is rewarded for tasks completed within an agreed time and to an agreed standard.

PAB-4 CONDITIONS OF TEMPORARY LABOUR EMPLOYMENT

The following conditions shall apply to the appointment of temporary labour from the community:

Minimum rate of payment per day for task-related activities : To be confirmed and submitted to Engineer
Holiday pay : Nil

Notice of termination of temporary employment

In accordance with Department of Labour Regulations

Severance pay : Nil
Workman's compensation Act (WCA) benefits : Applicable

Any change to these conditions, which affect the cost of the Works, will be negotiated with the Contractor at the time of change. The Contractor shall submit detailed daily labour returns to the Engineer indicating the numbers of temporary local personnel employed on the Works and the activities on which they were engaged.

The rate of payment to local labour will be based on the specified productivity levels. The Engineer's representative will monitor productivity to ensure that this principle is complied with.

The rate of payment to local labour for the various tasks as agreed upon with the Project Steering Committee and labour, based on the principles of the **EPWP**, shall also include Unemployment Insurance Fund (UIF) contributions for the duration of the labourer's employment on this project. UIF registration cards must be issued to all labourers.

PAB-5 LABOUR INTENSIVE CONSTRUCTION METHODS

PAB-5.1 DESCRIPTION OF THE WORKS

Employer's objectives

The employer's objectives are to deliver public infrastructure using labour intensive methods.

Labour-intensive works

Labour-intensive works comprise the activities described in the Labour-Intensive Specification. Such works shall be constructed using local workers who are temporarily employed in terms of this scope of work.

PAB-5.2 LABOUR INTENSIVE COMPETENCIES OF SUPERVISORY AND MANAGEMENT STAFF

Established contractors shall only engage supervisory and management staff in labour intensive works who, has either completed, or for the period 1 April 2004 to 30 June 2005, are registered for training towards, the skills programme outlined in Table 1.

Emerging contractors shall have personally completed, or be registered on a skills programme for the NQF level 2 unit standard. All other site supervisory staff in the employ of emerging contractors must have completed, or be registered on a skills programme for, the NQF level 2 unit standards or NQF level 4 unit standards.

Table 1: Skills programme for supervisory and management staff

Personnel	NQF level	Unit standard titles	Skills programme description
Team leader / supervisor	2	Apply Labour Intensive Construction Systems and Techniques to Work Activities	This unit standard must be completed, and
		Use Labour Intensive Construction Methods to Construct and Maintain Roads and Stormwater Drainage	any one of these 3 unit standards
		Use Labour Intensive Construction Methods to Construct and Maintain Water and Sanitation Services	
		Use Labour Intensive Construction Methods to Construct, Repair and Maintain Structures	
Personnel	NQF level	Unit standard titles	Skills programme description
Foreman/ supervisor	4	Implement labour Intensive Construction Systems and Techniques	This unit standard must be completed, and
		Use Labour Intensive Construction Methods to Construct and Maintain Roads and Stormwater Drainage	any one of these 3 unit standards

		Use Labour Intensive Construction Methods to Construct and Maintain Water and Sanitation Services	
		Use Labour Intensive Construction Methods to Construct, Repair and Maintain Structures	
Site Agent / Manager (i.e the contractor's most senior representative that is resident on the site)	5	Manage Labour Intensive Construction Processes	Skills Programme against this single unit standard

Details of these skills programmes may be obtained from the CETA ETQA manager
(e-mail:gerard@ceta.co.za , tel: 011-265 5900)

PAB-5.3 **EMPLOYMENT OF UNSKILLED AND SEMI-SKILLED WORKERS IN LABOUR-INTENSIVE WORKS**

PAB-5.3.1 Requirements for the sourcing and engagement of labour.

- 1.1.1 Unskilled and semi-skilled labour required for the execution of all labour intensive works shall be engaged strictly in accordance with prevailing legislation and SANS 1914-5, Participation of Targeted Labour.
- 1.1.2 The rate of pay set for the SPWP is set as per the rates for the Limpopo Province from SAFCEC.
- 1.1.3 Tasks established by the contractor must be such that:
 - a.) the average worker completes 5 tasks per week in 40 hours or less; and
 - b.) the weakest worker completes 5 tasks per week in 55 hours or less.
- 1.1.4 The contractor must revise the time taken to complete a task whenever it is established that the time taken to complete a weekly task is not within the requirements of 1.1.3.
- 1.1.5 The Contractor shall, through all available community structures, inform the local community of the labour intensive works and the employment opportunities presented thereby. Preference must be given to people with previous practical experience in construction and / or who come from households:
 - a) where the head of the household has less than a primary school education;
 - b) that have less than one full time person earning an income.
 - c) where subsistence agriculture is the source of income.
 - d) those who are not in receipt of any social security pension income.
- 1.1.6 The Contractor shall endeavour to ensure that the expenditure on the employment of temporary workers is in the following proportions:

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- a) 60 % women;
- b) 20% youth who are between the ages of 18 and 35; and
- c) 2% on persons with disabilities.

PAB-5.3.2 Specific provisions pertaining to SANS 1914-5

PAB-5.3.2.1 Definitions

Targeted labour: Unemployed persons who are employed as local labour on the project.

PAB-5.3.2.2 Contract participation goals

- (i) There is no specified contract participation goal for the contract. The contract participation goal shall be measured in the performance of the contract to enable the employment provided to targeted labour to be quantified.
- (ii) The wages and allowances used to calculate the contract participation goal shall, with respect to both time-rated and task rated workers, comprise all wages paid and any training allowance paid in respect of agreed training programmes.

PAB-5.3.2.3 Terms and conditions for the engagement of targeted labour

Further to the provisions of clause 3.3.2 of SANS 1914-5, written contracts shall be entered into with targeted labour.

PAB-5.3.2.4 Variations to SANS 1914-5

- (i) The definition for nett amount shall be amended as follows:

Financial value of the contract upon completion, exclusive of any value added tax or sales tax which the law requires the employer to pay the contractor.
- (ii) The schedule referred to in 5.2 shall in addition reflect the status of targeted labour as women, youth and persons with disabilities and the number of days of formal training provided to targeted labour.

PAB-5.3.3 Training of targeted labour

- (i) The contractor shall provide all the necessary on-the-job training to targeted labour to enable such labour to master the basic work techniques required to undertake the work in accordance with the requirements of the contract in a manner that does not compromise worker health and safety.
- (ii) The cost of the formal training of targeted labour shall be funded by the local office of the Department of Labour. This training shall take place as close to the project site as practically possible. The contractor must access this training by informing the relevant regional office of the Department of Labour in writing, within 14 days of being awarded the contract, of the likely number of persons that shall undergo training and when such training is required. The Employer and the Department of Public Works (Fax: 012 3258625/ EPWP Unit, Private Bag X65, Pretoria 0001) must be furnished with a copy of this request.
- (iii) The contractor shall do nothing to dissuade targeted labour from participating in training programmes and shall take all reasonable steps to ensure that each beneficiary is provided with two days of formal training for every 22 days worked.

- (iv) An allowance equal to 100% of the task rate or daily rate shall be paid by the contractor to workers who attend formal training, in terms of 1.3.3 above.
- (v) Proof of compliance with the requirements of 1.3.2 to 1.3.4 must be provided by the Contractor to the Employer prior to submission of the final payment certificate.

PAB-5.4 GENERIC LABOUR INTENSIVE SPECIFICATION

(This specification must be incorporated in the Scope of Works without amendment or modification. When SANS 1921-5, *Construction and management requirements for works contracts Part 5: Earthworks activities which are to be performed by hand*, is published, the earthworks portions of this generic specification must be replaced with a reference to SANS 1921-5 and its associated specification data)

Scope

This specification establishes general requirements for activities which are to be executed by hand involving the following:

- a) trenches having a depth of less than 1.5 metres
- b) stormwater drainage
- c) low-volume roads and sidewalks

Precedence

Where this specification is in conflict with any other standard or specification referred to in the Scope of Works to this Contract, the requirements of this specification shall prevail.

Hand excavatable material

Hand excavatable material is material:

- a) **Granular materials:**
 - i) materials of which the consistency, when profiled may in terms of **Table 1** be classified as very loose, loose, medium dense, or dense; or
 - ii) where the material is a gravel having a maximum particle size of 10mm and contains no cobbles or isolated boulders, no more than 15 blows of a dynamic cone penetrometer is required to penetrate 100mm;
- b) **Cohesive materials:**
 - i) material of which the consistency, when profiled may in terms of table 1 be classified as very soft, soft, firm, stiff and stiff / very stiff; or
 - ii) where the material is a gravel having a maximum particle size of 10mm and contains no cobbles or isolated boulders, no more than 8 blows of a dynamic cone penetrometer is required to penetrate 100mm;

Note: 1) A boulder, a cobble and gravel is material with a particle size greater than 200mm, between 60 and 200mm.

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c) Dynamic Cone Penetrometer (DCP)

A dynamic cone penetrometer is an instrument used to measure the in-situ shear resistance of a soil comprising a drop weight of approximately 10 kg which falls through a height of 400mm and drives a cone having a maximum diameter of 20mm (cone angle of 60° with respect to the horizontal) into the material being used.

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Table 1: Consistency of materials when profiled

GRANULAR MATERIALS		COHESIVE MATERIALS	
CONSISTENCY	DESCRIPTION	CONSISTENCY	DESCRIPTION
Very loose	Crumbles very easily when scraped with a geological pick.	Very soft	Geological pick head can easily be pushed in as far as the shaft of the handle.
Loose	Small resistance to penetration by sharp end of a geological pick.	Soft	Easily dented by thumb; sharp end of a geological pick can be pushed in 30-40 mm; can be moulded by fingers with some pressure.
Medium dense	Considerable resistance to penetration by sharp end of a geological pick.	Firm	Indented by thumb with effort; sharp end of geological pick can be pushed in up to 10 mm; very difficult to mould with fingers; can just be penetrated with an ordinary hand spade.
Dense	Very high resistance to penetration by the sharp end of geological pick; requires many blows for excavation.	Stiff	Can be indented by thumb-nail; slight indentation produced by pushing geological pick point into soil; cannot be moulded by fingers.
Very dense	High resistance to repeated blows of a geological pick.	Very stiff	Indented by thumb-nail with difficulty; slight indentation produced by blow of a geological pick point.

Trench excavation

All hand excavatable material in trenches having a depth of less than 1,5 metres shall be excavated by hand.

Compaction of backfilling to trenches (areas not subject to traffic)

Backfilling to trenches shall be placed in layers of thickness (before compaction) not exceeding 100mm. Each layer shall be compacted using hand stampers

- to 90% Proctor density;
- such that in excess of 5 blows of a dynamic cone penetrometer (DCP) is required to penetrate 100 mm of the backfill, provided that backfill does not comprise more than 10% gravel of size less than 10mm and contains no isolated boulders, or
- such that the density of the compacted trench backfill is not less than that of the surrounding undisturbed soil when tested comparatively with a DCP.

Excavation

All hand excavatable material including topsoil classified as hand excavatable shall be excavated by hand. Harder material may be loosened by mechanical means prior to excavation by hand.

The excavation of any material which presents the possibility of danger or injury to workers shall not be excavated by hand.

Clearing and grubbing

Grass and small bushes shall be cleared by hand.

Shaping

All shaping shall be undertaken by hand.

Loading

All loading shall be done by hand, regardless of the method of haulage.

Haul

Excavation material shall be hauled to its point of placement by means of wheelbarrows where the haul distance is not greater than 150 m.

Offloading

All material, however transported, is to be off-loaded by hand, unless tipper-trucks are utilised for haulage

Spreading

All material shall be spread by hand.

Compaction

Small areas may be compacted by hand provided that the specified compaction is achieved.

Grassing

All grassing shall be undertaken by sprigging, sodding, or seeding by hand.

Stone pitching and rubble concrete masonry

All stone required for stone pitching and rubble concrete masonry, whether grouted or dry, shall be collected, loaded, off loaded and placed by hand.

Sand and stone shall be hauled to its point of placement by means of wheelbarrows where the haul distance is not greater than 150m.

Grout shall be mixed and placed by hand.

Manufactured Elements

Elements manufactured or designed by the Contractor, such as manhole rings and cover slabs, pre-cast concrete planks and pipes, masonry units and edge beams shall not individually, have a mass of more than 320kg. In addition the items shall be large enough so that four workers can conveniently and simultaneously acquire a proper hand hold on them.

PAB-6 TRAINING**PAB-6.1 Competent Employees**

With the assistance of the Project Steering Committee (PSC) and the appointed Labour Desk Officer (LDO) a skills audit shall be conducted amongst the unemployed members of the community to assist the Contractor to identify unskilled and skilled labour in the local community.

PAB-6.2 Training of labour

It is a condition of this contract that formal training of semi-skilled as well as unskilled labour be provided to develop skills and to enhance their ability to secure future employment of similar nature. The cost of accredited training of labour must be covered in the rates and prices as tendered for under items in this Contract.

Each local labourer must be furnished with a letter of employment record as approved by the Engineer on completion of the project.

PAB-6-3 Training Programme

Details of the training programme shall be determined on completion of the skills audit through which the competency levels of the available skills shall be determined. This information shall be utilized to determine the level of training required.

PARTICULAR SPECIFICATION**PP DEALING WITH ESKOM SERVICES**

- PP-1 The Contractor is responsible for liaison with and compliance with Eskom's requirements regarding works in close proximity to or crossing of Eskom Services. Contractor is responsible for any damage done to Eskom Services by the Contractor's staff or labourers, or sub-contractors.
- PP-2 Eskom's rights, services and equipment must be acknowledged at all times and may not be interfered or tampered with.
- PP-3 All work within Eskom's servitude area must be done in accordance with the requirements of the Occupational Health and Safety Act, Act No 85/1993. Special attention must be given to the clearances between Eskom's conductors, structures, cables and electrical apparatus and the proposed construction work.
- PP-4 No mechanical equipment, including mechanical excavators and high lifting machinery, may be used within Eskom's servitude area, or within close proximity of Eskom's services and equipment, without prior permission in writing and supervision of Eskom's authorised area representative. Permission must be obtained at least 10 (ten) days prior to the commencement of any work or blasting within the servitude area.
- PP-5 No construction work may be executed closer than 6 metres from any of Eskom's power line structures or stay wires.
- PP-6 Eskom shall not be liable for the death of or injury to any person or for the loss of or damage to any property caused in whatsoever manner by the Contractor, his employees, agents or contractors. The Contractor indemnifies Eskom against all claims including claims for consequential damages by third parties which, includes but is not limited to claims as a result of damage to, or interruption of or interference with Eskom's services or equipment. The Contractor's attention is drawn to section 27(3) of the Electricity Act of 1987.
- PP-7 Eskom shall at all times have unobstructed access to and from its servitude area and power line structures.
- PP-8 Prior to the commencement of work, the Contractor must obtain permission from the registered owner of the property over which Eskom's servitude is registered.
- PP-9 Enquiries regarding Eskom Services in the Phiphidi area should be made with the Local Authorities in Thohoyandou.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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PARTICULAR SPECIFICATION

PQ DEALING WITH TELKOM SERVICES

- PQ-1 The Contractor shall be fully responsible for liaison with and compliance with Telkom's requirements regarding works in close proximity to or crossing of Telkom's services.
- The Contractor shall be responsible for any damage caused to Telkom services by the Contractor's staff or labourers, or sub-contractor's staff or labourers.
- PQ-2 Supervision by Telkom staff is required for any construction close to Telkom services and must be arranged in advance with Telkom in Thohoyandou whichever office may be responsible for services in his area.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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PARTICULAR SPECIFICATION**REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS****CONTENTS**

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1.0 INTRODUCTION

In terms of the Construction Regulation 4(1) (a) of the Occupational Health and Safety Act, No. 85 of 1993, VHEMBE DISTRICT Municipality, as the Client, is required to compile a Health & Safety Specification for any intended project and provide such specification to any prospective tenderer.

The Client's further duties are as in 3.1.1. below and in the Construction Regulations, 2003.

This specification has as objective to ensure that Principle Contractors entering into a Contract with the Vhembe District Municipality, achieve an acceptable level of OH&S performance. This document forms an integral part of the Contract and Principle and other Contractors should make it part of any Contracts that they may have with Contractors and/or Suppliers.

Compliance with this document does not absolve the Principle Contractor from complying with minimum legal requirements and the Principle Contractor remains responsible for the health & safety of his employees and those of his Mandatories.

2.0 SCOPE

Development of a health & safety specification that addresses all aspects of occupational health and safety as affected by the abovementioned contract work.

The specification will provide the requirements that Principle Contractors and other Contractors will have to comply with in order to reduce the risks associated with the abovementioned contract work that may lead to incidents causing injury and/or ill health, to a level as low as reasonably practicable.

3.0 GENERAL OCCUPATIONAL HEALTH & SAFETY PROVISIONS**3.1. Hazard Identification & Risk Assessment (Construction Regulation 7)****3.1.1. Risk Assessments**

Annexure 3 contains a list of Risk Assessment headings that have been identified by the VHEMBE DISTRICT Municipality as possibly applicable to the abovementioned contract work. It is, by no means, exhaustive and is offered as assistance to Contractors intending to tender.

3.1.2. Development of Risk Assessments

Every Principle Contractor performing Construction work shall, before the commencement of any Construction work or work associated with the aforesaid Construction work and during such work, cause a Risk Assessment to be performed by a competent person, appointed in writing, and the Risk Assessment shall form part of the OH&S Plan and be implemented and maintained as contemplated in Construction regulation 5(1).

The Risk Assessment shall include, at least:

- the identification of the risks and hazards to which persons may be exposed to the analysis and evaluation of the risks and hazards identified
- a documented plan of safe work procedures to mitigate, reduce or control the risks and hazards that have been identified
- a monitoring plan and
- a review plan

- 3.1.2.1 Based on the Risk Assessments, the Principal Contractor must develop a set of site-specific OH&S rules that will be applied to regulate the OH&S aspects of the construction.

The Risk Assessments, together with the site-specific OH&S rules must be submitted to the VHEMBE DISTRICT MUNICIPALITY before mobilization on site commences.

Despite the Risk Assessments listed in Annexure 7, the Principle Contractor is required to conduct a baseline Risk Assessment and the aforesaid listed Risk Assessments must be incorporated into the base-line Risk Assessment. The baseline Risk Assessment must further include the Standard Working procedures (SWP) and the applicable Method Statements based on the Risk Assessments.

All out-of-scope work must be associated with a Risk Assessment.

3.1.3. Review of Risk Assessments

- 3.1.3.1. The Principal Contractor is to review the Hazard Identification, Risk Assessments and SWP's at each Production Planning and Progress Report meeting as the Contract work develops and progresses and each time changes are made to the designs, plans and construction methods and processes.
- 3.1.3.2. The Principal Contractor must provide the Client, other Contractors and all other concerned-parties with copies of any changes, alterations or amendments as contemplated in 3.1.3.1. above.

3.2. Legal Requirements

All Contractors entering into a Contract with the VHEMBE DISTRICT Municipality shall, as a minimum, comply with the:

- Occupational Health & Safety Act and Regulations (Act 85 of 1993). A current, up-to-date copy of the OHS Act must be available on site at all times.

- Compensation for Occupational Injuries & Diseases Act (Act 130 of 1993). The principle Contractor will be required to submit a letter of Registration and “good-standing” from the Compensation Insurer before being awarded the Contract. A current, up-to-date copy of the COID Act must be available on site at all times.
- Where work is being carried out on mines’ premises the Contractor will have to comply with the Mine Health & Safety Act and Regulations (Act. 29 of 19960 and any other OH&S requirements that the mine may specify. A current, up-to-date copy of the OHS Act must be available on site at all times.

3.3. Structure and Responsibilities

3.3.1 Overall Supervision and Responsibility for OH&S

- * It is a requirement that the Principle Contractor, when he appoints Contractors (Sub-contractors) in terms of Construction Regulations 5(3), (5), (9), (10) and (12) he includes an OHS Act Section 37(2) agreement: “Agreement with Mandatory” in his agreement with such Contractors.
- * Any OH&S Act (85 /1993), Section 16(2) appointee/s as detailed in his/her/their respective appointment forms.

3.3.2. Further (Specific) Supervision Responsibilities for OH&S

The Contractor shall appoint designated competent employees and/or other competent persons as required by the Act and Regulations. Below is a list of identified appointments and may be used to select the appropriate appointments for the current contract:

Ref. Section/Regulation in OHS Act

Batch Plant Supervisor	(Construction Regulation 6(1)
Construction Vehicles/Mobile Plant/Machinery Supervisor	(Construction Regulation 21)
Demolition Supervisor	(Construction Regulation 12)
Drivers/Operators of Construction Vehicles/Plant	(Construction Regulation 21)
Electrical Installation and Appliances Inspector	(Construction Regulation 22)
Emergency/Security/Fire Coordinator	(Construction Regulation 27)
Excavation Supervisor	(Construction Regulation 11)
Explosive Powered Tool Supervisor	(Construction Regulation 19)
Fall Protection Supervisor	(Construction Regulation 8)
First Aider	(General Safety Regulation 3)
Fire Equipment Inspector	(Construction Regulation 27)
Formwork & Support work Supervisor	(Construction Regulation 10)
Hazardous Chemical Substances Supervisor	(HCS Regulations)
Incident Investigator	(General Admin Regulation 29)
Ladder Inspector	(General Safety Regulation 13A)
Lifting Equipment Inspector	(Construction Regulation 20)
Materials Hoist Inspector	(Construction Regulation 17)
OH&S Committee	(OHS Act Section 19)
OH&S Officer	(Construction Regulation 6(6)
OH&S Representatives	(OHS Act Section 17)
Person Responsible for Machinery	(General Machinery Regulation 2)
Scaffolding Supervisor	(Construction Regulation 14)
Stacking & Storage Supervisor	(Construction Regulation 26)
Structures Supervisor	(Construction Regulation 9)
Suspended Platform Supervisor	(Construction Regulation 15)
Tunneling Supervisor	(Construction Regulation 13)

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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Vessels under Pressure Supervisor
Working on/next to Water Supervisor
Welding Supervisor

(Vessels under Pressure Regulations)
(Construction Regulation 24)
(General Safety Regulation 9)

The appointments must be in writing and the responsibilities clearly stated together with the period for which the appointment is made. This information must be communicated and agreed with the appointees.

Copies of appointments must be submitted to VHEMBE DISTRICT Municipality together with concise CV's of the appointees. All appointments must be officially approved by VHEMBE DISTRICT Municipality. Any changes in appointees or appointments must be communicated to VHEMBE DISTRICT Municipality forthwith.

The Principle Contractor must, furthermore, provide the VHEMBE DISTRICT Municipality with an organogram of all Contractors that he/she has appointed or intends to appoint and keep this list updated on a weekly basis.

Where necessary, or when instructed by the VHEMBE DISTRICT Municipality or an Inspector of the Department of Labour, the Principle Contractor must appoint a competent OH&S Officer subject to the approval of the VHEMBE DISTRICT Municipality.

In addition the VHEMBE DISTRICT Municipality may require that a Traffic Safety Officer be appointed for any project.

3.3.3. Designation of OH&S Representatives (Section 18 of the OHS Act)

- 3.3.3.1. Where the Principal Contractor employs more than 20 persons (including the employees of other Contractors (sub-contractors) he has to appoint one OH&S Representatives for every 50 employees or part thereof. General Administrative Regulation 6, requires that the appointment OR election and subsequent designation of the OH&S Representatives are executed in consultation with Employee Representatives or Employees (Section 17 of the Act and General Administrative Regulation 6 & 7).
- 3.3.3.2. OH&S Representatives have to be designated in writing and the designation must include the area of responsibility of the person and term of the designation.

3.3.4. Duties and Functions of the OH&S Representatives (Section 19 of the OHS Act)

- 3.3.4.1. The Principal Contractor must ensure that the designated OH&S Representatives conduct a minimum monthly inspection of their respective areas of responsibility using a checklist and report thereon to the Principal Contractor
- 3.3.4.2. OH&S representatives must be included in accident/incident investigations
- 3.3.4.3. OH&S representatives must attend all OH&S committee meetings.

3.3.5. Appointment of OH&S Committee (Section 20 of the OHS Act)

- 3.3.5.1. The Principal Contractor must establish an OH&S Committee consisting of all the designated OH&S Representatives together with a number of management representatives that are not allowed to exceed the number of OH&S representatives on the committee and a representative of the Client who shall act as the chairman without a vote. The members of the OH&S committee must be appointed in writing.
- 3.3.5.2. The OH&S Committee must meet minimum monthly and consider, at least, the following Agenda:

1. Opening & Welcome
2. Present/Apologies/Absent
3. Minutes of previous Meeting

4. Matters Arising from the previous Minutes
5. OH&S Reps Reports
6. Incident Reports & Investigations
7. Incident /Injury Statistics
8. Other Matters
9. Endorsement of Registers and other statutory documents by a representative of the Principal Contractor
10. Close/Next Meeting

3.4. Administrative Controls and the Occupational Health & Safety File

3.4.1. The OH&S File (Construction Regulation 5 (7))

As required by Construction Regulation 5(7), the Principle Contractor and other Contractors will each keep an OH&S File on site containing the following documents as a minimum:

- * Notification of Construction Work (Construction Regulation 3.)
- * Copy of OH&S Act (updated) (General Administrative Regulation 4.)
- * Proof of Registration and good standing with a COID Insurer (Construction Regulation 4 (g))
- * OH&S Programme agreed with the Client including the underpinning Risk Assessment/s & Method Statements (Construction regulation 5 (1))
- * Copies of OH&S Committee and other relevant Minutes
- * Designs/drawings (Construction Regulation 5 (8))
- * A list of Contractors (Sub-Contractors) including copies of the agreements between the parties and the type of work being done by each Contractor (Construction Regulation 9)
- * Appointment/Designation forms as per 3.1.1. and 3.1.2. above.
- * Registers as follows:
 - * Accident/Incident Register (Annexure 1 of the General Administrative Regulations)
 - * OH&S Representatives Inspection Register
 - * Asbestos Demolition & Stripping Register
 - * Batch Plant Inspections
 - * Construction Vehicles & Mobile Plant Inspections by Controller
 - * Daily Inspection of Vehicles. Plant and other Equipment by the Operator/Driver/User
 - * Demolition Inspection Register
 - * Designer's Inspection of Structures Record
 - * Electrical Installations, -Equipment & -Appliances (including Portable Electrical Tools)
 - * Excavations Inspection
 - * Explosive Powered Tool Inspection, Maintenance, Issue & Returns Register (incl. cartridges & nails)
 - * Fall Protection Inspection Register
 - * First Aid Box Contents
 - * Fire Equipment Inspection & Maintenance
 - * Formwork & Support work Inspections
 - * Hazardous Chemical Substances Record
 - * Ladder Inspections
 - * Lifting Equipment Register
 - * Materials Hoist Inspection Register
 - * Machinery Safety Inspection Register (incl. machine guards, lock-outs etc.)
 - * Scaffolding Inspections
 - * Stacking & Storage Inspection
 - * Inspection of Structures
 - * Inspection of Suspended Platforms
 - * Inspection of Tunnelling Operations

Contractor's Paraph

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Client Paraph

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- * Inspection of Vessels under Pressure
- * Welding Equipment Inspections
- * Inspection of Work conducted on or Near Water
- * All other applicable records

VHEMBE DISTRICT Municipality will conduct an audit on the OH&S file of the Principle Contractor from time-to-time.

3.5. OH&S Goals & Objectives & Arrangements for Monitoring & Review of OH&S Performance

The Principal Contractor is required to maintain a CIFR of at least 8 (See Annexure 1. to this document: "Measuring Injury Experience) and report on this to VHEMBE DISTRICT MUNICIPALITY on a monthly basis

3.6. Notification of Construction Work (Construction Regulation 3.)

The Principle Contractor must, where the Contract meets the requirements laid down in Construction Regulation 3, within 5 working days, notify the Department of Labour of the intention to carry out construction work and use the form (Annexure A in the Construction Regulations) for the purpose. A copy must be held on the OH&S File and a copy must be forwarded to VHEMBE DISTRICT MUNICIPALITY for record keeping purposes.

3.7. Training, Awareness and Competence

The contents and syllabi of all training required by the Act and Regulations are to be included in the Principal Contractor's OH&S Plan.

3.7.1. General Induction Training

All members of Contractor's Site management as well as all the persons appointed as responsible for OH&S in terms of the Construction and other Regulations will be required to attend a general induction session by the Client

All employees of the Principal and other Contractors to be in possession of proof of General Induction training.

3.7.2. Site Specific Induction Training

The Principle Contractor will be required to develop Contract work project specific induction training based on the Risk Assessments for the Contract work and train all employees and other Contractors and their employees in this.

All employees of the Principal and other Contractors to be in possession of proof of Site Specific OH&S Induction training at all times.

3.7.3. Other Training

3.7.3.1. All operators, drivers and users of construction vehicles, mobile plant and other equipment to be in possession of valid proof of training.

3.7.3.2. All employees in jobs requiring training in terms of the Act and Regulations to be in possession of valid proof of training as follows:

3.7.3.2.1. OH&S Training Requirements: (as required by the Construction Regulations and as indicated by the OH&S Specification & the Risk Assessment/s):

- * General Induction (Section 8 of the Act)
- * Site/Job Specific Induction (also visitors) (Sections 8 & 9 of the Act)
- * Site/Project Manager
- * Construction Supervisor

- * OH&S Representatives (Section 18 (3) of the Act)
- * Training of the Appointees indicated in 3.3.1. & 3.3.2. above
- * Operators & Drivers of Construction Vehicles & Mobile Plant (Construction Regulation 21)
- * Basic Fire Prevention & Protection (Environmental Regulations 9 and Construction regulation 27)
- * Basic First Aid (General Safety Regulations 3)
- * Storekeeping Methods & Safe Stacking (Construction Regulation 26)
- * Emergency, Security and Fire Co-coordinator

3.7.4. Awareness &Promotion

The Principle Contractor is required to have a promotion and awareness scheme in place to create an OH&S culture in employees. The following are some of the methods that may be used:

- Toolbox Talks (Also see 3.8.6. below)
- OH&S Posters
- Videos
- Competitions
- Suggestion schemes
- Participative activities such as OH&S Safety circles.

3.7.5. Competence

- 3.7.5.1. The Principle Contractor shall ensure that his and other Contractors personnel appointed are competent and that all training required to do the work safely and without risk to health, has been completed before work commences
- 3.7.5.2. The Principle Contractor shall ensure that follow-up and refresher training is conducted as the contract work progresses and the work situation changes.
- 3.7.5.3. Records of all training must be kept on the OH&S File for auditing purposes.

3.8. Consultation, Communication and Liaison

- 3.8.1. OH&S Liaison between the Client, the principal Contractor, the other Contractors, the Designer and other concerned parties will be through the OH&S committee as contemplated in 3.3.3. above
- 3.8.2. In addition to the above, communication may be directly to the Client or his appointed Agent, verbally or in writing, as and when the need arises.
- 3.8.3. Consultation with the workforce on OH&S matters will be through their Supervisors, OH&S Representatives, the OH&S committee and their elected Trade Union Representatives, if any.
- 3.8.4. The Principal Contractor will be responsible for the dissemination of all relevant OH&S information to the other Contractors e.g. design changes agreed with the Client and the Designer, instructions by the Client and/or his/her agent, exchange of information between Contractors, the reporting of hazardous/dangerous conditions/situations etc.
- 3.8.5. The Principle Contractor will be required to do Site Safety Walks with VHEMBE DISTRICT MUNICIPALITY at least on a basis to be determined between the two parties.
- 3.8.6. The Principle and other Contractors will be required to conduct Toolbox Talks with their employees on a weekly basis and records of these must be kept on the OH&S File. Employees must acknowledge the receipt of Toolbox Talks which record must, likewise be kept on the OH&S File.
- 3.8.7. The Principle Contractors most senior manager on site will be required to attend all VHEMBE DISTRICT MUNICIPALITY OH&S meetings and

3.8.8. a list of dates, times and venues will be provided to the Principle Contractor by VHEMBE DISTRICT MUNICIPALITY.

3.9. Checking, Reporting and Corrective Actions

3.9.1. Monthly Audit by Client (Construction Regulation 1(d))

VHEMBE DISTRICT MUNICIPALITY will be conducting a Monthly Audit to comply with Construction Regulation 4(1)(d) to ensure that the principal Contractor has implemented and is maintaining the agreed and approved OH&S Plan.

3.9.2. Other Audits and Inspections by VHEMBE DISTRICT MUNICIPALITY:

VHEMBE DISTRICT MUNICIPALITY reserves the right to conduct other ad hoc audits and inspections as deemed necessary. This will include Site Safety Walks (See 3.8.5. above)

3.9.3. Conducting an Audit

A representative of the Principal Contractor must accompany VHEMBE DISTRICT MUNICIPALITY on all Audits and Inspections and may conduct his/her own audit/inspection at the same time. Each party will, however, take responsibility for the results of his/her own audit/inspection results.

3.9.4. Contractor's Audits and Inspections

The Principle Contractor is to conduct his own monthly internal audits to verify compliance with his own OH&S Management system as well as of with this specification.

3.9.5. Inspections by OH&S Representative's and other Appointees

OH&S Representatives must conduct weekly inspections of their areas of responsibility and report thereon to their foreman or supervisor whilst other appointees must conduct inspections and report thereon as specified in their appointments e.g. vehicle, plant & machinery drivers, operators and users must conduct daily inspections before start-up.

3.9.6. Recording and Review of Inspection Results

All the results of the abovementioned inspections to be in writing, reviewed at OH&S committee meetings, endorsed by the chairman of the meeting and placed on the OH&S File.

3.9.7. Reporting of Inspection Results

The Principal Contractor is required to provide the Client with a monthly report in the format as per the attached Annexure 2: "SHE Risk Management Report"

3.10. Incident Reporting and Investigation

3.10.1. Reporting of Accidents and Incidents (Section 24 & General Administrative Regulation 8 of the OHS Act)

3.101.1 The Principal Contractor must report all incidents where an employee is injured on duty to the extent that he/she:

- * dies
- * becomes unconscious
- * loses a limb or part of a limb

- * is injured or becomes ill to such a degree that he/she is likely either to die or to suffer a permanent physical defect or likely to be unable for a period of at least 14 days either to work or continue with the activity for which he/she was usually employed

OR where:

- * a major incident occurred
- * the health or safety of any person was endangered
- * where a dangerous substance was spilled
- * the uncontrolled release of any substance under pressure took place
- * machinery or any part of machinery fractured or failed resulting in flying, falling or uncontrolled moving objects
- * machinery ran out of control to VHEMBE DISTRICT MUNICIPALITY within two days and to the Provincial Director of the Department of Labour within seven days (Section 24 of the Act & General Administrative Regulation 8.) EXCEPT that, where a person has died, has become unconscious for any reason or has lost a limb or part of a limb or may die or suffer a permanent physical defect, the incident must be reported to both VHEMBE DISTRICT MUNICIPALITY

and the Provincial Director of the Department of Labour forthwith by telephone, telefax or E-mail.

- 3.10.1.2. The Principal Contractor is required to provide VHEMBE DISTRICT MUNICIPALITY with copies of all statutory reports required in terms of the Act within 7 days of the incident occurring.
- 3.10.1.3 The Principal Contractor is required to provide VHEMBE DISTRICT MUNICIPALITY with copies of all internal and external accident/incident investigation reports including the reports contemplated in 3.10.2.3. and 3.10.2.4. below within 7 days of the incident occurring.

3.10.2 Accident and Incident Investigation (General Administrative Regulation 9)

- 3.10.2.1. The Principal Contractor is responsible for the investigation of all accidents/incidents where employees and non-employees were injured to the extent that he/she/they had to be referred for medical treatment by a doctor, hospital or clinic
- 3.10.2.2. The results of the investigation to be entered into the Accident/Incident Register listed in 3.4.1. above.
- 3.10.2.3. The Principal Contractor is responsible for the investigation of all minor and non-injury incidents as described in Section 24 (1) (b) & (c) of the Act and keeping a record of the results of such investigations including the steps taken to prevent similar accidents in future.
- 3.10.2.4. The Principal Contractor is responsible for the investigation of all road traffic accidents and keeping a record of the results of such investigations including the steps taken to prevent similar accidents in future.
- 3.10.2.5. The VHEMBE DISTRICT Municipality reserves the right to hold its own investigation into an incident or call for an independent external investigation.

4.0 OPERATIONAL CONTROL

4.1. Emergency Preparedness, Contingency Planning and Response

- 4.1.1. The Principle Contractor must appoint a competent person to act as Emergency Controller/Coordinator.
- 4.1.2. The Principle Contractor must conduct an emergency identification exercise and establish what emergencies could possibly develop. He/she must then develop detailed contingency plans and emergency procedures, taking into account any emergency plan that VHEMBE DISTRICT MUNICIPALITY may have in place.

- 4.1.3. The Principle Contractor and the other Contractors must hold regular practice drills of contingency plans and emergency procedures to test them and familiarize employees with them.

4.2. First Aid (General Safety Regulation 3)

- 4.2.1. The Principle Contractor must provide First Aid equipment (including a stretcher) and have qualified First Aider/s as required by General Safety Regulation 3 of the OHS Act.
- 4.2.2. The Contingency Plan of the Principle Contractor (See 3.11.1. above) must include the arrangements for speedily and timeously transporting injured/ill person/s to a medical facility or of getting emergency medical aid to person/s that may require it.
- 4.2.3. The Principle Contractor must have firm arrangements with his other Contractors in place regarding the responsibility of the other Contractors injured/ill employees

4.3. Security

- 4.3.1. The Principal Contractor must establish site access rules and implement and maintain these throughout the construction period. Access control must include the rule that non-employees will not be allowed on site unaccompanied.
- 4.3.2. The Principal Contractor must develop a set of Security rules and procedures and maintain these throughout the construction period

4.4. Fall Protection (Working in Elevated Positions (Construction regulation 8.))

- 4.4.1. A pre-emptive Risk Assessment will be required for any work to be carried out above two metres from the ground or any floor level and will be classified as "Work in Elevated Positions".
- 4.4.2. As far as is practicable, any person working in an elevated position will work from a platform, ladder or other device that is at least as safe as if he/she is working at ground level and whilst working in this position be wearing a single belt with lanyard that will be worn to prevent the person falling from the platform, ladder or other device utilized. This safety belt will be, as far as is possible, secured to a point away from the edge over which the person might fall and the lanyard must be of such a length that the person will not be able to move over the edge.

Alternatively any platform, slab, deck or surface forming an edge over which a person may fall may be fitted with guard rails at two different heights as prescribed in SABS 085: Code of Practice for the Design, Erection, Use and Inspection of Access Scaffolding.

- 4.4.3. Where the requirement in 4.4.2. is not practicable, the person will be provided with a full body harness that will be worn and attached above the wearer's head at all times and the lanyard must be fitted with a shock absorbing device OR the person must be attached to an approved, by AL, fall arrest system.
- 4.4.4. Where the requirements in 4.4.2. and 4.4.3. are not practicable, a suitable catch net must be erected.
- 4.4.5.1. Workers working in elevated positions must be trained to do this safely and without risk to health
- 4.4.5.2. Where work on roofs is carried out, the Risk Assessment must take into account the possibility of persons falling through fragile material. Skylights and openings in the roof.

4.5 Structures (Construction Regulation 9)

The Principle Contractor must ensure that:

- Steps are taken to ensure that no structure becomes unstable or collapses due to construction work being performed on it or in the vicinity of it
- No structure is overloaded to the extent where it becomes unsafe
- He/she has received from the designer the following information:
- Information on known or anticipated hazards relating to the construction work and the relevant information required for the safe execution of the construction work
- A geo-scientific report (where applicable)
- The loading the structure is designed to bear
- The methods and sequence of the construction process
- all drawings pertaining to the design are on site and available for inspection

4.6. Formwork & Support Work (Construction Regulation 10.)

- Formwork & Support work (F&SW) must be carried out under the supervision of competent person designated in writing
- F&SW structures must be so designed, erected, supported, braced and maintained that it will be able to support any vertical or lateral loads that may be applied
- No load to be imposed onto the structure that the structure is not designed to carry
- F&SW must be erected in accordance with the structural design drawings for that F&WS and, if there is any uncertainty, the designer must be consulted before proceeding with the erection/use of the F&WS
- All drawings pertaining to the F&SW must be kept available on site
- All equipment used in the erection of F&WS must be checked by a competent person before use
- The foundation or base upon which F&SW is erected must be able to bear the weight and keep the structure stable
- Employees erecting F&SW must be trained in the safe work procedures for the erection, moving and dismantling of F&SW
- Safe access (and emergency escape) must be provided for workers
- A competent person must inspect F&SW structures that have been erected before, during and after pouring of concrete or the placing of any other load and thereafter daily until the F&SW is stripped. The results of all inspections must be recorded in a register kept on site
- The F&SW must be left in place until the concrete has reached sufficient strength to bear its own weight plus any additional weight that may be imposed upon it and not until the designated competent person has authorised its stripping in writing
- Any damaged F&SW must be repaired/rectified immediately
- Deck panels must be secured against displacement
- The slipping of persons on release agents on deck panels prevented
- Persons health must be protected against the use of solvents, oils or other similar substances

4.7. Excavations (Construction Regulation 11.)

Where excavations will exceed 1,5 m in depth the Contractor will be required to submit a Method Statement to VHEMBE DISTRICT MUNICIPALITY for approval before commencing with the excavation and VHEMBE DISTRICT MUNICIPALITY will issue a permit to proceed once the Risk Assessment and Method Statement are approved.

- Excavation work must be carried out under the supervision of a competent person who has been appointed in writing
- Before excavation work begins the stability of the ground must be evaluated
- Whilst excavation work is being performed, the contractor must take suitable and sufficient steps to prevent any person from being buried or trapped by a fall or dislodgement of material
- No person may be required or permitted to work in an excavation that has not been adequately shored or braced or where:
 - the excavation is in stable material or where
 - the sides of the excavation are sloped back to at least the maximum angle of repose measured relative to the horizontal plane
- The shoring or bracing may not be left out unless written permission has been obtained from the appointed competent person and shoring and bracing must be designed and constructed to safely support the sides of the excavation
- Where uncertainty exists regarding the stability of the soil the opinion of a competent professional engineer or professional technologist must be obtained whose opinion will be decisive. The opinion must be in writing and signed by the engineer or technologist as well as the appointed excavator
- No load or material may be placed near the edge of an excavation if it is likely to cause a collapse of the trench unless suitable shoring has been installed to be able to carry the additional load
- Any neighbouring building, structure or road that may be affected or endangered by the excavation must be protected from damage or collapse
- Every excavation must be provided with means of access that must be within 6 metres of any worker within the excavation
- The location and nature of any existing services such as water, electricity, gas etc. must be established before any excavation is commenced with and any service that may be affected by the excavation must be protected and made safe for workers in the excavation
- Every excavation including the shoring and bracing or any other method to prevent collapse must be inspected by the appointed competent person as follows:
 - Daily before work commences
 - After every blasting operation
 - After an unexpected collapse of the excavation
 - After substantial damage to any supports
 - After rain

The results of any inspections must be recorded in a register kept on site

Contractor's Paraph

Witness
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Paraph

Client Paraph

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Paraph

- Every excavation accessible to the public or that is adjacent to a public road or thoroughfare or that threatens the safety of persons, must be adequately barricaded or fenced to at least one metre high and as close to the excavation as practicable and
- Provided with warning lights or visible boundary indicators after dark or when visibility is poor
- Upon entering an excavation the requirements of General Safety Regulation 5 must be observed:
 - any confined space may only be entered after the air quality has been tested to ensure that it is safe to breathe and does not contain any flammable mixture or
 - the confined space has been purged and ventilated of any hazardous or flammable gas, vapour, dust or fumes and
 - the safe atmosphere must be maintained or
 - employees have to be using breathing apparatus and wearing a safety harness with a rope with the free end of the rope being attended to by a person outside the confined space, furthermore,
 - an additional person trained in resuscitation must be in full-time attendance immediately outside the confined space and
 - additional breathing and rescue apparatus must be kept immediately outside the confined space for rescue purposes
 - all pipes, ducts etc. that may leak into the confined space to be blanked off sufficiently to prevent any leakage or seepage
 - the employer must ensure that all employees have left the confined space after the completion of work
 - where flammable gas is present in a confined space no work may be performed in close proximity to the flammable atmosphere that may ignite the flammable gas or vapour.

4.8. Demolition Work (Construction Regulation 12.)

- Demolition work to be carried out under the supervision of a competent person who has been appointed in writing
- A detailed structural engineering survey of the structure to be demolished to be carried out and a method statement on the procedure to be followed in demolishing the structure to be developed by a competent person, before any demolition may be commenced
- As demolishing progresses the structural integrity of the structure to be checked at intervals as determined in the method statement by the appointed competent person in order to prevent any premature collapse
- Steps must be taken to ensure that where a structure is being demolished:
 - no floor, roof or any other part of the structure is overloaded with debris or material that would make it unsafe
 - precautions are taken to prevent the collapse of the structure when any frame or support is cut or removed
 - shoring or propping is applied where necessary
 - No person must be required or allowed to work under unsupported overhanging material
 - THE STABILITY OF AN ADJACENT BUILDING, STRUCTURE OR ROAD MUST BE MAINTAINED AT ALL TIMES

- The location and nature of any existing services such as water, electricity, gas etc. must be established before any demolition is commenced with and any service that may be affected by the demolition must be protected and made safe for workers
- Every stairwell in a building being demolished must be adequately illuminated
- Convenient and safe means of access must be provided
- A catch platform or net must be erected over every entrance to the building or structure being demolished where the likelihood exists of material or debris falling on persons entering and leaving and every other area where the likelihood exists of material or debris falling on persons, must be fenced or barricaded
- No material may be dropped on the outside of the building unless the area into which it is dropped is fenced off or barricaded
- Waste and debris may only be disposed of from a height in a chute with the following design:
 - Adequately constructed and rigidly fastened
 - If inclined >45 degrees enclosed on all four sides
 - Fitted with a gate or control mechanism to control the flow of material that may not freefall down the chute
 - Discharged into a container or a barricaded area
 - Demolition equipment may only be used on floors or slabs that are able to support it
- Asbestos related work must be conducted to the requirements of the Asbestos regulations promulgated under the OHS Act and in particular Asbestos Regulation 21:
 - Demolition of asbestos may only be carried out by a registered (with the Department of Labour) Asbestos Contractor
 - All asbestos materials likely to become airborne must be identified
 - A Plan of Work must be submitted for approval to an Approved Asbestos Inspection Authority (AAIA) (approved by the Department of Labour) 30 days prior to commencement of demolishing work unless the Plan was drawn up by an AAIA and a signed (by all parties) copy must be submitted to the Department of Labour 14 days before commencement of the demolishing

During demolition work:

- all asbestos containing material must be disposed of safely
- workers must be issued with appropriate PPE and the proper use thereof enforced
- After the demolition has been completed the area/premises must be thoroughly checked to ensure that all asbestos waste has been removed
- No person is allowed to:
 - Use compressed air or permit the use of compressed air to remove asbestos dust from any surface or person
 - Smoke, eat, drink or keep food or beverages in an area not specifically designated for this
 - Apply asbestos by spraying

Lead related work must be conducted to the requirements of the Lead regulations promulgated under the OHS Act

Where demolition work will involve the use of explosives a method statement must be developed by a competent person in accordance with applicable explosives legislation.

4.9. Tunnelling (Construction Regulation 13.)

- To be performed in accordance with the Tunnelling Regulations as published under the Mines Health & Safety Act (29 of 1996)
 - No person shall enter a *tunnel that has a height dimension less than 800 mm
- * Definition of Tunnelling: "the construction of any tunnel beneath the natural surface of the earth for the purpose other than the searching for or winning of a mineral"

4.10. Access Scaffolding (Construction Regulation 14)

Access Scaffolding must be erected, used and maintained safely in accordance with Construction Regulation 14 and SA Bureau of Standards Code of Practice, SANS 085 entitled, "The Design, Erection, Use & Inspection of Access Scaffolding.

Detailed consideration must be given to all scaffolding to ensure that it is properly planned to meet the working requirements, designed to carry the necessary loadings and maintained in a sound condition. It must also be ensured that there is sufficient material available to erect the scaffolding properly.

Scaffolding may only be erected, altered or dismantled by a person who has adequate training and experience in this type of work or under the supervision of such a person.

4.11. Suspended Platforms & Boatswains Chairs (Construction Regulation 15 & 16)

4.11.1. The Contractor to design, erect, use and maintain suspended platforms in accordance with the requirements of Construction Regulation 15.

4.11.2. Boatswains chairs are to be erected, used maintained and inspected in accordance with the requirements of Construction Regulation 16.

4.12. Batch Plants (Construction Regulation 18)

The Contractor to erect, operate and maintain Batch Plants in accordance with the requirements of Construction Regulation 18.

4.12.1. Explosive Powered Tools (Construction Regulation 19)

Every Explosive Powered Tools (EPT) must be:

- Provided with a guard around the muzzle to confine flying fragments or particles
- A firing mechanism that will prevent the EPT from firing unless it is pushed against the surface and at right angle (where the EPT is fitted with an intermediate piston between the charge and the nail this requirement is waived)

The Contractor or user must ensure that:

- Only the correct type of cartridge is used
- The EPT is cleaned inspected and cleaned daily before use by an appointed competent person who keeps register with the findings of his inspection and the details of cleaning, service and repairs

- The safety devices are in good working order before the EPT is use
- When the EPT is not being used it is stored in an unloaded condition together with the cartridges in a safe/secure place inaccessible to unauthorised persons
- A warning notice is displayed at the point where the EPT is in use
- The issue and return of cartridges must be by issue/returns register signed by both issuer and user and empty cartridge cases must be returned with unspent cartridges
- Users/operators of the EPT have received the necessary training and has been authorised as competent to use/operate the EPT
- Users/operators must wear the prescribed PPE whilst using/operating the tool

4.13 Cranes & Lifting Equipment (Construction Regulation 20)

Cranes and Lifting equipment must be designed and constructed in accordance with generally accepted technical standards and operated, used, inspected and maintained in accordance with the requirements of Driven Machinery Regulation 8 of the OHS Act:

- to be clearly and conspicuously marked with the maximum mass load (MML) that it is designed to carry safely. When the MML varies with the conditions of use, the a table should be used by the driver/operator
- each winch on a lifting machine must al all time have, at least, three full turns of rope on the drum when the winch has been run to its lowest limit
- fitted with a brake or other device capable of holding the MML. This brake or device to automatically prevent the downward movement of the load when the lifting power is interrupted
- fitted with a load limiting device that automatically arrest the lift when
- the load reaches its highest safe position or
- when the mass of the load is greater than the MML
- every chain or rope on a lifting machine that forms an integral part of the machine must have a factor of safety as prescribed by the manufacturer of the machine and where no standard is available the factor of safety must be:
 - chains – 4 (four)
 - steel wire ropes - 5 (five)
 - fibre ropes- 10 (ten)
- every hook or load attaching device must be designed such or fitted with a device that will prevent the load from slipping off or disconnecting
- every lifting machine must be inspected and load tested by a competent person every time it has been dismantled and re-erected and every 12 months after that. The load test must be in accordance with the manufacturers prescription or to 110% of the MML
- in addition all ropes, chains, hooks or other attaching devices, sheaves, brakes and safety
- devices forming an integral part of a lifting machine must be inspected every 6 months by a competent person
- all maintenance, repairs, alterations and inspection results must be recorded in a log book
- and each lifting machine must have its own log book.
- no person may be lifted by a lifting machine not designed for lifting persons unless in a

- cradle approved by the inspector of the Department of Labour
- every jib crane with an MML of 5 000 kg or more at minimum jib radius must be provided
- with a load indicator or a load lifting limiting device

Lifting Tackle:

- to be manufactured of sound material, well-constructed and free from patent defects
- to be clearly and conspicuously marked with ID number and MML
- factor of safety:
 - Natural fibre ropes -10(ten)
 - Man-made fibre ropes & woven webbing -06(six)
 - Steel wire ropes – single rope -06(six)
 - Steel wire ropes – combination slings -08(eight)
 - Mild Steel chains -05(five)
 - High tensile/alloy steel chains -04(four)
- steel wire ropes must be discarded (not used any further for lifting purposes) when excessive wear and corrosion is evident and must be examined by a competent person every three months for this purpose and the results recorded.

Operator

- Every lifting machine operator must be trained specifically for the type of lifting machine that he/she is operating
- Operators of Jib cranes with a MML of 5 00 kg or more must be in possession of a certificate of training issued by an accredited (by The Department of Labour) training provider.

Construction Regulation 20:**Where tower cranes (TC) are used:**

- account must be taken of the effects of wind force on the structure
- account must be taken of the bearing capacity of the ground on which the TC is to be erected
- the bases for the TC and tracks for rail mounted TC's must be firm and level
- must be erected at a safe distance from excavations
- clear space must be provided and maintained for erection, operation, maintenance and dismantling
- TC operators must be competent to carry out the work safely TC operators must be in possession of a valid medical certificate testifying that the holder is physically and psychologically fit to work on a TC.

All lifting operations where the lift will exceed 2000 kg must be planned by a competent person and the plan submitted to VHEMBE DISTRICT MUNICIPALITY for approval and permission to carry out the lift.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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4.14 Construction Vehicles & Mobile Plant (Construction Regulation 21)

Construction Vehicles and Mobile Plant will be inspected by VHEMBE DISTRICT MUNICIPALITY prior to being allowed on a project site and suppliers of hired vehicles, plant and equipment will be required to comply with this specification as well as the OHS Act and Regulations.

Construction Vehicles and Mobile Plant (CV&MP) to be:

- of acceptable design and construction
- maintained in good working order
- used in accordance with their design and intention for which they were designed
- operated/driven by trained, competent and authorised operators/drivers. No unauthorised persons to be allowed to drive CV&MP
- operators and drivers of CV&MP must be in possession of a valid medical certificate declaring the operator/drive physically and psychologically fit to operate or drive CV&MP
- provided with safe and suitable means of access
- fitted with adequate signalling devices to make movement safe including reversing
- excavations and other openings must be provided with sufficient barriers to prevent CV&MP from falling into same
- provided with roll-over protection
- inspected daily before start-up by the driver/operator/user and the findings recorded in a register/log book
- CV&MP to be fitted with two head and two tail lights whilst operating under poor visibility conditions
- No loose tools, material etc. is allowed in the driver/operators compartment/cabin nor in the compartment in which any other persons are transported
- CV&MP used for transporting persons must have seats firmly secured and sufficient for the number of persons being transported

No person may ride on a CV&MP except for in a safe place provided for the purpose

The construction site must be organised to facilitate the movement of CV&MP and that pedestrians and other vehicles are not endangered. Traffic routes to be suitable, sufficient in number and adequately demarcated

CV&MP left unattended after hours adjacent to roads and areas where there is traffic movement must be fitted with lights reflectors or barricades to prevent moving traffic to come into contact with the parked CV&MP.

In addition CV&MP left unattended after hours must be parked with all buckets, booms etc. full lowered, the emergency brakes engaged and, where necessary, the wheels chocked, the transmission in neutral and the motor switched off and the ignition key removed and stored safely

Workers employed adjacent or on public roads must wear reflective safety vests

All CV&MP inspection records must be kept in the OH&S File

4.15 Electrical Installations (Construction Regulation 22)

The installation of temporary electricity for Construction shall be in accordance with the Construction regulation 22 and the Electrical Installation Regulations.

The Contractor must ensure that:

- existing services are located and marked before construction commences and during the progress thereof
- where the abovementioned is not possible, workers with jackhammers etc. are protected against electric shock by the use of suitable protective equipment e.g. rubber mats, insulated handles etc
- electrical installations and -machinery are sufficiently robust to withstand working conditions on site
- temporary electrical installations must be inspected at least once per week by a competent person and a record of the inspections kept on the OH&S File
- electrical machinery used on a construction site must be inspected daily before start-up by the competent driver/operator or any other competent person and a record of the inspections kept on the OH&S File
- all temporary electrical installations must be controlled by a competent person appointed in writing

4.16. Electrical & Mechanical Lock-Out

An electrical and mechanical lock-out procedure must be developed by the Principle Contractor and submitted to VHEMBE DISTRICT MUNICIPALITY for approval before construction commences. This lock-out procedure to be adhered to by all Contractors on site

4.17. Use & Storage of Flammables (Construction Regulation 23)

The Contractor to ensure that:

- No person is required or permitted to work in a place where there is the danger of fire or an explosion due to flammable vapours being present unless adequate precautions are taken
- No flammable is used or applied e.g. in spray painting, unless in a room or cabinet or other enclosure specially designed and constructed for the purpose unless there is no danger of fire or explosion due to the application of adequate ventilation
- The workplace is effectively ventilated. Where this cannot be achieved:
 - Employees must wear suitable respiratory equipment
 - No smoking or other sources of ignition is allowed in the area
 - The area is conspicuously demarcated as "flammable"
- Flammables stored on a construction site are stored in a well-ventilated, reasonably fire-resistant container, cage or room that is kept locked with access control measures in place and sufficient firefighting equipment installed and fire prevention methods practised e.g. proper housekeeping
- Flammables stored in a permanent flammables store are stored so that no fire or explosion is caused i.e.:
 - stored in a locked well-ventilated reasonably fire resistant container, cage or room conspicuously demarcated as "Flammable Store – No Smoking or Naked Lights"
 - the flammables store to be constructed of two-hour fire retardant walls and roof and separated from adjoining rooms or workplaces by means of a two-hour fire retardant fire wall
 - Adequate and suitable firefighting equipment installed around the flammables store and marked with the prescribed signs
 - All electrical switches and fittings to be of a flameproof design
 - Any work done with tools in a flammables store or work areas to be of a non-sparking nature

- No Class A combustibles such as paper, cardboard, wood, plastic, straw etc. to be stored together with Flammables
- The flammable store to be designed and constructed to, in the event of spillage of liquids in the store, to contain the full quantity + 10% of the liquids stored
- A sign indicating the capacity of the store to be displayed on the door
- Only one day's quantity of Flammable is to be kept in the workplace
- Containers (including empty containers) to be kept closed to prevent fumes/vapours from escaping and accumulating in low lying areas
- Metal containers to be bonded to earth whilst decanting to prevent build-up of static
- Welding and other flammable gases to be stored segregated as to type of gas and empty and full cylinders

4.18. Working on or Near Water (Construction Regulation 24)

The Principle Contractor must ensure that, where construction work is being carried out over or in close proximity to water:

- Measures are in place to prevent workers from falling into the water and drowning. These measure to include the availability of lifejackets
- Measures are in place to rescue any worker/ that has fallen into the water
- Measures for the timorous warning of flooding are in place (Also see 4.1. above)

4.19. Housekeeping (Construction Regulation 25)

The Contractor to ensure that:

- Housekeeping is continuously implemented
- Materials & equipment are properly stored
- Scrap, waste & debris are removed regularly
- Materials placed for use are placed safely and not allowed to accumulate or cause obstruction to free flow of pedestrian and vehicular traffic
- Waste & debris not to be removed by throwing from heights but by chute or crane
- Where practicable, Construction sites are fenced off to prevent entry of unauthorised persons
- Catch platforms or –nets are erected over entry and exit ways or over places where persons are working to prevent them being struck by falling objects
- An unimpeded work space is maintained for every employee
- Every workplace is kept clean, orderly and free of tools etc. that are not required for the work being done materials
- As far as is practicable, every floor, walkway, stair, passage and gangway is kept in good state of repair, skid-free and free of obstruction, waste and materials
- The walls and roof of every indoors workplace is sound and leak-free

- Openings in floors, hatchways, stairways and open sides of floors or buildings are barricaded, fences, boarded over or provided with protection to prevent persons from falling

4.20. Stacking & Storage (Construction Regulation 27)

The Contractor/Employer must ensure that:

- A competent person is appointed in writing to supervise all stacking and storage on a construction site
- Adequate storage areas are provided and demarcated
- The storage areas are kept neat and under control
- The base of any stack is level and capable of sustaining the weight exerted on it by the stack
- The items in the lower layers can support the weight exerted by the top layers.
- Cartons and other containers that may become unstable due to wet conditions are kept dry
- Pallets and containers are in good condition and no material is allowed to spill out
- The height of any stack does not exceed 3X the base unless stepped back at least half the depth of a single container at least every fifth tier or
- the approval of an inspector has been obtained to build the stacks higher with the aid of a machine. (The operator of the machine must be protected against items falling from overhead off the stack and no items may overhang)
- The articles that make up a single tier are consistently of the same size, shape and mass
- Structures for supporting stacks are structurally sound and able to support the mass of the stack
- No articles are removed from the bottom of the stack first but from the top tier first
- Anybody climbing onto a stack can and does do it safely and that the stack is sufficiently stable to support him/her
- Stacks that are in danger of collapsing are broken down and restacked
- Stability of stacks are not threatened by vehicles or other moving plant and machinery
- Stacks are built in a header and stretcher fashion and that corners are securely bonded
- Stepped back at least half the depth of a single container at least every fifth tier
- Persons climbing onto stacks do not approach unguarded moving machinery or electrical installations

4.21. Storage of Flammables and Hazardous Chemicals (Hazardous Chemical Substances Regulations)

See 4.17 above and 4.21 below.

4.22. Fire Prevention and Protection

The Principle Contractor must ensure that:

- The risk of fire is avoided

- Sufficient & suitable storage of flammables is provided
- Sources of ignition is obviated wherever flammable or highly combustible material is present in the workplace e.g.:
 - notices prohibiting smoking is displayed and enforced
 - welding and flame cutting is only allowed under controlled conditions that includes written hot work permits
 - only spark-free hand and power tools are used
 - no grinding, cutting and shaping of ferrous metals are allowed using electrically driven power tools that produces sparks
 - flameproof switches & fittings are to be used in the flammable atmosphere
 - Good housekeeping is maintained to prevent the accumulation of unnecessary combustibles
 - Adequate ventilation is maintained
 - Adequate and suitable fixed and portable fire appliances is provided and maintained in good working order.
 - Maintenance must include:
 - Regular inspection by a competent person appointed in writing and keeping a register
 - Annual inspection and service by an accredited service provider
- All employees are instructed in the use of the Fire equipment and know how to attempt to extinguish a fire
- A sufficient number of employees are appointed and trained to act as Emergency Team to deal with fires and other emergencies
- Employees are informed re. emergency evacuation procedures and escape routes
- Emergency escape routes are kept clear at all times
- After evacuation assembly points are demarcated
- Evacuation is practised to ensure that all is evacuated timeously
- Rollcall is held after evacuation to account for all personnel and ensure that no-one has been left behind.
- A clearly audible to all persons on site siren or alarm is fitted

4.23. Eating, Changing, Washing & Toilet Facilities (Construction Regulation 28)

The following will be the minimum requirements:

Toilets

The provision of Toilets is required in terms of the National Building Regulations and Construction Regulation 28. Chemical toilets are allowed instead of the water borne sewerage type. Toilets have to be provided at

a ratio of 1 toilet per 30 workers

Showers

At least cold-water showers of some sort have to be provided to a ratio of 1 shower per 15 workers.

Change Rooms

Some form of screened off changing facility must be provided separately for each sex.

Eating Facility

Some form of shelter from the sun, wind and rain must be provided

Living Accommodation

Where the site is in a remote location and transport home is not readily available, reasonable and suitable living accommodation must be provided.

4.24. Personal & Other Protective Equipment (Sections 8/15/23 or the OHS Act)

The Contractor is required to identify the hazards in the workplace and deal with them. He must either remove them or, where impracticable take steps to protect workers and make it possible for them to work safely and without risk to health under the hazardous conditions.

Personal Protective equipment (PPE) should, however, be the last resort and there should always first be an attempt to apply engineering and other solutions to mitigating hazardous situations before the issuing of PPE is considered.

Where it is not possible to create an absolutely safe and healthy workplace the Contractor is required to inform employees regarding this and issue, free of charge, suitable equipment to protect them from any hazards being present and that allows them to work safely and without risk to health in the hazardous environment.

It is a further requirement that the said equipment be maintained by the Contractor, that he instructs and trains the employees in the use of the equipment and ensures that the prescribed equipment is used by the employee/s.

Employees do not have the right to refuse to use/wear the equipment prescribed by the employer and, if it is impossible for an employee to use or wear prescribed protective equipment through health or any other reason, the employee cannot be allowed to continue working under the hazardous condition/s for which the equipment was prescribed but an alternative solution has to be found that may include relocating or discharging the employee.

The Contractor may not charge any fee for protective equipment prescribed by him/her but may charge for equipment under the following conditions:

- Where the employee requests additional issue in excess of what is prescribed
- Where the employee has patently abused or neglected the equipment leading to early failure
- Where the employee has lost the equipment

All employees shall, as a minimum, be required to wear the following PPE on any VHEMBE DISTRICT MUNICIPALITY projects:

- Protective overall
- Protective footwear
- Protective headwear
- Eye/face protection

4.25 Portable Electrical Tools & Equipment (Electrical Machinery Regulation 9)

Portable electrical tools and equipment includes every unit that takes electrical power from a 15 amp. plug point and is moved around for use in the workplace i.e. drills, saws, grindstones, portable lights, etc. In addition electrical appliances such as fridges, hotplates, heaters, etc. must be inspected and maintained to the same standards as portable electrical tools and appliances.

The use, inspection and maintenance of portable electrical tools and equipment must be governed by the following:

- Regular inspections by a competent person appointed in writing
- Inspection results must be recorded in a register
- Only competent authorised persons are allowed to use portable electrical tools and equipment
- The correct protective equipment is worn/used whilst operating portable electrical tools and equipment

Portable Electrical Tools

- Must be maintained in good condition at all times to prevent an electrical shock to the user
- The main source must incorporate an earth leakage protection device or receive power through a double wound transformer or be double insulated and clearly marked as such
- All equipment must be fitted with a switch to allow for safe & easy starting and stopping

Portable Lights

- Must be fitted with a robust non-hygroscopic non-conducting handle
- Live metal parts/parts which may become live must be protected against contact
- The lamp must be protected by a strong guard
- The cable lead-in must withstand rough handling
- It is suggested that a register be kept for each piece of equipment and findings of regular inspections must be entered
- Inspections must concentrate on plug, cord, switch and any obvious faults
- When used in wet/damp/metal container conditions, it must be protected as for portable electrical tools, above

4.26. Public Health & Safety (Section 9 of the OHS Act)

The Principle Contractor will be responsible for ensuring that non-employees affected by the construction work are made aware of the dangers likely to arise from said construction work as well as the precautionary measures to be observed to avoid or minimise those dangers. This includes:

- Non- employees entering the site for whatever reason
- The surrounding community
- Passers-by to the site

Appropriate signage must be posted to this effect and all employees on site must be instructed on ensuring that non-employees are protected at all times

All non-employees entering the site must receive induction into the hazards and risks and the control measures for these.

4.27 Hazardous Chemical Substances

The Contractor/Employer must ensure that:

- Employees receive the necessary information & training to be able to use and store HCS safely
- Employees obey lawful instructions regarding:
 - the wearing and use of protective equipment
 - the use and storage of HCS
 - the prevention of the release of HCS
 - the wearing of exposure monitoring and measuring equipment
 - the cleaning up and disposal of materials containing HCS
 - housekeeping, personal hygiene and the protection of the environment
 - the Risk Assessments required in terms of Construction Regulation 7 include employee exposure to HCS and that the necessary to protect persons from being detrimentally affected by HCS present or used in the workplace, are taken
 - suppliers provide the necessary information in the form of a Material Safety Data Sheet (MSDS) regarding an HCS required to ensure the safe use and storage of that HCS
 - an up-to-date list is kept on site of HCS's stored and used together with the MSDS's of the said HCS's
- HCS containers are clearly marked as to the contents and main hazardous category e.g. "Flammable" or "Corrosive" and the reference number of the HCS on the list indicated above
- HCS e.g. Asbestos dust is not cleared by the use of compressed air but is vacuumed
- No person eats or drinks in a HCS workplace
- HCS waste is disposed of safely in terms of hazardous waste disposal requirements

4.28 Project/Site Specific Requirements

See Annexure 3

Annexure 1:

Annexure 2:

Annexure 3.

Measuring Injury Experience

SHE Risk Management Report

List of Risk Assessments

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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ANNEXURE 1: MEASURING INJURY EXPERIENCE

Injury experience has traditionally been measured by the use of a disabling injury frequency rate, the so-called "DIFR". The DIFR is calculated by multiplying the number of disabling injuries by 1 million and dividing by the number of man hours worked.

Lately the DIFR has been replaced internationally with a DIIR: disabling injury incidence rate. The only difference between the two rates are that the 10 million in the calculation is replaced with 200 000. (200 000 purported to be the number of hours and average person works in a lifetime.)

The use of the two rates above has proved to be somewhat problematical as they are open to manipulation and disabling injuries are often "hidden" by returning the injured employee to the workplace so as not to lose a shift and therefore having to register a disabling injury.

The Construction Industry recently decided to promote the use of a new frequency rate based on the number of compensation injury claims as these are more difficult to hide or manipulate because the reporting of compensable injuries is a legal requirement.

The industry is hoping that adoption of this new measurement of injury experience will enable the industry to monitor itself as far as work related injuries are concerned.

Below follows an explanation of this new rating system.

COMPENSATION INCIDENCE FREQUENCY RATE (CIFR)**FORMULA**

$$\frac{\text{No. of Compensation Claims} \times 200\,000}{220 \text{ man-hours} \times \text{No. of Employees}}$$

DEFINITIONS

No. of Compensation Claims: The number of claims lodged with the COID insurer for the period under review

200 000: The fixed factor to align the rate with other rates used internationally

Man-hours Worked Include:

- * Hourly Paid Employees
- * Sub-contractors (No. of Employees X *220 each)
- * Staff (No. of Employees X *220 hours each)

220 man-hours: The average number of hours worked by one employee in one month in the Construction industry.

Overtime, absence on leave or sick leave, unrecorded after hours time worked by senior and middle management factored into this average.

No. of Employees: The actual or average number of employees employed for the period under review.

2002/03CIFRSystem

ANNEXURE 2: EXECUTIVE SHE RISK MANAGEMENT REPORT

The SAFCEC OH&S committee recently developed the following report in an attempt to standardise on reporting and assist contractors in obtaining a clear picture of their SHE Risk Management performance. It is hoped that clients will also accept this standardised report. Your comments/suggestions for improvement is invited.

EXAMPLE ONLY: ALL INFORMATION IS FICTITIOUS

XYZ construction

*SHE RISK MANAGEMENT REPORT

PERIOD JANUARY TO MARCH 2002

*(SHE = Safety, Health & Environment)

1. Introduction

We hope that this new format of quarterly SHE Risk Management reporting will provide a clear picture of the company's performance as far as occupational health & safety is concerned.

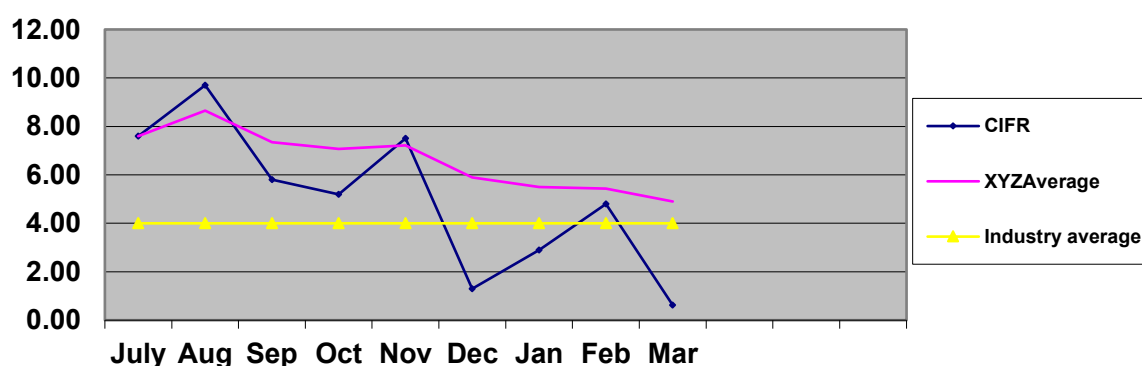
The first quarter of 2002 generally reflected an improvement in injury experience and shows a decline in the number of injuries. Although Building was the only division where there was an increase in compensation claims, figures are still well down from the average 2001 figures. A sub-contractor experienced one fatality.

All divisions are eagerly awaiting the final implementation in May of the new electronic SHE Management system that will make the tools to implement the SHE programme available to all management and supervisory staff.

2. Incident Statistics**2.1 Compensation Incident Frequency Rate (CIFR)**

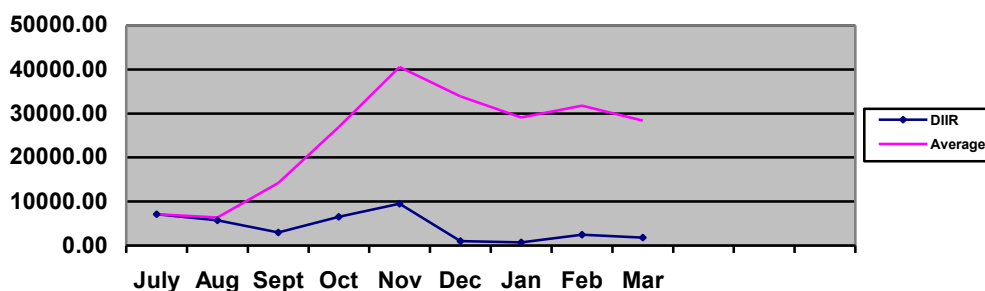
$\text{CIFR} = \frac{\text{Total No. of Claims against the Workmen's Compensation Fund} \times 200\,000}{\text{Man-hours worked}}$

Man-hours worked

**2.2. Disabling Injury Incidence Rate (DIIR)**

$\text{DIIR} = \frac{\text{No. Disabling Injuries} \times 200\,000}{\text{Man-hours worked}}$

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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2.3. Other Major Incidents

Three other major incidents were experienced in the period under review:

- 2.3.1. A major trench collapsed at Job. 00123: XYZ Head Office, Bochum: No personnel injured, extensive damage to foundations: 3 days delay.
- 2.3.2. A concrete dumper ran away when its brakes failed. It smashed into the glass façade of the building on Job 00332: McDonalds, Polokwane. The driver jumped off and was not injured. Cost of damage to façade: R45 000.
- 2.3.3. A storage hut on Job 00567: BP Petrol Station, Swartruggens was demolished by fire when the night watchman made a fire inside the storage hut which contained concrete vibrators and levelling machines. Cost of replacing the hut and machines: R30 000

3. RISK AREAS

The following items of concern need priority consideration by management:

- 3.1. New employees must undergo pre-employment medical examinations to:
 - protect XYZ from claims at a later stage
 - ensure that only healthy persons are employed
 - prevent injuries and illness in the workplace
 - enhance XYZ image
- 3.2. Vehicle drivers and plant operators must be instructed to inspect their vehicles daily before start-up using the prescribed checklists to ensure that these are safe to operate and in good condition.

4. AUDITS

Three SHE audits were conducted in February and March:

- | | | | |
|------|------------|----------------------|-----------------------|
| 4.1. | Job 00432: | Gillooly's Mall | Compliance: 56%(*) |
| | Job 00786: | Cullinan Head Office | Compliance: 83%(****) |
| | Job 00589: | Cleveland Station | Compliance: 76%(***) |

5. TRAINING

One hundred and forty two employees, representing 7% of employees, attended nine training courses. *Our objective is to train 5,5% of employees quarterly.

Month	No. of Employees Trained	Course	Source
January	26	Induction	Internal
	15	OH&S Reps	Consultant
	3	Crane Drivers	External
February	23	Induction	Internal
	17	OH&S Reps	Consultant
March	43	Induction	Internal
	9	OH&S Reps	Consultant
	3	Bomag Rollers	Supplier
	3	First Aiders	St. John's

6. LEGAL ISSUES

- 6.1. An inspector of the Department of Labour issued an improvement notice on Job 00987: Gilooley's Mall. The notice requires that all scaffolding comply with the SABS standards for the Erection and Maintenance of Access Scaffolding (SABS 085). This is currently being attended to and the inspector will return on 15 April 2002 to ascertain if the notice has been complied with.

8. OCCUPATIONAL AND OTHER HEALTH MATTERS**8.1. HIV Aids**

The proposed SAFCEC clinic will soon be operational and we will then be able to send our employees who have tested positive to the clinic for counselling and eventual treatment when necessary

The mobile clinic saw and tested fifty employee volunteers at 3 sites this month. Eighteen of them tested positive.

8.2. Tuberculosis

The mobile clinic will be calling at Gilooley's Mall and Cleveland Station on 15 and 16 October respectively to screen employees for TB.

8.3. Noise

All suspected noise pollution areas have been tested and the results are awaited. Employees working in areas testing over 85dBa will be issued with suitable hearing protectors.

9. ENVIRONMENTAL MEASURES

Inspectors from the Botswana Department of the Environment visited Djwaneng and inspected the site and yard. They gave it a "clean bill of health" and advised that we should increase the dust control measures by spraying roads three times per day instead of the present twice per day.

10. ACHIEVEMENTS/AWARDS

- 10.1. The client at Djwaneng (Job 00786) awarded the XYZ site first position in the housekeeping competition conducted bi-monthly by the client's SHE managers. The project manager and his team are to be congratulated for this sterling effort.
- 10.2. Job 0987: Refurbishment of Pretoria Main Railway Station has just completed 1million compensation claim free days. This was no easy achievement if we consider the conditions being worked under after the extensive fire that caused major damage.
SHE Risk Manager
2002.09.27

ANNEXURE 3: LIST OF RISK ASSESSMENTS

Clearing & Grubbing of the Area/Site

- * Site Establishment including:
 - Office/s
 - Secure/safe storage for materials, plant & equipment
 - Ablutions
 - Sheltered eating area
 - Maintenance workshop
 - Vehicle access to the site
- * Dealing with existing structures
- * Location of existing services
- * Installation and maintenance of temporary construction electrical supply, lighting and equipment
- * Adjacent land uses/surrounding property exposures
- * Boundary and access control/Public Liability Exposures (NB: the Employer is also responsible for the OH&S of non-employees affected by his/her work activities.)
- * Health risks arising from neighbouring as well as own activities and from the environment e.g. threats by dogs, bees, snakes, lightning etc.
- * Exposure to noise
- * Exposure to vibration
- * Protection against dehydration and heat exhaustion
- * Protection from wet & cold conditions
- * Dealing with HIV/Aids and other diseases
- * Use of Portable Electrical Equipment including
 - Angle grinder
 - Electrical drilling machine
 - Skill saw
- * Excavations including
 - Ground/soil conditions
 - Trenching
 - Shoring
 - Drainage of trench
- * Welding including
 - Arc Welding
 - Gas welding
 - Flame cutting
 - Use of LP gas torches and appliances

-
- * Loading & offloading of trucks
 - * Aggregate/sand and other materials delivery
 - * Manual and mechanical handling
 - * Lifting and lowering operations
 - * Driving & operation of construction vehicles and mobile plant including
 - Trenching machine
 - Excavator
 - Bomag roller
 - Plate compactor
 - Front end loader
 - Mobile cranes and the ancillary lifting tackle
 - Parking of vehicles & mobile plant
 - Towing of vehicles & mobile plant
 - * Use and storage of flammable liquids and other hazardous substances
 - * Layering and bedding
 - * Installation of pipes in trenches
 - * Pressure testing of pipelines
 - * Backfilling of trenches
 - * Protection against flooding
 - * Gabion work
 - * Use of explosives
 - * Protection from overhead power lines
 - * As discovered by the Principal Contractor's hazard identification exercise
 - * As discovered from any inspections and audits conducted by the Client or by the Principal Contractor or any other Contractor on site
 - * As discovered from any accident/incident investigation.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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6.2 ELECTRICAL & ELECTRONICAL SPECIFICATIONS

SUPPLY AND INSTALLATION OF A TELEMETRY SYSTEM AT RESERVOIRS UNDER THE VONDO RWS

TELEMETRY AND ASSOCIATED WORK INDEX

PART	DESCRIPTION	PAGE
1	PROJECT SPECIFICATIONS	181
2	PARTICULAR SPECIFICATIONS	Separate Index
3	SCHEDULES OF INFORMATION TO TENDERER	Separate Index
4	SCHEDULES OF INFORMATION BY TENDERER – RETURNABLES (To be completed by Tenderer and submitted with Tender)	Separate Index
5	SCHEDULE OF QUANTITIES	Separate Index
5.1	Preamble	
5.2	Schedules	
6	DRAWINGS	Separate Index

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**SUPPLY AND INSTALLATION OF A TELEMETRY
SYSTEM AT RESERVOIRS UNDER THE VONDO RWS**

TELEMETRY AND ASSOCIATED WORK

PART 1: PROJECT SPECIFICATIONS

PART 1

PROJECT SPECIFICATIONS

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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PART 1: PROJECT SPECIFICATIONS

This document was prepared by Buro Tech Consulting Engineers. For any enquiries contact:

Tel: 012 542 1010
Nico Van Wyk/Pine Pienaar/Darius Jacobs
Email: burotech@burotech.co.za

PS EL1 SCOPE OF WORK

PS EL1.1 General

- The client requires the replacement of obsolete/vandalised telemetry equipment (situated at selected existing reservoir locations only) as well as the supply, installation, commissioning of new Telemetry systems and equipment at several more reservoir locations currently not equipped. The reservoir locations are indicated on diagrams and images elsewhere in this documentation.
-
- It must be accepted that electricity is not available at any of the reservoir locations. Stand-alone Solar PV Systems therefore forms part of this specification and schedules of quantities. The Solar PV equipment shall be mounted on robust, durable steel masts, and mounted inside vandal proof enclosures. The manufacturer / supplier of the masts, equipment and enclosures, is specified elsewhere in this document. Alternatives will not be considered.
-
- The equipment to be monitored at each of the indicated sites, will comprise of flow meters mounted on pipe work, as well as hydrostatic level sensors mounted on the reservoirs. As for the Solar PV equipment, similar measures will be implemented to prevent vandalism to the equipment to be monitored.
-
- Earthing and Lightning Protection shall be provided as specified. Certificates for this part of the installation, shall be provided.
-
- Low voltage cables will be protected from the environment and also from theft and vandalism. The remoteness of some of the locations must not be under estimated.
- The Project Engineers for the project is Infraburo, the Civil & Mechanical Engineers and **Buro Tech Consulting Engineers CC**, the Electrical Consulting Engineers.
- The following is a list of items that summarises the scope of work for the Telemetry Installations and associated electrical work at the various reservoir locations, as well as at the Water Treatment Works and the Control Room at the Vhembe Municipal Offices:
- Telemetry Equipment for monitoring of flow and water levels, by means of Radio Transmission
 - Cables and terminations between Field equipment and Telemetry Equipment
 - Protected enclosures for PV Solar and Telemetry Equipment
 - PV Solar power supplies consisting of Solar Panels and associated equipment
 - Masts for PV Solar panels including mast foundations designed by a Structural Engineer

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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- Master Station Hardware and Software at the Water Treatment Works
- Earthing, Lightning and Surge Protection of electrical, as well as electronic equipment
- Receiving and accumulation of signals from equipment, and shall communicate the signals to the existing SCADA systems at the Water Treatment Works and the Municipal Control Room (Programming of SCADA by others)
- Servicing and commissioning of the complete installation.

Proposed Tender and Construction Programme:

Refer to Main Contract

PS EL2 GEOGRAPHICAL LOCATION OF SITES

The localities of the sites are indicated on the drawings enclosed, with a minimised image here below.

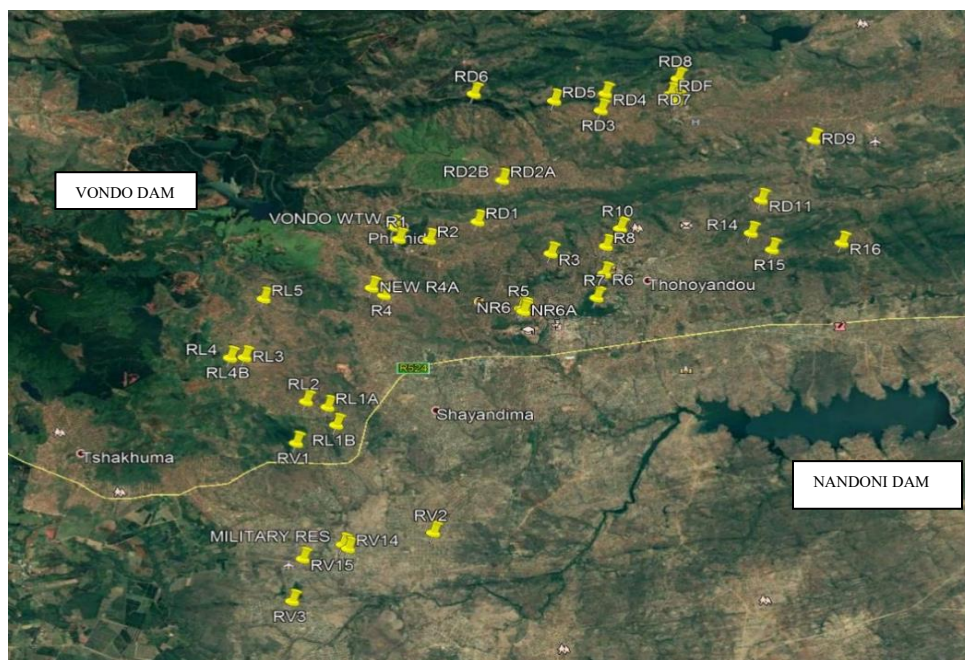


Figure 1: Google Image showing geographical location of Sites

PS EL3 STANDARD TECHNICAL REQUIREMENTS

PS EL3.1 Standard Specifications

The standard specifications are included elsewhere in the Telemetry Equipment specification.

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PS EL3.2 Regulations and Standards

PS EL3.2.1 Where reference is made to any Code of Practice or Standard Specification the **latest amendment or edition** shall apply. Tenderers and Contractors shall ensure that they are acquainted with the contents of such documents. The Contractor shall ensure compliance with these specifications and if requested by the Engineer shall prove compliance at his own cost.

PS EL3.2.2 The Contractor shall immediately after receipt of the official appointment **issue all notices and pay all required fees** in respect of the installation to the Authorities, and shall exempt the Engineer from all losses, claims, costs or expenditure which may arise as a result of the Contractor's negligence to comply with the requirements of the Regulations. Copies of such correspondence shall be forwarded to the Engineer, but this shall not release the Contractor of his responsibilities.

PS EL3.2.3 The **costs of all arrangements** with ESKOM and the Local Authority or Supply Authority with regard to inspections, tests and requirements to comply with the Regulations, and any associated costs shall be included in the tender amount.

All work shall be subject to inspection and approval by ESKOM or the Supply Authority where applicable

PS EL3.2.4 **Conflicts** between any of the Regulations and Standards and the Contract Specifications shall be referred to the Engineer in writing for his ruling. Where the Standard Specifications in part 4, is contradictory to the Project Specifications (Part 5A) the Project Specifications will apply.

PS EL3.2.5 Regulations

The installation shall comply with the latest issues and amendments of the following regulations, as applicable:

PS EL3.2.5.1 The Occupational Health and Safety Act.

- a) Register himself and sub-contractors in terms of the **Compensation for Occupational Injuries and Diseases Act** and a copy thereof shall be submitted to the Engineer.
- b) Appoint in writing a **capable person** that complies with the Act to act as a capable person, and a copy of such an appointment shall be submitted to the Engineer.
- c) Ensure the **safe operation** and safety of all people on site and to strive for a proper management and clean and safe site.
- d) Where work is to be carried out in the proximity of live electrical equipment the Contractor shall make all necessary arrangements with the relevant Supply Authority to **isolate and earth** such equipment.
- e) The Electrical Contractor shall annually register with the **Electrical Contracting**

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Board of South Africa as required by the Act.

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PS EL3.2.5.2 SANS Code of Practice 10142 for the Wiring of Premises, refer to herein as the "Wiring Code"

PS EL3.2.5.3 National Building Regulations.

PS EL3.2.5.4 The Local Municipal By-Laws and Regulations as well as the Regulations of the Local Supply Authority.

PS EL3.2.5.5 The Standard Regulations of any Government Department, other Statutory Body or Public Service Company where applicable.

PS EL3.2.5.6 The Local Fire Regulations.

PS EL3.2.5.7 The Mines and Works Regulations and Government Notice No R1609 where applicable.

PS EL3.2.5.8 The Regulations of the Department of Posts and Telkom.

PS EL3.2.5.9 The Regulations of the Supplier of Electricity.

PS EL3.2.5.10 The applicable SABS and NRS Specifications and SA Codes of Practice.

PS EL 4 TELEMETRY AND ELECTRONIC INSTALLATIONS**PS EL 4.1 SCADA System**

The SCADA System is provided by the electrical contractor appointed for the extensions to the Vondo Water Treatment Works. The Contractor shall allow for coordination with the SCADA Contractor / programmer, in order to add the monitoring signals that forms part of this Contract.

A 17-inch Human Machine Interface(HMI) shall be provided in the Water Treatment Works Control Room as a view node as addition to the SCADA system, no logging and trending required. Programming shall be included under this contract.

PS EL.4.2 Level Switches

Level switches will not be required for this installation

PS EL.4.3 Level Sensor

Level sensors of the Hydrostatic type will be installed in all Reservoirs, with an indication on the SCADA System at both the Water Treatment Works and Municipal Control Room. The distances between reservoir locations and the above-mentioned Data capturing stations are located elsewhere in this documentation. GPS coordinates are also provided to enable the Tenderers to determine the Design Parameters on which the tender and pricing are based upon.

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The specification for the Hydrostatic Level Sensor is as follows or similar approved:

WIKA TYPE LH-20;
0...6 bar gauge; 4...20 mA, 2-wire
@ 8...30 V DC Accuracy: 0.2% of span
Cable material: PUR Cable length: 70 meter
U+=BN, U-=BU
Case material: stainless steel
Process connection: M14x1 female with protection cap
Sealing Sensor: dual FKM (VP2/A)
Specifications according to data sheet: PE 81.56

A 4-20mA output, as well as high and low-level signals will be available for monitoring by telemetry. Proper setting and calibration of this shall be carried out during the commission stage. The signal will be transmitted by means of new telemetry radio link equipment, to the SCADA System. The Telemetry will require the need for a stand-alone system at each site. There is no electricity available at these sites, therefore provision is made for a Solar PV System to power each site. Fully measured and quantified (itemised) allowance is made in the Tender Bills of Quantities for this Item.

PS EL.4.4 Pressure Switches & Transducers

Pressure switches will not be required for this installation

Altitude control valves (Leveldex or similar) will serve as backup on some of the Reservoirs.

PS EL.4.5 Flow Switches – Not Required

Flow switches will not be required because of the above-mentioned pressure control.

PS EL 4.6 Flow meter

A flow meter will be provided in the pipelines at all positions indicated on the mechanical drawings. The flow meters will not be utilised for control, but only for monitoring. Loop Isolators (4 – 20mA) as well as Lightning and Surge Protection shall be included.

The specification for the Flow Meter is as the follows or similar approved:

SENSUS Type Mei-Stream Plus 60 with HRI-Mei data interface and high-resolution flexible pulse output.
Self-diagnostic and tamper detection

The flow meters will be provided and installed inside tamper-resistant concrete structures which form part of Civil / Structural component of the Contract.

PS EL.4.7 Valve Position Switches – Not Required

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Position switches will be mounted on the bypass valve of the pump sets to monitor the open and close positions of the valve. The position will be integrated with the pumps' control/protection circuit.

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PS EL 5. MONITORING

Monitoring shall be as described in Item PS EL 4.1 to PS EL 4.7 above.

PS EL 6. LIGHTING AND SMALL POWER INSTALLATION

Any lighting and small power (if required) will be provided by others.

PS EL 7. POWER SUPPLIES & CABLING

PS EL7.1 Power Supplies

Power supplies do not exist at any of the reservoir sites for telemetry purposes, therefore the PV Solar specifications and related BOQ items will apply, with battery storage for each location (by Telemetry sub-contractor).

Power supplies for telemetry equipment will be available at the water treatment works.

PS EL7.2 Cabling

Cables and terminations shall be provided between the PV Solar power source and the Telemetry Equipment, as well as from the Field Instruments to the Telemetry Equipment. The cables required at each respective reservoir site, consist of the following schedules:

FROM	TO	CABLE
Field Instruments	Telemetry Panel	
Level Sensors in reservoirs	Telemetry Panel	1.0 mm ² 4-pair armoured cable
Flow Meters on pipelines	Telemetry Panel	1.0 mm ² 4-pair armoured cable

The Contractor must ensure that no cables are visible after installation. Cables must be buried at 2m below final ground level.

Cables shall be installed in 75mm diameter galvanised steel pipes with 5mm minimum wall thickness, as follows:

From the concrete structure housing the flow meters, a slow radius bend screwed onto a straight pipe length, levelling out at 2m below final ground level. A second slow radius bend screwed onto the other end of the straight pipe length, entering at the position of the Telemetry Equipment Mast specified elsewhere.

From the above-mentioned Telemetry Equipment Mast, a second slow radius bend screwed onto a straight pipe length, levelling out at 2m below final ground level. Another

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slow radius screwed onto the other end of the straight pipe length, protruding above ground level at the nearest wall of the reservoir structure.

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From this position, a vertical length of pipe, suitably fixed to the reservoir wall, with proper chemically anchored bolts. At the top of the reservoir wall, a 90-degree bend screwed onto the vertical pipe, and from the other end of the elbow a straight length of pipe entering the side of the Level Sensor protective enclosure. The length of vertical mounted pipe shall be filled with 40MPA concrete after the installation of the cable inside the pipe.

PS EL 8. TELEMETRY, SECURITY AND SCADA SYSTEM FOR MONITORING

PS EL 8.1 Telemetry System

A new GE/Schneider radio link monitoring system shall be provided for each reservoir site and a master station at the Water Treatment Works.

The existing vandalised systems shall be removed. The main purpose of the new system will mainly be as follows:

- Monitoring levels at all reservoir sites as well as flow in the designated pipelines where flow meters are installed by the Civil/Mechanical Contractor.

The Telemetry System shall consist of the following equipment (in brief) mounted on the Telemetry Equipment Mast, all powered by the PV Solar Equipment installed on the same Mast:

- Radio transmitter / receiver, antenna, power supply, RTU (refer to part 3 for I/O schedules), battery Back-up, etc. for a complete functional system.
- Master Station Hardware, Human Machine Interface(HMI) and Software as specified and in the BOQ
- Outstations Hardware as specified and in the BOQ

PS EL 8.2 Security System

Tamper monitoring of equipment and biometric programming access control shall be allowed for.

PS EL 8.3 PV Solar System

The PV Solar System shall be as specified and in the BOQ, manufactured and supplied by **Interlock Systems**.

Secured Enclosure to house all Telemetry Equipment, Victron Charge Controller, deep cycle batteries as specified, as well as key / opening tool.

PV Solar panels shall be complete with all related equipment, connections, and

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terminations, installed in Secured Enclosures.

DC cabling for equipment as per drawings.

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The contact details for **Interlock Systems** is:

Tel: 012-664-2647
 Fax: 086-672-8912
 Email: sales@interlock.co.za
 Postal: PO Box 478
 Groenkloof; 0027
 South Africa

PS EL 8.4 **PV Solar System mounting Mast and Earthing / Lightning Protection**

The PV Solar mast shall be as specified, manufactured and supplied by **Interlock Systems**:

The Mast (or dual pole-mount structure where applicable) shall be constructed of robust steel materials, (anti-cut poles) suitably braced and treated to withstand the prevailing conditions.

The required mast or structure length shall be determined by the specialist supplier, but shall typically be 4 to 6m at the reservoir locations and 10m height at the Master stations (Water Treatment Works and Municipal Offices).

Line of sight problems do exist and the RTU system shall support a polling mode where any Master station or any other station RTU connected to the communications network shall be able to poll the RTU for IO and other data registers.

The mast or structure shall be mounted on a reinforced concrete base, designed and approved by a Structural Engineer.

The top end of the mast or structure shall be suitably designed for mounting of all the required components, including but not limited to solar panels and equipment enclosures.

The mast or structure shall further be earthed and protected from lightning.

PS EL 8.5 **PV Solar and other Equipment Protection Enclosures**

The PV Solar Equipment Protection Equipment shall be as specified below, manufactured and supplied by **Interlock Systems**.

Robust indestructible steel plates bolted together with vandal proof bolt heads.

Vandal proof hinges where applicable.

High resistance Perspex cover lids with weather-proof seals.

Suitably sized for the equipment to be accommodated inside the enclosures.

The enclosures shall be provided for Solar and Telemetry equipment on the masts, as

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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well as for the Hydrostatic level sensors on top of the reservoirs.

The Civil Contractor will core drill into the reservoir top slab (roof) to make provision for the mounting of the hydrostatic level sensors.

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The enclosures for the hydrostatic level sensors shall be suitably sized and shall be mounted over the sensor position and bolted onto the reservoir roof. Provision shall be made on the side of the enclosure, for a seamless entry of the 75mm diameter galvanised pipe as specified in PS EL 7.2 above.

PS EL 9 Fibre Optic cable network – Not Required

Not Applicable

PS EL 10 Programmable Logic Controller(PLC). – Not Required

PS EL 11 Inspection and Testing

PS EL 11.1 Coordination with Other Services

The civil and mechanical information forms part of the construction drawings and notice shall be taken of all the services to be installed. The drawings might not be available during tender stage but will be made available during the construction stage.

All the necessary coordination shall also be carried out with any of the services as provided and installed by the Civil and or Mechanical Contractors.

PS EL 11.2 Inspection, Testing and Commissioning

PS EL 11.2.1 The Contractor, his sub-contractors, and manufacturers of equipment, shall carry out their **own inspections and testing** to ensure that the installation complies with the Specifications. The Engineer will **not** act as the Contractor's foreman, inspector, or quality control officer.

PS EL 11.2.2 **Written notice** shall be given to the Engineer once the installation **is completed** in order that inspections can be carried out by the Engineer or his representative and the Supply Authority and/or ESKOM. However, the Engineer shall have the power at any time to examine any part of the installation or materials at the place of manufacture or on site.

PS EL 11.2.3 A **defect list** shall be compiled by the Engineer or his representative, which will be made available to the Contractor for his further attention. A rectification period of seven days will be allowed unless otherwise indicated in the taking-over certificate.

PS EL 11.2.4 **Written notice** shall then again be given to the Engineer when the **defects items** have been attended to and to confirm that the installation is ready for inspection by the Engineer or his representative. This procedure will continue until the entire installation has been completed according to the specification

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PS EL 11.2.5 All time and travelling **costs** incurred by the Engineer for further inspections after the second inspection will be for the Contractor's account.

PS EL 11.2.6 A **Certificate of Compliance** by an accredited person shall be submitted to the Client in terms of the Occupational Health and Safety Act. A copy shall be submitted to the Engineer.

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PS EL 11.2.7 The necessary arrangements will be made to carry out **inspections and tests** as required by the Supplier of Electricity and/or ESKOM.

PS EL 11.2.8 All **test equipment**, tools and other instruments shall be made available to the Engineer who may perform tests.

PS EL 11.2.9 The **costs** related to all inspections and tests shall be priced in the Preliminary and General of the Schedule of Quantities if not priced elsewhere.

Final payment will be withheld until all the conditions related to inspections and testing have been met.

PS EL 11.3 **Factory Inspections and Tests**

PS EL 11.3.1 **Written notice** shall be given to the Engineer of any factory inspections and tests to be carried out during the course of manufacture in the manufacturer's factory or works. The Contractor shall submit a list of inspections and tests to be performed on the equipment for approval.

PS EL 11.3.2 **Equipment dispatched** from the factory without being inspected and tested, will be at the Contractor's own risk.

PS EL 11.3.3 The manufacturer shall perform **all routine tests** in the factory as described by SABS, NRS, IEC and/or BSS as well as the manufacturers' own standard routine tests. **Type tests** shall be performed as described in the relevant equipment specifications.

PS EL 11.3.4 The Contractor shall submit **certified copies** of all type, routine and rating test certificates to the Engineer not later than the delivery date of the equipment.

PS EL 11.4 **Site Tests**

PS EL 11.4.1 The Contractor shall pay special attention to the Inspection Requirements as specified above.

PS EL 11.4.2 Inspections will be carried out from time to time by the Engineer's representative during the progress of the work. **Defects or discrepancies** will be pointed out to the Contractor and under no circumstances will these inspections relieve the Contractor of his obligations in terms of the contract nor will these inspections be regarded as final approval of the works or portions thereof.

Inspections by any representative of the Engineer shall not be regarded as relief

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of the Contractor's obligations in terms of the contract. The Contractor shall notify the Engineer timeously when the installation reaches important stages of completion (e.g., Before closing of cable trenches).

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PS EL 11.4.3 The installation shall on completion **be inspected and test** specifically in accordance with the Wiring Code, the Occupational Health and Safety Act and Regulations of the Supplier of Electricity and/or ESKOM requirements. The following tests shall inter-alia be carried out and test results shall be submitted to the Engineer:

- Operation of pump control circuit
- Continuity of ring circuit.
- Continuity and resistance of earth conductors including all bonding conductors.
- Ensure correct polarity, phase rotation and balance load between the phases.
- Verify polarity and phase identification.
- Trip testing and proving of all protection equipment.

PS EL 11.4.4 The Contractor shall perform any **additional standard tests** that may be required by the Engineer or the Client.

PS EL 11.4.5 **Copies of Site Test Certificates** shall be submitted to the Engineer within seven days after completion of tests.

PS EL 11.5 **Commissioning**

PS EL 11.5.1 The complete installation shall be comprehensively **pre-commissioned** as individual and integrated systems by the Contractor to satisfy himself that the installation is in an acceptable working condition.

PS EL 11.5.2 **Competent commissioning personnel** shall be made available during the whole duration of the total commissioning stage.

PS EL 11.5.3 The necessary **co-ordination** shall be carried out between contractors to ensure the proper operation of the complete installation. The Contractor shall prove the full operation, working and compliance of the installation in accordance with the specification.

PS EL 11.5.4 **Written notice** shall be given to the Engineer when the installation is ready for final commissioning.

PS EL 12. **DRAWINGS, MANUALS AND TUITION**

PS EL 12.1 **Drawings**

PS EL 12.1.1 **Engineer's Drawings**

The Electrical drawings as issued by the Engineer shall form part of the contract. The drawings are listed in the schedules. These drawings are of **schematic nature** only and, unless specific dimensions to equipment are shown, these drawings shall not be

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scaled to determine physical dimensions or positions of equipment.

PS EL 12.1.2 The working drawings of the contract shall consist of the following:

- a) Electrical Engineer's drawings;
- b) All other Engineer's drawings of other disciplines;
- c) Installation drawings of other contractors and sub-contractors.

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PS EL 12.1.3 **Three sets** of Engineer's drawings will be issued to the Contractor for installation purposes. Further copies will be made available at the cost of the Contractor.

PS EL 12.2 Workshop Drawings

PS EL 12.2.1 The Contractor shall submit for approval **three sets of copies of workshop drawings** to the Engineer, of all items to be manufactured or assembled.

PS EL 12.2.2 The Workshop Drawings shall include all necessary **information** e.g., Schematic diagrams, general layouts, schedules etc. to demonstrate compliance with the contract.

PS EL 12.2.3 The Contractor shall allow at least **one-week approval time** for the Engineer.

PS EL 12.2.4 Examination of shop drawings by the Engineer shall not relieve the Contractor of **responsibility from any deviation** from requirements of this contract unless written approval for specific deviations has been obtained from the Engineer.

PS EL 12.2.5 The existing drawings shall also be marked-up and reproduced to allow for all the required modifications.

PS EL 12.3 "As-Built" Drawings

PS EL 12.3.1 **"As-built" drawings** shall be prepared by the Contractor as each portion of the work is completed. The "as-built" requirements shall be marked-up on paper drawings or on CAD drawings provided by the Engineer.

PS EL 12.3.2 The **costs** related to all drawings shall be priced in the Preliminary and General section of the Schedule of Quantities if not priced elsewhere.

PS EL 12.4 Manuals

PS EL 12.4.1 **Four sets of manuals** shall be submitted before the works are taken over by the Client. The manuals shall be hard cover bound and properly indexed. A draft manual shall first be submitted for approval by the Engineer.

PS EL 12.4.2 The manuals shall contain the following minimum information:

1. Physical layout and general arrangement drawings of equipment.
2. System and component descriptions.
3. Schematic diagrams and drawings.
4. Cable schedules and diagrams.
5. All test and commissioning certificates.
6. Equipment and system descriptions.

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7. Operating, maintenance and tests instructions with recommended program.
8. Fault-finding analysis.
9. Spare parts with component and supplier details.

PS EL 12.4.3 The **contract shall not be regarded as complete** until the manuals have been finally approved by the Engineer and handed over to the Client. Final payment will be withheld until the final manuals are produced.

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PS EL 12.5 Tuition

PS EL 12.5.1 The Contractor shall allow for **tuition of the Client's staff** during the commissioning period.

PS EL 12.5.2 Thorough tuition of the staff shall also be provided at the time of completion of the works. The necessary **tuition material** and manuals shall be made available to the staff.

PS EL 12.5.3 The **costs** related to tuition shall be priced in the Summary section of the Schedule of Quantities if not priced elsewhere.

PS EL 12.5.4 The Contractor shall allow for tuition of Local Residents during the Construction period. The necessary tuition material shall be made available, and the Contractor shall apply the necessary skilled personnel for such tuition.

PS EL 13. SPARES AND TOOLS

PS EL 13.1 The Schedule for Spares and Tools shall be properly completed and **priced** during the tender stage. The price shall be carried forward and included in the tender sum when required.

PS EL 13.2 Spares shall cover at least **ten (10) years** of operation.

PS EL 13.3 **Specific tools** required for equipment shall be regarded to form part of such equipment and shall be priced as such.

PS EL 14. MAINTENANCE AND GUARANTEE

PS EL 14.1 The Contractor will not be required to do any maintenance during the **guarantee period** unless otherwise specified. Maintenance will be carried out by the Supply Authority or the Client.

PS EL 14.2 The Contractor shall guarantee the material, apparatus and workmanship delivered by him for a **period of twelve (12) months**. The guarantee must be valid for a period starting on the date when the Contract is accepted by the Engineer as completed and in working condition. The complete installation must be guaranteed against defects as a result of patent and latent defects of the design and apparatus, save design defects made or specified by the Engineer, as well as against faulty materials and workmanship. Fair wear and tear is excluded from the guarantee. The guarantee must provide that all parts, spares, and appliances that become defective during the guarantee period be replaced free of charge of any nature to the Employer or the Engineer. The costs of labour and transportation required to replace such part of a

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defective installation shall be borne by the Contractor and shall be included in his guarantee.

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SUPPLY AND INSTALLATION OF A TELEMETRY SYSTEM AT RESERVOIRS UNDER THE VONDO RWS

TELEMETRY AND ASSOCIATED WORK

PART 2: PARTICULAR SPECIFICATIONS

INDEX

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STANDARD SPECIFICATION

GENERAL REQUIREMENTS

EL 001

STANDARD SPECIFICATION GENERAL REQUIREMENTS C O N T E N T S

CLAUSE	DESCRIPTION	PAGE
1	SCOPE OF WORK	1
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***For Specifier use

1. SCOPE OF WORK

- 1.1 The specific scope of work shall be as specified in the Project Specification, *** as indicated on the Drawings, as reflected in the Schedules of Quantities and other Schedules.
- 1.2 All items indicated with “ *** ” in this Standard Specification is only for the assistance of the specifier and can be ignored by the Tenderers.
- 1.3 The Contract shall include the supply, delivery, installation, testing, commissioning, and handing over in proper working order of the complete services installation as described in all the constituent parts of this document.

2. GENERAL INFORMATION AND DEFINITIONS

2.1 Standard Technical Specification

This Standard Technical Specification covers the standard of workmanship and quality of materials for the electrical installation and shall be read in conjunction with the Project Specification, Drawings and Schedules, and if applicable, Schedules of Quantities.

2.2 Tender Documents

- 2.2.1 Tenderers shall ensure that all pages and drawings are **included** upon receiving of a tender document. The Tenderer must immediately inform the Engineer should any page, drawing or part of the document be missing. Any doubt or obscurity about the meaning of any section of any part of the documentation or obvious errors must also immediately be referred to the Engineer.
- 2.2.2 Where **contradictions** occur between the Project Specification and the Standard Specification, preference shall be given to the Project Specification.
- 2.2.3 A tender may not be considered and may be disqualified if the information requested in the **Schedules are not completed** and other information called for not submitted.
- 2.2.4 Any **deviations from the specifications** shall be explicitly stated in the tender submission, by stating the specific deviations and applicable reference clauses.
- 2.2.5 Tenderers may submit **alternative offers**, only if a **main tender** is submitted.

2.3 Definitions

- 2.3.1 DOCUMENT shall mean the complete set of contract documents, consisting of the Conditions of Tender, Conditions of Contract, the Standard Technical Specification and the Project Specification, Schedule of Quantities, other Schedules including all Drawings and Variation Orders issued in terms of the Contract.
- 2.3.2 CONTRACTOR shall mean the person, partnership, company or firm appointed for the manufacture, installation, testing, commissioning and maintenance of the Electrical Installation. In the case of the Electrical Installation being subcontracted, nominated, selected, or otherwise in terms of the Main Contract, the word CONTRACTOR shall have the meaning of SUBCONTRACTOR in terms of Subcontract Conditions for the specific installation. Where applicable the Builder or Principal Contractor shall be referred to as MAIN CONTRACTOR.

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- 2.3.3 EXTRA LOW VOLTAGE shall mean voltages of 50V or less.
- 2.3.4 LOW VOLTAGE shall mean voltages between 50V and 1000V.
- 2.3.5 MEDIUM VOLTAGE shall mean voltages between 1000V and 11kV.
- 2.3.6 HIGH VOLTAGE shall mean voltages above 11kV.
- 2.3.7 PROVIDE shall mean supply and install.
- 2.3.8 SUPPLY shall mean purchase, procure, acquire, store off site as necessary, deliver to site, and off-load, position, stack and store on site.
- 2.3.9 INSTALL shall mean set out, erect, mount, align, fix, connect, adjust, test and commission and hand-over in proper working order.

3. REGULATIONS AND STANDARDS

- 3.1 Where reference is made to any Code of Practice or Standard Specification the **latest amendment or edition** shall apply. Tenderers and Contractors shall ensure that they are acquainted with the contents of such documents. The Contractor shall ensure compliance with these specifications and if requested by the Engineer shall prove compliance at his own cost.
- 3.2 The Contractor shall immediately after receipt of the official appointment **issue all notices and pay all required fees** in respect of the installation to the Authorities, and shall exempt the Engineer from all losses, claims, costs or expenditure which may arise as a result of the Contractor's negligence to comply with the requirements of the Regulations. Copies of such correspondence shall be forwarded to the Engineer, but this shall not release the Contractor of his responsibilities.
- 3.3 The **costs of all arrangements** with the Local Authority or Supply Authority with regard to inspections, tests and requirements to comply with the Regulations, and any associated costs shall be included in the tender amount.
- 3.4 **Conflicts** between any of the Regulations and Standards listed below and the Contract Specifications shall be referred to the Engineer in writing for his ruling.

3.5 Regulations

The installation shall comply with the latest issues and amendments of the following regulations, as applicable:

- 3.5.1 The Occupational Health and Safety Act.
- 1) Register himself and sub-contractors in terms of the **Compensation for Occupational Injuries and Diseases Act** and a copy thereof shall be submitted to the Engineer.
 - 2) Appoint in writing a **capable person** that complies with the Act to act as a capable person, and a copy of such an appointment shall be submitted to the Engineer.
 - 3) Ensure the **safe operation** and safety of all people on site and to strive for a proper management and clean and safe site.

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- 4) Where work is to be carried out in the proximity of live electrical equipment the Contractor shall make all necessary arrangements with the relevant Supply Authority to **isolate and earth** such equipment.
- 5) The Electrical Contractor shall annually register with the **Electrical Contracting Board of South Africa** as required by the Act.

3.5.2 SABS Code of Practice 0142 for the Wiring of Premises, refer to herein as the "Wiring Code"

3.5.3 National Building Regulations.

3.5.4 The Local Municipal By-Laws and Regulations as well as the Regulations of the Local Supply Authority.

3.5.5 The Standard Regulations of any Government Department, other Statutory Body or Public Service Company where applicable.

3.5.6 The Local Fire Regulations.

3.5.7 The Mines and Works Regulations and Government Notice No R1609 where applicable.

3.5.8 The Regulations of the Department of Posts and Telkom.

3.5.9 The Regulations of the Supplier of Electricity.

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3.6 **Standard Specifications**

The Installation shall conform to the following applicable SABS or NRS Specifications and Codes of Practices or the BSS or IEC Specifications where no SABS Specifications or Code of Practices exist:

All the equipment and materials shall conform to the relevant SABS, NRS, BSS or IEC Specifications and the latest revisions thereof, where applicable.

*SANS/SABS IEC SPECIFICATION

DESCRIPTION	NRS	SABS	IEC	BSS
1. AERIAL BUNDLE CONDUCTORS				
1.1 Aerial bundled conductor cable systems.....		1418		
1.2 Installation of ABC cables		10198 Part XIV		
1.3 LV Aerial Bundled Conductors : Fittings	018			
1.4 Aerial Bundled Conductors : Cable Ties.....	020			
2. BATTERIES AND CHARGERS				
2.1 <u>Batteries</u> General Information Definitions, Abbreviations, Symbols and Formulae		1632-1		
2.2 Stationery Lead Acid Batteries Vented Types.....		1632-2		
2.3 Vented Type Prismatic Ni-Cad.....		1632-3		
2.4 Battery Chargers	026	1652		
3. BUSBAR TRUNKING SYSTEMS		1195 1473-2 1473-1 60439-2	439*	

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DESCRIPTION	NRS	SABS	IEC	BSS
4. CABLE TRUNKING AND DUCTING			61084-2-1	
5. CABLES				
5.1 3,3 kV 33 kV Paper insulated cables		10198, 97		
5.2 PVC insulated cables		10198, 1507,1574		
5.3 XLPE insulated cables		10198, 1339		
5.4 Materials of insulated cables and cords		1411		
5.5 Cables, lugs and ferrules.....	028			
6. CIVIL WORKS EXCAVATIONS				
6.1 Standardized specification for civil engineering construction: (1) Site clearance.....		1200C		
(2) Earthworks (small work)		1200DA		
(3) Earthworks (pipe trenches).....		1200DB		
(4) Bedding (pipes)		1200LB		
(5) Cable ducts		1200LC		
7. CODE OF PRACTICE FOR EARTHING OF LOW VOLTAGE DISTRIBUTION SYSTEMS		0292		
8. COPPER FOR ELECTRICAL PURPOSE, ROD & BAR				1433
9. DEGREE OF PROTECTION		1222	60529 529	
10. DIESEL ALTERNATOR SETS	024			
11. EARTH CODE OF PRACTISE		10313		
12. ELECTRICAL DISTRIBUTION BOARDS, ARCHITRAVE, SURFACE AND SMALL TYPES		1765, 1973, 1473		
13. IDENTIFICATION COLOUR MARKING		60439, 0140		
14. INSTRUMENTS AND RELAYS				
14.1 Electrical instruments and meters		1799	64, 53	37 5685 + 89
14.2 Electrical Protective Relays		1299	51,57	142

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DESCRIPTION	NRS	SABS	IEC	BSS
15. LIGHTING				
15.1 Interior lighting		0114		5206
15.2 Interior luminaires for fluorescent lamps		1119	598	
15.3 Safety of Luminaires		1464		
15.4 Streetlighting		10098		
15.5 Classification of hazardous locations and the selection of electrical apparatus for use in such locations		10108	79 Part 10	
15.6 Degrees of protection of enclosures			144	
15.7 Photo Electric Control Units (PECU's) for Lighting	025	1777		
15.8 Luminaires		60598 60570		
16. LOW-COST RETICULATION				
16.1 Distribution Board for use in low cost Urban Reticulation Development ("Ready Board")	019	1619		
16.2 Recommended Practices for low-cost Urban Reticulation	023			
17. MEASURING DEVICES, EQUIPMENT & INSTRUMENTS				
		10140	414	
18. MOTORS				
18.1 Motors		948	4999 60034	5000
18.2 General requirements for rotating electrical machines				4999
18.3 Specification for electrical overhead travelling cranes				466
18.4 Dimensions of electric meters				7856
18.5 Specifications for grey iron castings				1452
19. OVERHEAD LINES				
19.1 Code of Practice for Overhead Lines	041			
19.2 Aluminium conductors, steel reinforced, for overhead power transmission lines		182		215
19.3 Aluminium Alloy Conductors		182		3242
19.4 Pine Poles and Cross-arms		753		

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DESCRIPTION	NRS	SABS	IEC	BSS
19.5 Eucalyptus Poles and Cross-arms		754		
19.6 Insulators, Lines, HV and LV		161 & 177	383	137
19.7 Insulator and conductor fittings		178		3288
19.8 Zinc coated steel wire		182 10244		
19.9 Manual No 52 (1971) Guide for the design of steel transmission lines		ASCE		
19.10 General purpose galvanized steel wire				183
19.11 Covered overhead conductor (1kV to 24kV)		182		
19.12 Stays and associated equipment	022			
20. PAINTING				
20.1 Painting		630		
20.2 Undercoat painting		681		
20.3 Zinc chromate primers for steel		679		
20.4 Colours		1091		3819
21. PLUGS AND SOCKETS FOR HOUSEHOLD APPLICATIONS		164	884*	
22. PLUGS AND SOCKETS FOR INDUSTRIAL APPLICATIONS		1239	309*	
23. PRE-PAYMENT METERS (Electricity sales systems)	009			
24. RETICULATION				
24.1 Outdoor-type current transformer	029			
24.2 Electromagnetic voltage transformers	030			
24.3 Alternating current disconnectors and earthing switches (above 1000V)	031			
24.4 Electricity distribution - Service distribution boxes - Pole-mounted (at 320V)	032			
24.5 Guidelines for the provision of electrical distribution networks in residential areas, Part 1	034-1			
24.6 Guidelines for the provision of electrical distribution networks in residential areas, Part 3 :	034-3			
24.7 Outdoor distribution cut-outs (drop-out fuses) - pole-mounted type up to 22 kV	035			

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DESCRIPTION	NRS	SABS	IEC	BSS
24.8 Auto-reclosers and sectionalizers pole-mounted types	036-1			
24.9 Surge arresters - application guide for distribution systems.....	039			
24.10 HV operating regulations, Part 1: Definitions of terms	040-1			
24.11 HV operating regulations, Part 2: Voltage colour coding	040-2			
24.12 HV operating regulations, Part 3: Model regulations	040-3			
25. SEMI CONDUCTOR CONVERTORS			146	62477-1
26. SWITCHGEAR, DISTRIBUTION AND CIRCUIT BREAKERS				
26.1 Circuit breakers above 1 kV	003/91		56*	
26.2 Contactors		947	158/ 947*	5424
26.3 Contactors above 1 kV.....				7671
26.4 Electrical power, switchgear and associated equipment.....		152/156	947*	
26.5 Earth leakage protection units		767		
26.6 Metal-enclosed switchgear				
26.7 Insulation co-ordination		1019	71	
26.8 Bushings for alternating voltage above 1 kV.....			137	
26.9 Busbars and busbar connections		60439-2, 61641	228	159
26.10 Bushings		1035 +1037	60073	223
26.11 Indicator lights			947	
26.12 Post insulators			273	
26.13 Push buttons.....			947*	4794
26.14 Specification and acceptance on Sulphur Hexa Fluoride (SF6)			376	
26.15 Disconnectors and earthing switches (above 1000V)	031	947		
26.16 Switches above 1kV			265*	
26.17 Lightning arresters (LV)			171, 99	

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DESCRIPTION	NRS	SABS	IEC	BSS
26.18 Surge diverters	029		61643	3938
26.19 Switchgear and control gear above 1 kV			298*	
26.20 Current transformers			185	
26.21 Switch fuse combinations (HV)	030		62274-105	3941
26.22 Voltage transformers			60044	
26.23 Capacitors			871	
26.24 Cable sealing boxes		156	947*	2562
26.25 Moulded case circuit breakers				
26.26 Flameproof enclosures for electrical				
26.27 Isolators and earthing switches		314, 79	129*	5253
26.28 Glass-fibre products				
26.29 FUSES				
(1) Low voltage	009	60282	282* & 947*	88
(2) High voltage			282*	2692
26.30 Electricity sales systems				
27. SWITCHGEAR AND CONTROL GEAR ASSEMBLIES (LOW VOLTAGE)		1473-1	439*	
28. STEELWORK AND TREATMENT				
28.1 Structural steel sections		222		4
28.2 Weldable structural steels				4360
28.3 Isometric black hexagon and square bolts, screws and nuts		135		
28.4 The use of structural steel in Buildings: Part 2:				449
28.5 Code of Practice for the Structural use of Steelwork		0162		
28.6 Structural steel		1431		
28.7 Structural steel tables		SAISC		
28.8 Mild steel rivets		435		

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DESCRIPTION	NRS	SABS	IEC	BSS
28.9 Electro-plated coatings of tin				1872
28.10 Hot-dip galvanized coatings on iron and steel		763		729
28.11 Phosphate treatment of iron and steel				3189
29. THE WIRING OF PREMISES		SANS 10142-1		
30. TRANSFORMERS AND MINISUBS				
30.1 Distribution power transformers.....	005	780	76*	171
30.2 Isolating transformers.....		743, 767		
30.3 Minisubs.....	004	1029+1030		
30.4 Specification for large power transformers.....		NEMA	76	171
30.5 Insulating oil for transformers and switchgear.....		555	296	
30.6 Distribution Transformers - completely self-protecting type	027			
31. WALL AND APPLIANCE SWITCHES		60669		
32. WIREWAYS FOR ELECTRICAL CABLES		1197		

4. ELECTRICITY SUPPLY

- 4.1 Electricity power supply for the Contract shall be as specified in the Project Specification.***
- 4.2 The design and arrangements for **permanent power supplies** and connection fees shall be done and paid for by others unless otherwise specified in the Project Specification.*** The provisional amount when allowed for in the Schedule of Quantities shall be included in the tender amount.
- 4.3 The Contractor shall ensure that the installation complies with the **Supply Authorities' requirements** regarding voltage, current and frequency and any other requirements which may be imposed by the Supply Authority.

5. INSTALLATION WORK, MATERIAL AND EQUIPMENT

- 5.1 The Contractor shall be responsible to carry out the work in accordance with this document, to provide the logistics and infrastructure required, to provide adequate full time supervision, to programme and manage the works, and to provide registered and qualified staff at all times.

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5.2 All materials shall be of **high quality and suitable** for the specific site conditions. These conditions shall include weather conditions as well as conditions under which the equipment are installed and operated.

5.3 Samples of equipment and material shall be submitted of all materials and equipment for approval by the Engineer prior to the installation thereof , unless prior approval to the contrary has been obtained in writing from the Engineer . Samples may be retained by the Engineer until the contract is completed.

5.4 Tenderers may offer alternative makes of equipment where the term "similar and equivalent" is used in description of equipment . The decision whether these equipment comply with the specified equipment shall be the responsibility of the tenderer to prove to the Engineer . The final decision whether the alternative equipment are acceptable will be taken by the Engineer and any decisions shall not alterate the tender sum or any rates

5.5 Materials shall be, where possible, of South African manufacture.

6. CO-ORDINATION

6.1 The Contractor shall be responsible for the co-ordination with other Contractors to ensure the correct installation and operation of equipment. Co-ordination problems that cannot be solved amongst the Contractors shall be referred to the Engineer for his ruling and or his assistance .

6.2 The costs associated with co-ordination work shall be priced as a Preliminary and General item in the Schedule of Quantities.

6.3 The cost of relocation of or adjustment to equipment due to the lack of co-ordination shall be for the Contractors own account.

7. DESIGN RESPONSIBILITIES

The design responsibility of the systems, rest with the Engineer with regard to the interpretation of the Client's requirements, the general layouts and arrangements and the functionality of the systems. The detailed installation design responsibility does, however, rest with the Contractor with regard to the design for manufacturing, installation and the compliance to specifications and requirements which are stipulated in the Contract documents and indicated on the drawings.

8. BUILDER'S WORK

8.1 The Contractor shall be responsible to co-ordinate with the Builder the placing in position as well as building-in of all conduits, other wireways, etc. as required. The Contractor shall ensure firm fixing and accurate positioning acceptable to the Builder. Costs due to lack of co-ordination shall be for the Contractor's own account.

8.2 Chasing shall only be acceptable where it is impossible to build-in or cast-in equipment.

8.3 Structural concrete, face-brick or finished surfaces shall not be chased without the permission of the Engineer and Builder.

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8.4 The Contractor will be responsible for the repair to any damages caused by him to building work because of chasing.

8.5 The Contractor shall timeously co-ordinate and provide information to the Builder for all openings, sleeves, ducts and other requirements under this contract.

9. FIXING MATERIALS

9.1

General

9.1.1 This section covers the general requirements for the fixing of electrical equipment such as luminaires, switch outlets, cable racks, trunking etc.

9.1.2 The contractor shall be responsible to **provide and fix** all supports, clamps, brackets, hangers and other fixing materials.

9.1.3 **Samples** shall be submitted to the Engineer for his approval where fasteners are not specified or covered by this specification .

9.1.4 Fixing materials shall be installed in accordance with the **manufacturer's instructions**.

9.1.5 **Galvanized** screws, bolts and nuts shall be used to fix galvanized equipment or any equipment exposed to corrosive conditions. **Brass or stainless steel** fasteners will also be acceptable in corrosive conditions.

9.1.6 Clamps and brackets used to fix support elements such as cable racks, trays and ducts shall be **purposely fabricated by the suppliers** of the support elements, for the specific application. Specially made brackets or clamps shall only be used after written approval has been obtained from the Engineer.

9.1.7 **Screws** for wood work shall be used for fixings to wood and nails shall not be accepted.

9.2 Welding

The welding of supports, brackets, hangers etc. to steel structural members shall only be allowed when permission has been obtained from the Engineer.

9.3 Wall Plugs

9.3.1 Wall plugs may be used for the fixing of equipment where the mass of the equipment is **less than 15 kg**.

9.3.2 Wall plugs shall only be of the **hard nylon** type similar or equivalent to the "fisher" type. Wooden plugs shall not be acceptable.

9.3.3 Plugs shall not be installed in seams between bricks and the correct size of masonry drill shall be used.

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9.4 Anchor Bolts

- 9.4.1 Only Anchor bolts shall be used for the fixing of equipment where the mass of the equipment is **more than 15 kg**.
- 9.4.2 Equipment shall be fixed by means of expanding anchor bolts or bolts cast into the concrete or built into the walls.

9.5 Shot-fired Fixing

- 9.5.1 Shot-firing shall only be permissible when **permission** has been obtained from the Engineer in writing. Shot-firing shall not be permissible into any brickwork, aerated-concrete or precast concrete. The Contractor shall be responsible for any damages to building work because of any unauthorized fixing by shot-firing.
- 9.5.2 Materials such as **metal trunking or channels** may be fixed by means of shot-firing. The contractor shall ascertain whether this method of fixing is adequate for the total installed mass of equipment and materials.
- 9.5.3 The Contractor shall take all necessary precautions to **prevent accidents**.

10. SUBSTATION REQUIREMENTS**10.1 Danger Signs and Notices**

- 10.1.1 Danger Signs and Notices shall be provided at entrances, doors and on equipment as required by the relevant Regulations.
- 10.1.2 A “**flash**” sign and notices **prohibiting unauthorised persons** from entering premises shall be provided on all outside doors of substations as well as on all gates of substation yards.
- 10.1.3 The following notices shall also be provided and mounted inside substation buildings:
1. A notice containing directions as to **resuscitation** of persons suffering from the effects of electrical shock.
 2. A notice containing directions as to procedure **in case of fire**.
 3. A notice prohibiting **unauthorised persons** from handling or interfering with electrical apparatus.

10.2 First Aid Kits

- 10.2.1 One First Aid Kit shall be provided for every substation building unless otherwise specified.*** The kit shall be of the **industrial type** as supplied by St Johns Ambulance or the South African First Aid Society. The kit shall be housed in a suitable metal box.
- 10.2.2 The First Aid Kit shall be **mounted** in an approved manner at the main substations' main entrance door.

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10.3 Fire Extinguishers

- 10.3.1 The room of every substation building i.e. MV room, LV room, and Transformer room shall be equipped with a multi-purpose **dry powder type fire extinguisher** unless otherwise specified.***
- 10.3.2 The expellant of the powder shall be of the **CO₂ type to extinguish fires** associated with electrical equipment. The total mass of the extinguishers shall not be less than 10 kg and be not more than 12,5 kg.
- 10.3.3 The fire extinguisher shall be mounted on **wall brackets** next to the exit doors.

11. NAME BOARDS

- 11.1 Name boards shall be supplied, delivered and erected by the Contractor when specified in the Project Specification.***
- 11.2 The requirements and layout for the name board shall be according to the drawings.
- 11.3 The name boards shall be manufactured and constructed from durable materials, suitable for the environmental conditions exposed to.
- 11.4 The number of name boards required shall be indicated in the Schedule of Quantities.

12. FINISHING AND PAINTING**12.1 General**

- 12.1.1 The finishing and painting of materials and equipment shall be adequate to **avoid corrosion**.
- 12.1.2 Conditions shall be deemed corrosive within **50 km radius from the coast or at pump stations, water treatment and sewage treatment works**.
- 12.1.3 Dry film **thickness** shall be measured to SABS Standard Test Method 140 or 141.
- 12.1.4 Steel metal components of switchgear panels shall be finished with a high-quality paint applied according to the best applicable method. Electrostatically applied **powder coating** or **baked enamel coating** shall be used unless otherwise specified.*** Special care shall be taken to ensure that all edges and corners are properly covered.
- 12.1.5 The Contractor shall ensure that all paint surfaces are **cleaned and undamaged** before handing over to the Client. Small, damaged areas may be covered up with matching touch up paint.
- 12.1.6 The **colour** shall be in accordance with the requirements specified for the specific equipment. Any uncertainties shall be referred to the Engineer.

12.2 Corrosive Applications

- 12.2.1 **Hot dip galvanizing** of equipment shall be in accordance with SABS 763 heavy duty when galvanizing is required or specified.

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12.2.2 The galvanizing process shall only be applied when the **fabrication is completed** including all drilling and cutting of steel work.

12.2.3 **Damage** to galvanizing shall be pointed out to the Engineer before reinstatement there-of. Seriously damaged surfaces shall only be reinstated by returning the equipment for re-galvanizing. Minor damaged galvanized surfaces shall be reinstated as follows:

- When hot dipped galvanized : Hot zinc spraying to SABS 763
- When electro-galvanized : Two coats of zinc-rich paint

12.2.4 The Engineer reserves the right **to reject** any unsatisfactory and misfit equipment resulting from any unsatisfactory galvanizing. The cost for all such corrections shall be borne by the Contractor.

12.3 Non-corrosive Applications

12.3.1 Baked Enamel Finish

- 1) All metal parts shall be thoroughly **cleaned**, prior to painting, of rust, mill scale, grease and foreign matter to ensure a continuous metallic finish. Sand or shot blasting or acid pickling and washing shall be used for this purpose.
- 2) Immediately after cleaning, all surfaces shall be covered by an electrolytically applied rust inhibiting, tough, unbroken **metal phosphate** film and be thoroughly dried
- 3) Within 48 hrs after phosphating, a **passivating layer** consisting of high-quality zinc chromate painter shall be applied, followed by **2 coats of high quality baked enamel** according to SABS 783 Type 1. The minimum thickness, after baking, shall be **90micro mm**.
- 4) The paint shall have a **shock resistance of 25kg** cm on 0.9mm soft steel plate and a **scratch resistance of 2kg**.

12.3.2 Powder Coated Finish

- 1) All metal parts shall be thoroughly **cleaned**, prior to painting, of rust, mill scale, grease and foreign matter to ensure a continuous metallic finish. Sand or shot blasting or acid pickling and washing shall be used for this purpose.
- 2) The metal parts shall be **pre-heated** and then covered by a micro structured paint **powder** applied electrostatically.
- 3) The paint shall be **baked on** and shall be hardened within 10min at a temperature of 190°C.
- 4) The minimum paint thickness after painting shall be **70micro mm**.
- 5) The paint shall have a **shock resistance of 25kg** cm on 0.9mm soft steel plate and a **scratch resistance of 2kg**.

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13. INSPECTION, TESTS AND COMMISSIONING

13.1 Inspection Requirements

- 13.1.1 The Contractor, his sub-contractors and manufacturers of equipment, shall carry out their **own inspections and testing** to ensure that the installation complies with the Specifications. The Engineer will **not** act as the Contractor's foreman, inspector or quality control officer.
- 13.1.2 **Written notice** shall be given to the Engineer once the installation **is completed** in order that inspections can be carried out by the Engineer or his representative. However, the Engineer shall have the power at any time to examine any part of the installation or materials at the place of manufacture or on site.
- 13.1.3 A **defect list** shall be compiled by the Engineer or his representative which will be made available to the Contractor for his further attention. A rectification period of seven days will be allowed unless otherwise indicated in the taking-over certificate.
- 13.1.4 **Written notice** shall then again be given to the Engineer when the **defects items** have been attended to and to confirm that the installation is ready for inspection by the Engineer or his representative. This procedure will continue until the entire installation has been completed according to the specifications.
- 13.1.5 All time and travelling **costs** incurred by the Engineer for further inspections after the second inspection will be for the Contractor's account.
- 13.1.6 The installation shall on completion **be inspected and test** specifically in accordance with the Wiring Code, the Occupational Health and Safety Act and Regulations of the Supplier of Electricity. The following tests shall inter alia be carried out and test results shall be submitted to the Engineer:
- Operation of earth leakage protection devices and circuit breakers.
 - Earth fault loop impedance test.
 - Insulating resistance.
 - Earth electrode resistance.
 - Continuity of ring circuit.
 - Continuity and resistance of earth conductor including all bonding conductors.
 - Ensure correct polarity, phase rotation and balance load between the phases.
Verify polarity and phase identification.
 - Trip testing and proving of all protection equipment.
- 13.1.7 A **Certificate of Compliance** by an accredited person shall be submitted to the Client in terms of the Occupational Health and Safety Act. A copy shall be submitted to the Engineer.
- 13.1.8 The necessary arrangements will be made to carry out **inspections and tests** as required by the Supplier of Electricity.

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13.1.9 All **test equipment**, tools and other instruments shall be made available to the Engineer who may perform tests.

13.1.10 The **costs** related to all inspections and tests shall be priced in the Preliminary and General section of the Schedule of Quantities if not priced elsewhere.

Final payment will be withheld until all the conditions related to inspections and testing have been met.

13.2 **Factory Inspections and Tests**

13.2.1 **Written notice** shall be given to the Engineer of any factory inspections and tests to be carried out during the course of manufacture in the manufacturer's factory or works. The Contractor shall submit a list of inspections and tests to be performed on the equipment for approval.

13.2.2 **Equipment dispatched** from the factory without being inspected and tested, will be at the Contractor's own risk.

13.2.3 The manufacturer shall perform **all routine tests** in the factory as described by SABS, NRS, IEC and/or BSS as well as the manufacturers' own standard routine tests. **Type tests** shall be performed as described in the relevant equipment specifications.

13.2.4 The Contractor shall submit **certified copies** of all type, routine and rating test certificates to the Engineer not later than the delivery date of the equipment.

13.3 **Site Tests**

13.3.1 The Contractor shall pay special attention to the Inspection Requirements as specified above.

13.3.2 Inspections will be carried out from time to time by the Engineer's representative during the progress of the work. **Defects or discrepancies** will be pointed out to the Contractor and under no circumstances will these inspections relieve the Contractor of his obligations in terms of the contract nor will these inspections be regarded as final approval of the works or portions thereof.

Inspections by any representative of the Engineer shall not be regarded as relief of the Contractor's obligations in terms of the contract. The Contractor shall notify the Engineer timeously when the installation reaches important stages of completion (eg. Before closing of cable trenches).

13.3.3 The Contractor shall perform any **additional standard tests** that may be required by the Engineer or the Client.

13.3.4 **Copies of Site Test Certificates** shall be submitted to the Engineer within seven days after completion of tests.

13.4 **Commissioning**

13.4.1 The complete installation shall be comprehensively **pre-commissioned** as individual and integrated systems by the Contractor to satisfy himself that the installation is in an acceptable working condition.

13.4.2 **Competent commissioning personnel** shall be made available during the whole duration of the total commissioning stage.

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- 13.4.3 The necessary **co-ordination** shall be carried out between contractors to ensure the proper operation of the complete installation. The Contractor shall prove the full operation, working and compliance of the installation in accordance with the specification.
- 13.4.4 **Written notice** shall be given to the Engineer when the installation is ready for final commissioning.
- 13.4.5 All **relay settings** shall be calculated by the Contractor and settings shall be submitted for approval to the Engineer at least one week prior to commissioning. Calculation sheets and graphs shall accompany these settings.
- 13.4.6 All **protection equipment** shall be properly calibrated and set up by the Contractor before the system is energised.

14. DRAWINGS, MANUALS AND TUITION

14.1 Drawings

14.1.1 Engineer's Drawings

- The Electrical drawings as issued by the Engineer shall form part of the contract. The drawings are listed in the schedules. These drawings are of **schematic nature** only and, unless specific dimensions to electrical equipment are shown, these drawings shall not be scaled to determine physical dimensions or positions of equipment.
- The working drawings of the contract shall consist of the following:
 - Electrical Engineer's drawings;
 - Architect's drawings;
 - All other Engineer's drawings of other disciplines;
 - Installation drawings of other contractors and sub-contractors.
- Three sets** of Engineer's drawings will be issued to the Contractor for installation purposes. Further copies will be made available at the cost of the Contractor.

14.1.2 Workshop Drawings

- The Contractor shall submit for approval **three sets of copies of workshop drawings** to the Engineer, of all items to be manufactured or assembled.
- The Workshop Drawings shall include all necessary **information** e.g., Schematic diagrams, general layouts, schedules etc. to demonstrate compliance with the contract.
- The Contractor shall allow at least **one week approval time** for the Engineer.
- Examination of shop drawings by the Engineer shall not relieve the Contractor of **responsibility from any deviation** from requirements of this contract unless written approval for specific deviations has been obtained from the Engineer.

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14.1.3 "AS-BUILT" Drawings

1. **"As-built" drawings** shall be prepared by the Contractor as each portion of the work is completed. The "as-built" requirements shall be marked-up on paper drawings or on CAD drawings provided by the Engineer.
2. **Schematic drawings** of main distribution boards and reticulation systems showing all cables shall be mounted in aluminum picture frames with glass and sealed rear backing inside substations.
3. **Final schematic drawings** of distribution boards shall be provided in book format or in a suitable durable folder and shall be stored inside the most convenient place of the boards.
4. The **costs** related to all drawings and picture frames shall be priced in the Preliminary and General section of the Schedule of Quantities if not priced elsewhere.

14.2 Manuals

14.2.1 **Four sets of manuals** shall be submitted before the works are taken over by the Client. The manuals shall be hard cover bound and properly indexed. A draft manual shall first be submitted for approval by the Engineer.

14.2.2 The manuals shall contain the following minimum information:

1. Physical layout and general arrangement drawings of equipment.
2. System and component descriptions.
3. Schematic diagrams and drawings.
4. Cable schedules and loop diagrams.
5. All test and commissioning certificates.
6. Equipment and system descriptions.
7. Operating, maintenance and tests instructions with recommended program.
8. Fault-finding analysis.
9. Spare parts with component and supplier details.

14.2.3 The **contract shall not be regarded as complete** until the manuals have been finally approved by the Engineer and handed over to the Client. Final payment will be withheld until the final manuals are produced.

14.3 Tuition

14.3.1 The Contractor shall allow for **tuition of the Client's staff** during the commissioning period.

14.3.2 Thorough tuition of the staff shall also be provided at the time of completion of the works. The necessary **tuition material** and manuals shall be made available to the staff.

14.3.3 The **costs** related to tuition shall be priced in the Preliminary and General section of the Schedule of Quantities if not priced elsewhere.

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15. SPARES AND TOOLS

- 15.1 The Schedule for Spares and Tools shall be properly completed and **priced** during the tender stage. The price shall be carried forward and included in the tender sum when required.
- 15.2 Spares shall cover at least **ten years** of operation.
- 15.3 **Specific tools** required for equipment shall be regarded to form part of such equipment and shall be priced as such.

16. MAINTENANCE AND GUARANTEE

- 16.1 The Contractor will not be required to do any maintenance during the **guarantee period** unless otherwise specified. Maintenance will be carried out by the Client.
- 16.2 **Four scheduled visits** shall be paid by the Contractor to the site during the guarantee period to ensure and prove full operation, working and compliance of the installation in accordance with the specification. Any non-compliance shall be reported to the Engineer. The **costs** related to these visits shall be priced in the Preliminary and General Section of the Schedule of Quantities if not priced elsewhere.
- 16.3 The Contractor shall guarantee the material, apparatus and workmanship delivered by him for a **period of twelve months**. The guarantee must be valid for a period starting on the date when the Contract is accepted by the Engineer as completed and in working condition. The complete installation must be guaranteed against defects as a result of patent and latent defects of the design and apparatus, save design defects made or specified by the Engineer, as well as against faulty materials and workmanship. Fair wear and tear is excluded from the guarantee. The guarantee must provide that all parts, spares and appliances that become defective during the guarantee period be replaced free of charge of any nature to the Employer or the Engineer. The costs of labour and transportation required to replace such part of a defective installation shall be borne by the Contractor and shall be included in his guarantee.

All **fluorescent and gaseous discharge lamps** shall also be replaced free of charge by the Contractor during the twelve (12) months period which commences and expires simultaneously with the guarantee period stated above.

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STANDARD SPECIFICATION

EARTHING AND LIGHTNING PROTECTION

EL 009

STANDARD SPECIFICATION

EARTHING AND LIGHTNING PROTECTION

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1. EARTHING

1.1 General

All electrical installations shall be earthed in accordance with the requirements of **SABS 0142, NRS 016 and the OSH act.**

1.2 Substation Earthing

1.2.1 Main Earth Bar

- 1) A **main copper earth** bar shall be provided and installed in the cable duct or against the substation wall near the L.V. terminals of the transformer.
- 2) The minimum **length** of the earth bar shall be 500mm and shall be mounted on substantial insulators.
- 3) **Terminations** onto the earth bar shall be according to the requirements as indicated on the drawings and all terminations shall be clearly marked for identification purposes.***
- 4) Terminations shall be by means of 10mm diameter **brass bolts**, nuts and locknuts.

1.2.2 Earth Electrode System

- 1) An **earth electrode system** shall be provided when indicated on the drawings or specified in the project specification.***
- 2) Earth electrodes shall be **solid and of circular** cross section. The **diameter** of the earthing electrodes shall not be less than 16mm.
- 3) The earth electrodes shall be **interconnected** and connected to the main earth bar by means of 70mm² copper conductors as indicated on the drawings.
- 4) The **distance** between earth electrodes shall be at least twice the electrode length.
- 5) The **actual earth resistance** achieved shall be measured on completion of the installation and the results shall be submitted to the Engineer for approval.

The earth resistance shall preferably **not exceed 2 ohm** and additional earthing might be required if not achieved.
- 6) The **MV equipment earth** and **LV neutral earth** shall be kept separate if the overall resistance to earth exceeds 1 ohm. Segregation shall be as specified in NRS 016 with MV equipment earth electrodes at least 5m apart from LV neutral earth electrodes.

1.3 Miniature Substation Earthing

1.3.1 The earthing of **mini-substations** shall be similar to the earthing of substations as specified above.

1.3.2 The **earth bar** in the LV compartment shall become the main earth bar.

1.3.3 All electrical equipment associated with the mini-sub shall be connected to the earth bar by means of **70mm² bare copper conductors**.

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1.4 Outdoor Substation Earthing

The earthing of outdoor substations shall be similar to the earthing of substations as specified above with the following additional requirements:

1.4.1 Perimeter Fence Earthing

- 1) A **70mm² earth conductor** shall be installed 600mm below ground level and 1000mm from the fence on the outside of the substation along the entire length of the fence.
- 2) The earth conductor shall be connected to **1,8m long earth electrodes** at each corner.
- 3) The perimeter earth wire shall be **connected to the fence** at 5m intervals as well as to the main earthing system at two points.

1.4.2 Equipment Earthing

- 1) A 70mm² bare copper earth conductor shall be buried at a depth of 600mm **around all switchgear, transformers or other equipment**.
- 2) The conductor shall be **connected to the equipment** and shall be **bonded** to the main earthing system.

1.5 Distribution Board and Equipment Earthing

1.5.1 The earth bar or earth terminal of distribution boards and electrical equipment shall be **connected** to the earth bar of the supplying distribution board in accordance with the requirements of SABS 0142, in particular Table 1 and Table 2 to determine minimum conductor sizes.

1.5.2 Earthing conductors shall be **bare copper conductors** and shall be installed on cable racks or trays or in conduits for wired systems.

1.5.3 The earthing conductor shall generally be **one size smaller** than the phase conductor but shall not be less than 2,5mm².

1.5.4 All connections shall be with **lugs and bolted** connections.

1.6 Installation Earthing

Metallic parts in the installation shall be bonded to earth in accordance with the requirements of SABS 0142. Strapping shall be carried out with minimum 12mm x 0,8mm copper strapping fixed with nuts and bolts. Particular care shall be taken with the bonding of the following:

- 1.6.1 Metallic water supply system.
- 1.6.2 Hot and cold-water systems.
- 1.6.3 Antenna and antenna coaxial cable.
- 1.6.4 Roofs, gutters, down pipes and waste pipes.
- 1.6.5 Cable ladders and trays.

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2. LIGHTNING PROTECTION

2.1 General

2.1.1 The complete lightning installation shall comply with **SABS Code of Practice 03 and 03A**.

2.1.2 All electrical, telephone, data, signal, communication, antenna and other conductors entering a lightning protected building or structure shall be **protected against potential surges** and a safe current discharge shall be provided for each conductor in the event of a **direct or induced lightning strike**.

2.2 Specialist Contractor

2.2.1 The tenderer shall include the provisional amount, as indicated in the schedule of quantities ***, in their tender price for the appointment of a **specialist contractor** for the lightning installation.

2.2.2 Unless otherwise specified ***, immediately after the award of the contract, the successful tenderer shall appoint a reputable organization, approved by the Engineer, to conduct **soil resistivity tests** on site and obtain proposals for suitable lightning protection of the building.

2.2.3 The **proposals** by the specialist contractor shall be submitted to the Engineer timeously. The proposal shall be accompanied by a **quotation** for the complete lightning installation as proposed.

2.3 Materials

2.3.1 The installation may be carried out in **copper** or suitable corrosion resistant **aluminum alloy**. The use of copper shall be avoided at ground level to avoid the possibility of theft.

2.3.2 Aluminium shall **not be installed in direct contact** with soil or any concrete or plaster surface. The aluminum conductors shall be installed on spacer bar saddles or in sleeves when below ground level.

2.3.3 **Connections between aluminum and copper** shall only be by means of cadmium-plated or tinned connectors.

2.3.4 **Connections between copper and galvanized steel** shall only be by means of tinned connectors above ground.

2.3.5 Steel components shall be **hot dipped galvanised** to SABS 763.

2.3.6 Galvanised steel shall not be used within **50 km from the coast**.

2.3.7 Roof conductors, finials and down conductors shall have a **minimum cross-sectional area of 50 mm²**.

2.3.8 **Steel reinforcing** of concrete may be used as down conductors only when specific approval has been obtained from the Engineer.

2.4 Fixings

2.4.1 Fixing material shall be of the **same material** as the conductors.

2.4.2 Conductors shall be fixed at **intervals not exceeding 1.5 m**.

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2.4.3 The fixing shall be as such to allow for the **thermal expansion and contraction** of the conductors.

2.4.4 Fixing materials shall be **durable to resist deterioration** because of environmental conditions.

2.5 Joints and Connections

2.5.1 Joints between **dissimilar metals** shall be avoided.

2.5.2 Jointing of conductors shall be with suitable **crimped ferrules**.

2.5.3 Riveted, screwed or bolted joints shall be **painted or coated** with compound.

2.5.4 Connections onto steel reinforcing shall be with **suitable clamps**.

2.6 Earth Electrodes

2.6.1 Refer to abovementioned earthing specification for specific requirements on earth electrodes.

2.6.2 An **earth electrode of at least 1.5m** shall be installed at every down conductor.

2.6.3 The **resistance to earth** of any structure shall not exceed 10 ohms, and the resistance of any single earth electrode shall not exceed 20 ohms.

2.7 Bonding

2.7.1 Refer to above-mentioned earthing specification for specific requirements on bonding of building elements.

2.7.2 All **metallic objects** within 0.5 m of a roof conductor or down conductor shall be bonded.

2.7.3 All **metallic objects on a roof** shall be bonded.

2.8 Testing

2.8.1 **Testing points** shall be provided at the connection point between every down conductor and earth electrode.

2.8.2 A **test certificate** shall be submitted with the following test results:

1) Earth resistance of every earth electrode.

2) Continuity of down conductor system by measuring from one down conductor to the other down conductors with all down conductors disconnected.

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STANDARD SPECIFICATION

PHOTOVOLTIAIC SOLAR SYSTEM

SYSTEM REQUIREMENTS

EL 033

STANDARD SPECIFICATION

SYSTEM REQUIREMENTS

C O N T E N T S

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1. GENERAL REQUIREMENTS

1.1. Introduction

The purpose of this standard specification is to provide tenderers with minimum technical specifications and performance requirements for grid and Off-grid connected solar PV systems. The standard is intended for small scale systems less than 1000 kW. The categories have been divided into the following categories:

- Grid connected systems (connected to the LV network) up to 1000 kW;
- Off-grid connected systems up to 1000 kW;

The specification will provide minimum specifications and performance requirements for system components, connection works, installations, interconnection, and quality of supply.

1.2. STANDRAD SPECIFICATIONS – GRID CONNECTED SYSTEMS

Solar PV systems of nominal capacity less than 1000kW connected to a single phase, dual phase, or three phase low-voltage (LV) utility network, shall at minimum comply with the following standards:

1.2.1. Interconnection and Quality of Supply standards

- NRS 097-2-1: 2010, Grid Interconnection of Embedded Generation, *Part 2: Small-scale embedded generation (Section 1: Utility interface)*
- NRS 048-2, Electricity supply – Quality of supply – Part 2: *Voltage characteristics, compatibility levels, limits and assessment methods.*
- Grid Connection Code For Renewable Power Plants (RPPs) Connected To The Electricity Transmission System (Ts) Or The Distribution System (Ds) In South Africa, Version 2.6, November 2011.
- NRS 048-4: Electricity supply – Quality of supply Part 4: *Application guidelines for utilities.*
- NRS 057-4: Electricity metering Part 4: *Code of practice*
- IEEE 1547 Parts 1 -6: IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
- IEC 61727, Photovoltaic (PV) systems – *Characteristics of the utility interface.*
- IEC 60364-7-712, Electrical installations of buildings – Part 7-712: *Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems.*
- IEC 62116:2008 (ed. 1), *Test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters.*
- SANS 60947-2/IEC 60947-2, Low-voltage switchgear and control gear – Part 2: *Circuit-breakers.*
- SANS 10142-1, The wiring of premises – *Part 1: Low-voltage installations.*

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The following table summarizes the technical requirements of grid connected generators under normal and abnormal operating conditions to ensure the safe operation of the embedded generator in conjunction with the utility network at all times. The embedded generator is required to automatically and safely disconnect from the grid in the event of an abnormal condition.

Description	Requirement
System under normal operating conditions	
Maximum Export Capacity	MEC < Rating of the supply point on the premises
Phase	EG > 10kW must be of the three phase type
Normal Operating Voltage	- System to be designed to be capable of operating within the voltage range of -15% to +10% around the nominal voltage. - System to synchronize with utility network before a connection is established.
Flicker	In line with NRS 048 – 2
DC injection	DC current shall not exceed 1% of rated output current into the utility AC interface under any operating condition.
Frequency (f)	$47.5 \text{ Hz} < f < 52 \text{ Hz}$
Harmonics current distortion	Total distortion $\leq 5\%$ at rated generator output. Refer to NRS 097-2-1 for individual harmonics
Power factor	- Design with capability to supply rated power for power factors ranging between 0.95 lagging and 0.95 leading available from 20 % of rated power measured at PUC. - Shall not inject reactive power into the network and the drain of reactive power limited to a power factor of 0.9.
Synchronization	Limits for the parameters for each phase: - Frequency difference: 0.3 Hz - Voltage: 5% = 11.5V per phase - Phase angle difference: 20°
Isolation	Provide means of isolating from the utility interface to allow for safe maintenance. The breaking capacity of the isolation circuit-breaker closest to the point of utility connection shall have a minimum fault current level of 6 kA in accordance with SANS 60947-2.
Earthing	In accordance with SANS 10142-1.
Short-circuit protection	In accordance with IEC 60364-7-712.
Metering	The metering installation shall measure the electricity imported and exported by the EG at the Point of Common Coupling pursuant to this agreement. The Metering Installation shall be managed in accordance to NRS 057. Metering will be the bi-directional, 4-quadrant type in line with NRS 057.

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Description	Requirement
System under abnormal operating conditions	
Disconnection switching unit	- Disconnection unit may be integrated into the inverter for utility-interconnected systems. - Unit shall be able to operate under all conditions. - The disconnection switching unit shall disconnect from the network by means of two series switches. Each switch shall be separately rated to the embedded generator's nominal power output. At least one of the switches shall be an electromechanical switch while the second switch may be part of the existing solid state switching circuits of a utility-interconnected static power converter. The electromechanical switch shall disconnect the embedded generator on the neutral and the live wire - Fault current breaking capacity of the disconnecting switch shall be appropriately sized for application
Voltage: Overvoltage and under voltage levels and conditions levels	EG shall cease to energize the system should the voltage deviate outside the conditions below. The maximum trip time in (s) under operating conditions ($V_{r.m.s}$) measured at the PUC are given below: $V_{r.m.s} < 50 \% : 0.2 \text{ s}$ $50 \% \leq V_{r.m.s} \leq 85 \% : 2 \text{ s}$ $85 \% \leq V_{r.m.s} \leq 110 \% : \text{Continuous operation}$ $110 \% < V_{r.m.s} < 120 \% : 2 \text{ s}$ $120 \% \leq V_{r.m.s} : 0.16 \text{ s}$
Frequency	- EG to provide active power reduction during high frequency conditions. Metering accuracy for frequency shall be at least $\pm 10\text{mHz}$. Disconnection conditions: - If $f < 47.5 \text{ Hz}$ for more than 200 ms. - If $f > 52\text{Hz}$ for more than 4s
Protection (Prevention of islanding)	EG shall comply with IEC 62116. EG shall be equipped with effective detection of islanded operation in all system configurations. At least one active islanding detection method should be used and be capable of shutting down generator within 2 s.
DC Current injection	Static power converter shall not inject d.c. current greater than 1 % of rated a.c. output. The EG shall cease to energize network within 500 ms if this threshold is exceeded.

1.2.2. System Components

Photovoltaic modules

The standards for PV modules have been categorized according to concentrating and non-concentrating. For definitions and terms used in the PV industry, please refer to IEC 61836: Solar photovoltaic energy systems - Terms, definitions and symbols.

I. Non- concentrating

- IEC 61724: Photovoltaic system performance monitoring – Guidelines for measurement, data exchange and analysis
- IEC 61727: Photovoltaic (PV) systems - Characteristics of the utility interface

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- IEC 61215: Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval
- IEC 61646: Thin-film terrestrial photovoltaic (PV) modules - Design qualification and type approval
- IEC 61730: Photovoltaic (PV) module safety qualification
- IEC 61277: Terrestrial photovoltaic (PV) power generating systems - General and guide.

II. Concentrating

- IEC 62108: Concentrator photovoltaic (CPV) modules and assemblies - Design qualification and type approval.
- IEC 62688: Concentrator photovoltaic (CPV) module and assembly safety qualification.
- IEC 62670-1: Concentrator photovoltaic (CPV) module and assembly performance testing and energy rating - Part 1: Performance measurements and power rating - Irradiance and temperature.
- IEC 62670-2: TS Concentrator photovoltaic (CPV) module and assembly performance testing and energy rating - Part 2: Energy rating by measurement.

Inverters

- IEC 62109-1 Safety of power converters for use in photovoltaic power systems - Part 1: General requirements.
- IEC 62109-2 Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters.
- IEC 61683 Photovoltaic systems - Power conditioners - Procedure for measuring efficiency.
- UL 1741: Standard for Inverters, Converters, and Controllers for Use in Independent Power Systems.

Balance of System

- IEC 60870 Tele control equipment and systems
- IEC 62093: Balance-of-system components for photovoltaic systems - Design qualification natural environments.

1.3. STANDRAD SPECIFICATIONS – NON-GRID CONNECTED SYSTEMS

Solar PV systems of nominal capacity less than 100kW shall at minimum comply with the following standards:

- NRS 052-3:2008: Off-grid solar home systems.
- IEC 61194: Characteristic parameters of stand-alone photovoltaic (PV) systems.
- IEC 61702: Rating of direct coupled photovoltaic (PV) pumping systems.
- IEC/PAS 62111: Specifications for the use of renewable energies in rural decentralised electrification.
- IEC 62124: Photovoltaic Stand-Alone Systems - Design Qualification and Type Approval.
- IEC 61173: Overvoltage protection for photovoltaic (PV) power generating systems - Guide.

Charge Controllers

- IEC 62509: Battery charge controllers for photovoltaic systems - Performance and functioning.
- IEC 62093: Balance-of-system components for photovoltaic systems - Design qualification natural environments.

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Batteries

- IEC 60086: Primary batteries
- IEC 61427: Secondary cells and batteries for solar photovoltaic energy systems - General requirements and methods of test.
- IEEE Std. 937: Recommended practice for installation and maintenance of lead-acid batteries for PV systems.
- IEEE Std. 1013: Recommended Practice for Sizing Lead-Acid Batteries for Photovoltaic (PV) Systems.
- IEEE Std. 1361: Recommended practice for determining performance characteristics and suitability of batteries in PV systems.

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2. PERFORMANCE GUARANTEES

2.1. Defect Warranty

2.1.1. Warranty Periods for key Components

Components	Warranty Period (Years)
Grid-Tie/Interactive Inverters	25
Mounting and Support Frames	10
Photovoltaic Solar Panels	10
AC/DC Cables	2
AC/DC Distribution Boards	2

2.1.2. In addition to the Defects Warranty, the Contractor warrants to maintain and replenish to its original level The *Employer's* Spare Parts Stock during the Defects Period, at its cost and expenses.

2.2. Solar PV Capacity Warranty

2.2.1. Nominal Installed Capacity is defined as the nominal installed capacity contracted under this Contract for the Solar PV System, measured in kWp.

2.2.2. The steady-state or long pulse illumination Test certificates, which are produced by the manufacturer of the PV Modules and delivered by the *Contractor* along with each PV Module delivered to the Site, shall be assessed by the *Employer and the Contractor* to determine whether the sum of the Test capacities (the Actual Installed Capacity) is equal to or higher than the Nominal Installed Capacity.

2.3. Delay Liquidated Damages

2.3.1. The Contractor guarantees to the Employer that the date of Substantial Completion Date during Project Construction and Commissioning. Delay liquidated damages will be applied if the Contractor is not able to achieve the guaranteed substantial completion date and if such delay is not caused by events attributable to the Employer, third party/ies, grid operator and force majeure events.

2.3.2. In the event that the delay liquidated damage Percentage is more than ten percent (10%), The Employer shall have the right to terminate the Contract in accordance with the provisions within the Contract.

2.4. Performance Warranty – Performance Liquidated Damages

2.4.1. The *Contractor* guarantees to The *Employer* that the electric output of the Plant during the 12-month period between Substantial Completion and Final Completion, shall achieve the Guaranteed Performance.

2.4.2. Exclusion from the Warranties – The *Contractor* shall not be liable for the breach of the warranties provided by this Contract, provided that such breaches are caused by:

2.4.2.1. Changes, repairs or incorrect operation by The *Employer* or its Subcontractors not expressly authorized in writing by the *Contractor*, its Subcontractors and the third parties appointed by The *Employer*;

2.4.2.2. Repairs or replacements that may be necessary because of misuse or negligent use of the equipment by the *Employer* or its Subcontractors;

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- 2.4.2.3 Use of materials, schemes or designs supplied or stipulated by The *Employer* or its Subcontractors and not validated by the *Contractor* or which do not conform to the *Contractor's* operation and maintenance manuals or technical instructions; or Failure of the *Employer* or its Subcontractors to observe the operating and maintenance instructions provided by the *Contractor* in the operation and maintenance manual, or the use of the equipment other than in the condition

6 STANDARD SYSTEM REQUIREMENTS

a. Minimum System Requirements

Maximum point power tracking (MPPT) of PV energy.

7 TECHNICAL SPECIFICATIONS

a. Solar PV modules and array

Crystalline high-power cells shall be used in the Solar Photovoltaic module. Each Solar module shall consist of 72(minimum) Photovoltaic cells redundantly interconnected and peak power rating shall not be less than 300 W. The bidder offering single module with highest wattage shall be given preference provided all other things are equal.

To connect the solar module interconnection cable shall be provided. Photo / electrical conversion efficiency of SPV module shall be greater than 17%. Module shall be made of high transmissivity glass front surface giving high encapsulation gain and hot butyl rubber edge sealant for module protection and mechanical support.

All materials used shall have a proven history of reliable and stable operation in external applications. It shall perform satisfactorily in relative humidity up to 100% with temperatures between -10 Deg C and +85 Deg C and with stand gust up to 200km/h from back side of the panel Solar module shall be crystalline type, employing lamination technology using established polymer (EVA) and Tedlar or Polyester laminate Sample modules, representative of the production processes employed in the manufacture of the offered module shall be in accordance with the requirements of IEC 61215 or UL or CE approval. Offered module may also be intrinsically safe.

The rated output power of any supplied module shall not vary more than 3 - 5% from the average power rating of all modules. The module frame is made of corrosion resistant materials, which is electrolytic ally compatible with the structural material used for mounting the module.

Protective devices against surges at the PV module shall be provided, if required. Low voltage drop bypass and / or blocking diode(s) may also be provided, if required.

Module Junction box (weather resistant) shall be designed for long life outdoor operation in harsh environment.

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A minimum warranty of 25 years shall be given with degradation of power generated not exceeding 20% over the entire period.

The solar modules shall have suitable encapsulation and sealing arrangements to protect the silicon cells from the environment. The arrangement and the material of encapsulation shall be compatible with the thermal expansion properties of the Silicon cells and the module framing arrangement/material. The encapsulation arrangement shall ensure complete moisture proofing for the entire life of the solar modules.

Each module shall have low iron tempered glass front for strength and superior light transmission. It shall also have tough multi layered polymer back sheet for environment protection against moisture and provide high voltage electrical insulation.

The fill factor of modules shall not be less than 0.70 (typical) Array capacity & PCU Capacity shall not be less than the requirement stated. Depending on size of the power plant, number of modules required shall be worked out accordingly Data sheet of the offered module shall be submitted along with the offer giving details of peak power, peak current, short circuit current, fill factor, open circuit voltage, peak power voltage etc.

Each PV module used in any solar power project must be labeled. The following minimum information must be mentioned on each module. (This can be inside or outside, but must be able to withstand harsh environmental conditions.)

- Name of the manufacturer of PV Module
- Name of the Manufacturer of Solar cells
- Month and year of the manufacture (separately for solar cells and module)
- Country of origin (separately for solar cells and module)
- I-V curve for the module
- Wattage, Im, Vm and FF for the module
- Unique Serial No and Model No of the module
- Date and year of obtaining IEC PV module qualification certificate
- Name of the test lab issuing IEC certificate
- Other relevant information on traceability of solar cells and module as per ISO 9000

2.5. Orientation / Tilt of PV Modules

Modules alignment and tilt angle shall be calculated to provide the maximum annual energy output. This shall be decided based on the location of array installation.

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2.6. Module mounting structure

The array structure shall be made of hot dip galvanized MS angles of size not less than 50 mm x 50 mm x 6 mm size. The minimum thickness of galvanization shall be at least 70 microns. All nuts & bolts shall be made of very good quality stainless steel. The minimum clearance of the lowest part of the module structure and the developed ground level shall not be less than 500 mm. The structure shall have tilt span of 0 to 60 Deg in steps of 5 deg.

Leg assembly of module mounting structure made of different diameter galvanized tubes may be accepted. The work should be completed with supply, fitting fixing of clamps, saddles, nut & bolts etc. While quoting the rate, the bidder may mention the design & type of structure offered. All nuts & bolts shall be made of very good quality stainless steel.

The structure shall be designed to allow easy replacement of any module and shall be in line with site requirements. The structure shall be designed for simple mechanical and electrical installation. It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly. There shall be no requirement of welding or complex machinery at site.

The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels at the same time it will withstand wind speed as per IS 875. The supplier/manufacturer shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings.

The drawings along with detailed design and calculations for wattage requirements shall be submitted approval before starting the execution work.

Array Foundation Base:

The legs of the structures made with GI angles will be fixed and grouted in the PCC foundation columns made with 1:2:4 cement concrete. The minimum clearance of the lowest part of any module structure shall not be less 500 mm from ground level. While making foundation design, due consideration shall be given to weight of module assembly, maximum wind speed as per Is 875 and seismic factors for the site.

The bidder can visit the site before quoting rate for civil works. After taking in to consideration all aspects of the site, condition of soil etc., the bidder shall quote for civil works. No extra claim shall be entertained at post project stage. The foundation design of module structure design shall be submitted to the client for approval. The work will be carried out as per designs approved by the client.

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2.7. Junction Boxes

The junction boxes shall be dust, vermin and waterproof and made of FRP.

The terminals shall be connected to copper bus bar arrangement of proper sizes.

The junction boxes shall have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables. Suitable markings shall be provided on the bus bar for easy identification and cable ferrules shall be fitted at the cable termination points for identification. The junction boxes shall have suitable arrangement for the following

- Combine groups of modules into independent charging sub-arrays that shall be wired to the PCU.
- Provide a test point for each sub-group for quick fault location.
- To provide group array isolation.

The rating of the JB's shall be suitable with adequate safety factor to interconnect the Solar PV array.

2.8. Power Conditioning Unit (PCU)

As SPV array produce direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels before powering equipment designed for nominal mains AC supply. Conversion shall be achieved using an electronic Inverter and the associated control and protection devices. All these components of the system are termed the "Power Conditioning Unit" OR simply PCU. In addition, the PCU shall also house MPPT (Maximum Power Point Tracker), an interface between Solar PV array & the Inverter, to maximize Solar PV array energy input into the System PCU refers to combination of charge controller and bi-directional inverter and shall be supplied as integrated unit.

2.9. Maximum Power Point Tracker (MPPT)

Maximum power point tracker (electronic) shall be integrated into the PCU to maximize energy drawn from the Solar PV array. The MPPT shall be microprocessor / micro-controller based to minimize power losses. The efficiency of the MPPT shall not be less than 97% and shall be suitably designed to meet array capacity.

The PCU shall be microprocessor / micro controller based suitable for automatic grid interaction. The time delay for grid interfacing should be minimum possible

2.10. PCU Minimum Requirements

The PCU shall be capable of complete automatic operation, including wake- up, synchronization and shut down.

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The PCU shall be self-commutated and shall utilize a circuit topology and components suitably for meeting the specifications listed above at low cost, high conversion efficiency and with high reliability.

The PCU shall be designed to withstand starting in-rush current when inductive loads is started and provide trip free operation.

In PCU there shall be a direct current isolation provided at the output by means of a suitable isolating transformer.

The PCU shall include appropriate self-protective and self-diagnostic features to protect itself and the PV array from damage in the event of PCU component failure or from parameters - beyond the PCU's safe operating range due to internal or external causes. The self-protective features shall not allow any operation from the PCU front panel to cause the PCU to be operated in a manner which may be unsafe or damaging.

The PCU generated harmonics measured at the point of connection to the utility service, when operating at the rated power shall not exceed a total harmonic distortion of 3 %.

The high voltage and power circuits of the PCU shall be separated from the low voltage and control circuits. All conductors shall be made of stranded copper and suitable insulation shall be used for the power and control cables.

The PCU shall withstand a high voltage test of 2 kV rms, between either the input or the output terminals and the cabinet (chassis). Full protection against accidental open circuit, short circuit and reverse polarity at the input shall be provided.

The PCU shall not produce Electromagnetic Interference (EMI) which may cause malfunctioning of electronic and electrical instruments including communication equipment, which are located within the facility in which the PCU is housed.

The PCU shall include ground lugs for equipment and PV array grounding. The DC circuit ground shall be a solid, single point ground connection in accordance with prevailing national standards. All exposed surfaces of ferrous parts shall be thoroughly cleaned, primed and painted or otherwise suitably protected to survive a nominal 15-year design life of the unit. The PCU enclosure shall be weatherproof and capable of surviving intact under all ambient conditions. Moisture condensation and entry of rodents and insects shall be prevented in the PCU enclosure.

Components and circuit boards mounted inside the enclosures shall be clearly identified with appropriate permanent designations, which shall – also serve to identify the items on the supplied drawings.

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All doors, covers, panels and cable exits shall have gasket or otherwise designed to limit the entry of dust and moisture. All doors shall be equipped with locks. All openings shall be provided with grills or screens with openings not larger than 0.95 cm (about 3/8 inch).

In the design and fabrication of the PCU the site temperature (0 to 50 degree C), incident sunlight and the effect of ambient temperature on component life shall be considered carefully. Similar consideration shall be given to the heat sinking of MOSFET's, blocking diodes and similar components.

2.11. PCU Specifications

Solar Charge Controller + Inverter+ Battery Charger	
Switching device	MOSFET (Metal Oxide Semi-Conductor Field Effect Transistor)
Type	MPPT based PWM charger to charge 96V/48 V (nominal) battery bank with not less than 94% Solar charge controller efficiency
Input voltage from PV array	48 /96V (nom) 68 V/136V max
Protections	Short circuit protection Input under voltage / Deep discharge of battery Input surge voltage protection Over current Battery reverse polarity protection Solar array reverse blocking diode (provided in array junction box) DC rated fuse at input and AC rated fuse at output with suitable contactor/solid-state switches for safe start-up & shutdown of system Load surge current Over temperature Under / Over output voltage Under / Over frequency Automatic / manual isolation at input & output Suitable protection for solid-state switching devices
Dielectric strength	1.1kV between input/output and ground with EMI protections removed
Cooling	Forced air cooling with temperature sensitive fan operation
Ambient operation (max)	50 deg C
Relative humidity	95% maximum

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Assembly & mounting	As per normal industry practice		
Finish	Epoxy powder coating		
Cable entry	From rear 200mm above ground level		
Load test at factory	Minimum 6 hours at full load		
Features	Bi-directional type inverter Stand-alone and hybrid mode of operation. High quality with high efficiency and reliability Microprocessor based intelligent controller Self-monitoring capability. Integral design with MPPT solar charge controller and inverter Highly reliable & efficient solid-state switching devices Rated for continuous operation at full load High over-load capability of 200% surge for 10 seconds Inverter output power factor of 0.8 lag Automatic re-start facility after over load triggered shutdown Sleep mode feature: Inverter shall switch off output when output load falls below 1-2 % of rated capacity to save no load losses.		
Efficiency	90% at rated load and normal operating conditions 83% (min) at 25% load and nominal input voltage with UPF load		
%THD	Sine wave output with 3% THD at full load UPF and nominal input voltage		
Output voltage	400V +/- 1%		
Output frequency	50Hz ± 0.5Hz		
%Regulation	2% against input voltage and load variation		
Battery charger	Bi-directional Inverter/Charger		
Indications	Inverter ON	Grid ON	
	Array ON	Inverter Under Voltage / Over Voltage	
	Inverter Overload	Inverter Over Temperature	
	Battery Low		
Enclosure	For Outdoor application		
Weight / Dimension	The details of the inverter will be provided in the specification / user manual		
Battery type	Tubular lead acid type		

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2.12. Battery Bank

The batteries shall be solar photo voltaic batteries of flooded electrolyte, low maintenance, lead Acid and made of hard rubber container.

The batteries shall use 2V cells and battery capacity is to be designed at C10 rate with end cell cut off voltage of 1.80V / cell.

The battery shall be designed for negative temperatures prevailing a site.

Battery terminal shall be provided with covers.

Batteries shall be provided with micro porous vent plugs with floats.

Charging instructions shall be provided along with the batteries.

Suitable carrying handle shall be provided.

A suitable battery rack with interconnections & end connector shall be provided to suitably house the batteries in the bank. The features and dimensions of the battery rack shall be provided along with the bid document.

The batteries shall be suitable for recharging by means of solar charge controller.

Bidder shall mention the design cycle life of batteries at 80%, 40% and 20% depth of discharge at 25 deg. C.

The self-discharge of batteries shall be less than 2 % per month.

The charge efficiency shall be more than 90% up to 70% state of charge.

The topping up frequency shall be >12 months.

The batteries shall consist of individual cells, which can be carried separately with ease while transporting.

Offered batteries shall at least comply with the following at 27 Deg C:

10 % of DOD: 7200 cycles
50 % of DOD: 3000 cycles
80 % of DOD: 1200 cycles

2.13. Battery Rack & Accessories

Battery interconnecting links shall be provided for interconnecting the cells in series and in parallel as needed. Connectors for inter cell connection (series / parallel) shall be maintenance free screws. Insulated terminal covers shall be provided.

2.14. DC Distribution Board (DCDB)

A DC distribution box shall be mounted close to the solar grid inverter. The DC distribution box shall be of the thermo-plastic IP65 DIN-rail mounting type and shall comprise the following components and cable terminations:

- Incoming positive and negative DC cables from the DC Combiner Box;

DC circuit breaker, 2 pole (the cables from the DC Combiner Box will be connected to this circuit breaker on the incoming side);

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- DC surge protection device (SPD), class 2 as per IEC 60364-5-53;
- Outgoing positive and negative DC cables to the solar grid inverter

As an alternative to the DC circuit breaker a DC isolator may be used inside the DC Distribution Box or in a separate external thermoplastic IP65 enclosure adjacent to the DC Distribution Box. If a DC isolator is used instead of a DC circuit breaker, a DC fuse shall be installed inside the DC Distribution Box to protect the DC cable that runs from the DC Distribution Box to the Solar Grid Inverter

2.15. DC Combiner Box

A DC Combiner Box shall be used to combine the DC cables of the solar module arrays with DC fuse protection for the outgoing DC cable(s) to the DC Distribution Box

2.16. AC Distribution Board (ACDB)

An AC distribution box shall be mounted close to the solar grid inverter. The AC distribution box shall be of the thermoplastic IP65 DIN rail mounting type and shall comprise the following components and cable Terminations

2.17. Cables

All the cables shall be supplied conforming to IS 1554 / 694 Part 1 of 1988 & shall be of 650 V/ 1.1 kV grade as per requirement. Only polyethylene copper cables shall be used. The size of the cables between array interconnections, array to junction boxes, junction boxes to PCU etc. shall be so selected to keep the voltage drop and losses to the minimum.

For the DC cabling, XLPE or XLPO insulated and sheathed, UV stabilized single core flexible copper cables shall be used. Multi-core cables shall not be used.

For the AC cabling, PVC or XLPE insulated and PVC sheathed single or multi-core flexible copper cables shall be used. Outdoor AC cables shall have a UV-stabilized outer sheath.

The total voltage drop on the cable segments from the solar PV modules to the solar grid inverter shall not exceed 2.0%.

The total voltage drop on the cable segments from the solar grid inverter to the building distribution board shall not exceed 2.0%

The DC cables from the SPV module array shall run through a UV- stabilized PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5mm Cables and wires used for the

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interconnection of solar PV modules shall be provided with solar PV connectors (MC4) and couplers All cables and conduit pipes shall be clamped to the rooftop, walls and ceilings with thermo-plastic clamps at intervals not exceeding 50 cm.

The minimum DC cable size shall be 4.0 mm² copper. The minimum AC cable size shall be 4.0 mm² copper. In three phase systems, the size of the neutral wire size shall be equal to the size of the phase wires. The following color coding shall be used for cable wires:

- DC positive: red (the outer PVC sheath can be black with a red line marking)
- DC negative: black
- AC single phase: Phase: red; neutral: black
- AC three phase: Phases: red, yellow, blue; neutral: black
- Earth wires: green

Cable conductors shall be terminated with tinned copper end-ferrules to prevent fraying and breaking of individual wire strands. The termination of the DC and AC cables at the Solar Grid Inverter shall be done as per instructions of the manufacturer, which in most cases will include the use of special connectors

Scope of the work also includes cable laying – including in trenches -, back-filling and restoration of excavated areas to original state.

2.18. Grid-Tied/Interactive Inverters

The solar grid inverter converts the DC power of the solar PV modules to grid-compatible AC power.

Liquid crystal display shall at least be provided on the inverters front panel or on separate data logging/display device to display following

- DC Input Voltage
- DC Input current
- AC Power output(kW)
- Current time and date
- Time active
- Time disabled
- Time Idle
- Temperatures (C)
- Inverter status

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Following shall also be displayed:

- Protective function limits (VIZ-AC over voltage, AC under voltage, Over frequency, under frequency, ground fault, PV starting voltage, PV stopping voltage, over voltage delay, under voltage delay over frequency, ground fault delay, PV starting delay, PV stopping delay.)

The detailed specifications of the solar grid inverter are given below.

Total output power (AC)	To match solar PV plant capacity while achieving optimum system efficiency
Input DC voltage range	As required for the solar grid inverter DC input.
Maximum power point (MPPT) tracking	Shall be incorporated
Number of independent MPPT inputs	1 or more
Operation AC voltage	Three phase 415V (+ 12.5%, -20%)
Operating Frequency range	47.5 – 52.5 Hz
Nominal frequency	50 Hz
Power factor of the inverter	>0.98 at nominal power
Total harmonic distortion	Less than 3%
Built-in Protection	AC high / low voltage; AC high /low frequency
Anti-islanding protection	As per VDE 0126-1-1, IEC 60255.5 / IEC 60255.27
Operating ambient temperature range	-10 to 50 Deg C
Humidity	0 – 95% Rh
Inverter efficiency	>=95%
Inverter weighted efficiency	>=94%
Protection degree	IP 65 for outdoor mounting, IP 54 for indoor mounting
Communication interface	RS 485 / RS 232 / RJ45
Safety compliance	IEC 62109-1, IEC 62109-2

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2.19. Earthing and lightning protection

The array structure of the PV yard shall be grounded properly using adequate number of Earthing kits. All metal casing / shielding of the plant shall be thoroughly grounded to ensure safety of the power plant. Earth resistance readings for each site must be measured by a qualified and licensed electrical contractor and submitted. Resistance values shall conform to either CCOE stipulations or that of IEE regulations.

Earthing shall be done in accordance with IS 3043-1986, provided that Earthing conductors shall have a minimum size of 6.0 mm² copper, 10 mm² aluminum or 70 mm² hot dip galvanized steel. Unprotected Aluminum or copper-clad aluminum conductors shall not be used for final underground connections to earth electrodes.

A minimum of two separate dedicated and interconnected earth electrodes must be used for the Earthing of the solar PV system support structure with a total earth resistance not exceeding 5 Ohm

The earth electrodes shall have a precast concrete enclosure with a removable lid for inspection and maintenance. The entire Earthing system shall comprise non-corrosive components.

The SPV Power Plant shall be provided with lightning & over voltage protection. The main aim in this protection shall be to reduce the over voltage to a tolerable value before it reaches the PV or other sub system components. The source of over voltage can be lightning, atmosphere disturbances etc.

Metal oxide variastors shall be provided inside the Array Junction Boxes. In addition, suitable MOV's (Metal Oxide Variastors) also shall be provided in the Inverter to protect the inverter from over voltage.

2.20. Surge protection

Surge protection shall be provided on the DC side and the AC side of the solar system.

The DC surge protection devices (SPDs) shall be installed in the DC distribution box adjacent to the solar grid inverter.

The AC SPDs shall be installed in the AC distribution box adjacent to the solar grid inverter

The SPDs Earthing terminal shall be connected to earth through the above mentioned dedicated Earthing system. The SPDs shall be of type 2 as per IEC 60364-5-53

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2.21. Tools and Spares

The Installer shall keep ready stock of tools, tackles and essential spares that will be needed for the day-to-day maintenance of the solar PV system. This shall include but not be limited to, the following:

- Screw driver suitable for the junction boxes and combiner boxes;
- Screw driver and / or Allen key suitable for the connectors, power distribution blocks, circuit breaker terminals and surge arrestor terminals;
- Spanners / box spanners suitable for the removal of solar PV modules from the solar PV module support structure;
- Solar panel mounting clamps;
- Cleaning tools for the cleaning of the solar PV modules;
- Spare fuses.

2.22. Battery room and control room

The bidder shall give the details of array layout and control room/battery room layout along with the offer. The room shall be provided by HPCL to meet the space requirement to house PCU, Distribution Boards and Battery bank etc.

2.23. Caution Signs

In addition to the standard caution and danger boards or labels as per Electricity Rules, the AC distribution box near the solar grid inverter, the building distribution board to which the AC output of the solar PV system is connected and the Solar Generation Meter shall be provided with a non-corrosive caution labels

2.24. Metering

An energy meter shall be installed in between the solar grid inverter and the building distribution board to measure gross solar AC energy production (the "Solar Generation Meter"). The Solar Generation Meter shall be of the same accuracy class.

The existing service connection meter needs to be replaced with a bidirectional (import kWh and export kWh) service connection meter (the "Solar Service Connection Meter") for the purpose of net-metering. Installation of the Solar Service Connection Meter will form part of the scope of the work of the Installer.

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2.25. Communication

The project envisages a communication interface which shall be able to support

- Real time data logging
- Event logging
- Supervisory control
- Operational modes
- Set point editing

The following parameters shall also be measured and displayed continuously Solar system temperature:

- Ambient temperature
- Solar irradiation/isolation
- DC current and Voltages
- DC injection into the grid (one time measurement at the time of installation)
- Efficiency of the inverter
- Solar system efficiency
- Display of I-V curve of the solar system
- Any other parameter considered necessary by supplier of the solar PV system based on prudent practice.

Data logger/Pc based monitoring system must record these parameters for study of effect of various environmental & grid parameters on energy generated by the solar system and various analysis would be required to be provided through bar charts, curves, tables, which shall be finalized during approval of drawings

The communication interface shall be an integral part of inverter and shall be suitable to be connected to local computer and also remotely via the Web using either a standard modem or a GSM / WIFI modem.

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STANDARD SPECIFICATIONS

TELEMETRY COMMUNICATION SYSTEM

SYSTEM REQUIREMENTS

EL034

STANDARD SPECIFICATION

SYSTEM REQUIREMENTS

C O N T E N T S

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GENERAL REQUIREMENTS

1.1 Introduction

The purpose of this standard specification is to provide tenderers with minimum technical specifications and performance requirements for the radio based telemetry system

The specification will provide minimum specifications and performance requirements for system components, connection works, installations, interconnection and quality of supply.

1.2 General Description

It is important to note that all hardware and software modules and sub-systems in the telemetry system shall seamlessly integrate and operate. All equipment to be used in the telemetry system shall have been used as one system in many previously installed systems. Where required, components and sub-systems from different suppliers shall be integrated together to form one system. These various components and sub-systems shall have well proven and operating successfully in previously installed systems. The client system shall not be used as testing ground for newly integrated sub-systems

TELEMETRY RTU CONFIGURATION /COMMUNICATIONS SERVER SPECIFICATIONS

A large number of telemetry remote stations shall be equipped with full-powered real-time RTU and wireless communications equipment. These stations shall be 220 V AC or Solar PV powered full al necessary battery backup, surge protection and other equipment as specified and listed under this section.

2.1 Telemetry Software Specification

For the Full Power Telemetry Stations to operate properly and seamlessly to the engineering designs as specified.

2.2 Configurability vs Programmability

- 2.2.1 Configurability is where most major functions in the RTU can be configured by simply entering values, set-points and tick boxes in user-friendly configuration environment. This shall be capable without utilising any specific programming language to setup the remote RTU station.
- 2.2.2 Programmability is where certain programming languages, and extensive engineering and programming is required to setup the RTU to execute monitoring, eventing, logging, data routing and mapping functions.
- 2.2.3 Both Configurability and Programmability shall be available in the RTU. However, configurability takes a very high priority, only when specific and extensive automated control functions are required will it be required to use the programmability capabilities of the RTU's.

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2.3 Telemetry RTU Configuration/Programming Toolbox

- 2.3.1 The Telemetry System shall have a well-proven user-friendly Software Configuration Toolbox. The Configuration Toolbox shall be based on the newest Microsoft .Net platform. The Configuration Toolbox shall be used to configure and program all the Telemetry RTU controller stations functions, features, control programs and configuration parameters. The complete system settings and parameters shall be stored in an industry standard database system.
- 2.3.2 The System Configuration Toolbox shall be an extremely important tool to be used in the Telemetry System. The contractor's proposed RTU equipment configuration and programming tools shall go through a comprehensive evaluation procedure during Tender Evaluation. The contractor's attention is drawn to all the features specified and listed in this specification. The contractor shall ensure that ALL the features listed here are available!
- 2.3.3 The configuration toolbox shall be capable to configure ALL parameters of the RTU Controllers. Typical parameters that shall be easily configurable are the following:
- The configuration of single and/or multiple communication mediums.
 - The configuration of the Communication Paths (Store and forward) and medium switching and routing.
 - Retry and time out patterns.
 - RTU IO scan timings.
 - Configuration of analogue input event sampling rates, percentage change reporting, alarm set points, logging parameters, SMS text messages, scaling variables, etc... Each analogue Input shall be individually configurable.
 - Configuration of digital input event sampling rates, dead times, logging parameters, alarm variables and SMS messages text configurations. Each digital input shall be individually configurable.
 - IP Address settings for master station and remote station.
 - Dual APN name (Access Point Names).
 - Cell Numbers for mobile users in case a remote site shall report alarms.
 - Intelligent Electronic Devices (IED's) register scanning and mapping parameters.
 - IO Mapping configurations.
 - Setting of remote RTU real time clock.
 - Development environment of PLC control programs.
 - Local and remote site diagnostic.
 - The registration of personnel biometric templates as well as the remote downloading of the biometric templates to the remote RTU.
 - Configuration of the password setup

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- 2.2.1 Remote Configurability: All functions, features, control programs and configuration parameters of the remote station RTU's shall be user configurable and shall have the ability to be performed locally at the remote site. Very important, all parameters shall be remote downloadable from any other remote or master station available on the communications network.
- 2.2.2 Configuration Uploading: The system shall be capable to upload all RTU parameters and settings from the RTU to the Configuration Toolbox, where it shall be possible to save it in the configuration database.
- 2.2.3 Remote Diagnostics: Comprehensive station diagnostics shall be available, either locally connected to the station RTU, or remotely from ANY other remote or master station connected on the communications network.
- 2.2.4 Remote Programming: Control programs can be developed on any RTU programming tool, and shall be remotely downloadable from any master station or from any other RTU node connected to the communications network.
- 2.2.5 Toolbox Client – Server: The Master station computer shall run a Main Configuration Toolbox Server program. Other “slave” (client) Configuration Toolboxes shall be able to link into the master Configuration Toolbox either through the WAN system, or through a Radio and GSM/GPRS Network link.

2.3 Communications Server

- 2.3.1 The Communications server software shall be loaded on the master station SCADA computers.
- 2.3.2 This server shall handle all outgoing and incoming protocols to and from all remote stations on the communications network. These protocols shall include the protocols to configure the remote stations, as well as data exchange protocols which shall include event, polling and logger data.
- 2.3.3 The server shall handle all available communication mediums, primary and secondary communication paths, as well as maintain remote station connectivity.
- 2.3.4 The server shall accommodate inherently the newest OPC UA and DA server standards which shall be primarily utilised to transfer or receive data to and from the SCADA software.
- 2.3.5 The server shall also inherently have the newest OPC UA and DA client drivers which can be used to connect to any other OPC server on the system.
- 2.3.6 The server shall have a configuration environment to define and set the OPC Tag Names to be linked to the SCADA system.
- 2.3.7 The communication server shall also be capable to store IO data, received from the remote stations directly into a MS SQL database, without utilising the SCADA software. This shall be the preferred method to ensure that all real-time as well as historical logged data to be stored directly to a database system.
- 2.3.8 The communication server shall be capable to handle Primary and Secondary communication routes and mediums. If, for example the primary UHF Radio communication medium fails, the server shall automatically select the best secondary communication route and medium such as GSM.

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RTU SOFTWARE FUNCTIONS AND FEATURES

The RTU shall be a highly configurable, highly programmable intelligent device. The RTU shall inherently support all the functions and features listed in this section as a minimum. The tenderer shall painstakingly evaluate the RTU to ensure that it fully and inherently support all the listed requirements as all these features shall be utilised.

3.1 Unsolicited Events:

- 3.1.1 The system data gathering at the master station shall not be primarily based on a round robin polling method, but primarily on Change of State (Eventing) basis.
- 3.1.2 The remote station RTU shall inherently have the ability to report change of state (event) of user configurable Input-Outputs. The remote RTU shall thus only initiate communication when a data change event occurred, which shall then be reported to the master station or to any other remote RTU.
- 3.1.3 The event settings shall be user configurable using the Configuration Toolbox at the master station and shall be downloadable from the master or any other remote site.
- 3.1.4 The RTU shall be equipped with a real-time clock. All events shall be remotely time stamped at the remote RTU when it occurred within a 10 mSec Accuracy.
- 3.1.5 Digital inputs dead time settings shall be individually configurable. The engineer/operator shall be able to set re-action times on each input which shall trigger an event when such changes occur.
- 3.1.6 All Analogues inputs shall also be individually configurable. The sample timings, number of samples, and sampling triggers shall be configurable and downloadable to the remote station from the master station.
- 3.1.7 It shall be able to also connect with a GPS system. The GPS can then be used to set the RTU real-time clock very accurately. The GPS co-ordinates can also be extracted and then reported to the SCADA system.

3.2 Data Polling.

- 3.2.1 The RTU system shall also support a polling mode where any Master station or any other RTU connected to the communications network shall be able to poll the RTU for IO and other data registers.
- 3.2.2 The station RTU shall also be capable to poll any other remote RTU, connected to the communication network, for IO and other data.
- 3.2.3 The polling rates shall be fully user configurable.
- 3.2.4 A polling data transfer method shall not be the primary data exchange method but can at any time be utilised as and when required.

3.3 3rd Party IED Protocols:

- 3.3.1 This is a functionality extensively used. It is imperative that the RTU Controller shall be able to interface and extract data from a wide range of IED devices located at the remote station.

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3.3.2 The RTU Controller shall be equipped with a number of protocol drivers inherently standard in the RTU. The RTU shall as a minimum support the following 3rd party IED protocols:

- Modbus RTU/ASCII Master.
- Modbus RTU/ASCII Slave.
- Enermax/Schneider energy meters.
- Tag Reader for Technician Identification.
- Biometrics Reader (Finger Print Readers).
- M-Bus protocols.
- DF1 protocol.
- VSD Protocols.
- HMI protocols.

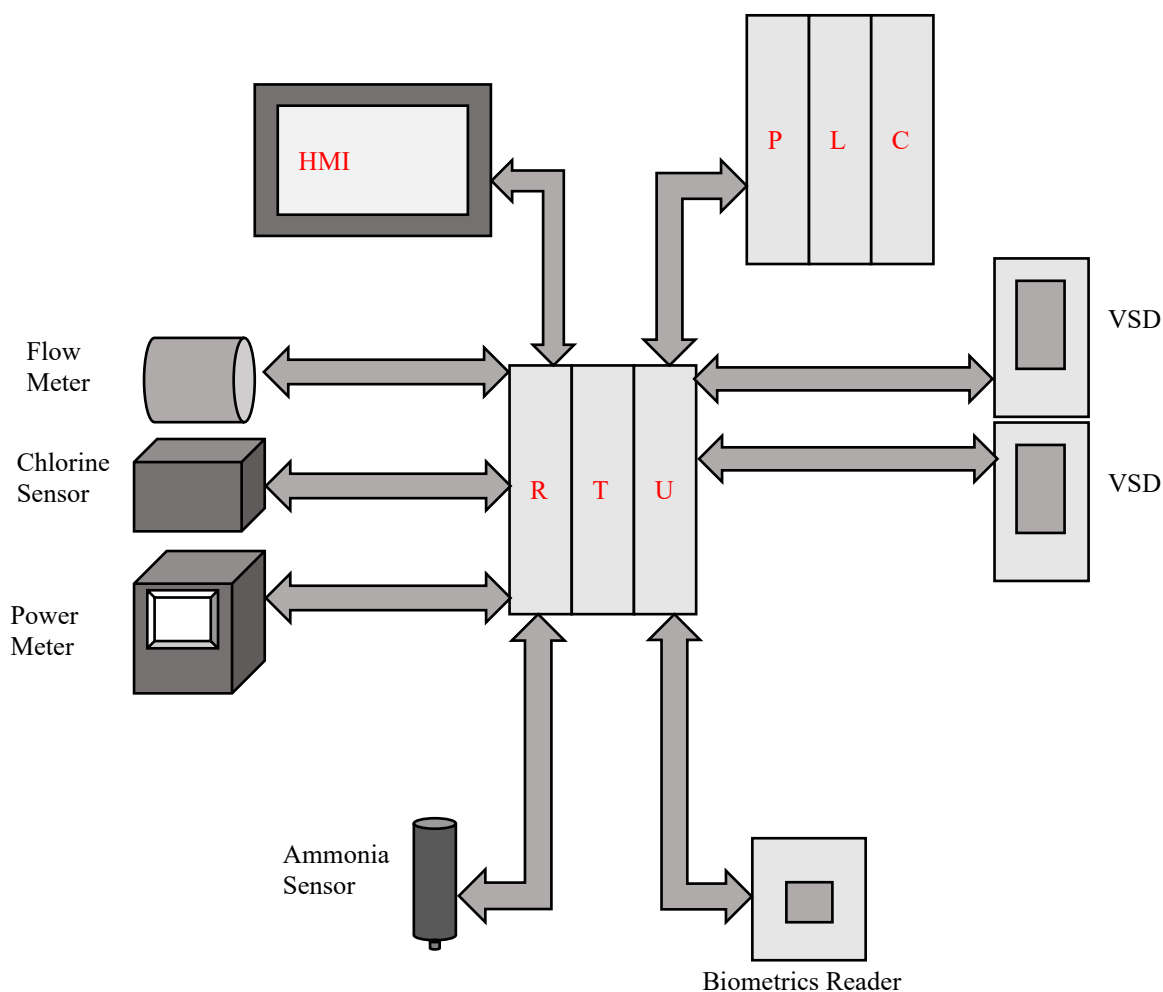
3.3.3 These protocols are all extensively been used and shall ALL inherently be supported by the RTU.

3.3.4 All the above listed protocols are utilised simultaneously at a remote site. Thus, the RTU shall be capable to run and utilise all these protocols and extract the data from all these devices into the one RTU.

3.3.5 The diagram below demonstrates typical how and what devices shall be and can be connected to one RTU.

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- 3.1.1 The RTU shall be capable to run 12 different protocols at the same time extracting data from 12 different devices into the one RTU.
- 3.1.2 The RTU shall be modularly designed that the contractor shall be able to implement other protocols as and when required by COMPANY ABC. This shall then be seamlessly integrated in the RTU firmware infrastructure.
- 3.1.3 The data extracted from the site local Intelligent Electronic Device (IED) shall be mapped into the RTU data structures. Once the IED data is in the RTU data structures, which is then available to the RTU processes such as eventing, logging, time stamping, reporting, and for auto control programs.
- 3.1.4 The RTU shall also be able to write data to the IED device utilising any or all the available protocols.

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3.3.6 This project shall require the RTU communicate as a minimum to the following devices during operation on one single RTU, using various protocols:

- On-Site PLC.
- One-to-six VSD drives.
- Biometrics finger print reader.
- High resolution colour HMI screen.
- One-to-four intelligent flow meters.
- Chlorine Sensors.
- Ammonia sensors.
- A power meters.
- Standby diesel pump controllers.
- Etc.

3.4 IO Mapping

- 3.4.1 The RTU shall be capable to map IO's data received from any other remote RTU to the local RTU.
- 3.4.2 Transmitted or received data shall be mapped or routed to any receiving RTU Controller internal data structures. The received data, once mapped into the receiving RTU data structures is the available to the RTU eventing, alarming, logging, reporting, and auto control processes.
- 3.4.3 The RTU shall also be capable to do local mapping of IO's on the RTU. Different IOs shall be map-able to any other IO parameter on the RTU.
- 3.4.4 No software development or programming shall be required to enable the RTU to do mapping of IO's. It shall be simply configured by completing an IO Map configuration table.
- 3.4.5 This configuration table shall be downloadable remotely from the master or from any other remote RTU station available on the communications network.

3.5 Intelligent Data Logging:

- 3.5.1 Remote data logging shall be utilised at the remote station.
- 3.5.2 The RTU shall be equipped with an intelligent data logging functionality.
- 3.5.3 The following data logging capabilities shall be available:
- Log user selectable digital IO values on change of state, either on high or low going edges.

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- Log user selectable analogue IO's values on user definable change of value. The logger function shall be capable to average analogue inputs values over a user definable time period and then log it.
- Log user selectable digital inputs and/or analogue IO values on user selectable regular time intervals such as every 5 Sec, or 5 Minutes, etc.
- Log user selectable digital and analogue IO's values when communication failures are experienced.
- All log values are time stamped when it is logged into memory.
- The RTU shall monitor the memory availability for the logger. When the logging memory fills-up to a user selectable capacity, the remote RTU shall notify the master station to upload the logged data.
- The RTU shall also be capable to up-load the logged data on user selectable intervals or at specific time in a day.
- No engineering or programming shall be required to implement logger functionality. It shall be as simple as completing a logger configuration table.
- These parameters shall then be downloadable remotely from the master station or from any other remote RTU available on the communications network.

3.5.4 As mentioned, the client shall utilise this logging functionalities extensively. The contractor shall thus ensure that this shall be inherently supported by its proposed RTU equipment.

3.6 Flexible Communication Solutions

- 3.6.1 RTU's shall support the following special communication modes:
- 3.6.2 Shared Transceiver Mode: All RTU's shall be able to share its communications transceiver (Radio, wire lines, GPRS etc.) with other RTU.
- 3.6.3 Store and Forward Repeater (Digipeating): Any RTU on the communications network shall be able to receive information from other sites, store it and then transmit (relay) the data to another site. The RTU shall be able to handle at least three store-and-forward "jumps" before reaching the destination station.
- 3.6.4 Network Interface Node: All RTU's shall be able to function as an interconnection point between different communication systems, e.g. cellular, radio, etc. The RTU shall be capable to route data received from one communication medium on one port to any one, or a combination of other communications ports and mediums on other RTU ports. Example: incoming protocol mages from a GPRS GSM communication medium to be routed to a port or ports running any, or a combination of Digital Radio, FSK Radio, RS485, Fibre or any other communications medium.
- 3.6.5 The RTU shall also be capable to utilise several communication mediums (Radio, GSM, Ethernet, fiber, WiFi, Satellite, etc...) simultaneously sending and receiving to and from multiple master or any other multiple remote RTU stations.
- 3.6.6 The RTU shall be capable to have primary and secondary communication medium and routes. Example: Should the primary UHF radio communication medium fail, it shall seamlessly switch to the secondary communication medium such as GSM.

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- 3.6.7 The features as listed above shall be easily configurable by completing a simple communication table.
- 3.6.8 These parameters shall be remotely downloadable from the master or from any other remote RTU connected to the communications network.
- 3.6.9 The RTU shall be capable to operate seamlessly over several communication mediums simultaneously including:
- Cellular (SMS and GPRS).
 - Serial RS232/485.
 - Fibre Optic.
 - Radio (FSK).
 - Radio (Digital).
 - Ethernet.
 - Wi-Fi.
 - Microwave networks.
 - Satellite.

3.7 Data Protocol:

- 3.7.1 Data communications between the Master station and the remote shall utilize a secure, smart protocol that optimizes the transmission of data between stations. The protocol shall allow flexible, efficient communication for transmission of data, complete programs, databases and/or other parameters. Configuration and diagnostic programs shall be transferable from/to the central site from any node. Complete RTU /system debugging shall be allowed without visiting each remote site.
- 3.7.2 The protocol used shall provide for:
- Levels of data privacy
 - Support data security techniques and
 - Sophisticated recovery and error detection procedures.
 - Encryption.
 - Cybersecurity.
- 3.7.3 The preferred protocols shall comply with the IEC 60875-5-101, DNP3, SDLP or similar acceptable telemetry protocol approved by the client. It shall be a protocol that supports both unsolicited (eventing) and polling standards as well as time stamping on events. No master slave PLC protocol shall be acceptable.

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- 3.1.1 Acknowledgement Procedure: The RTU S shall acknowledge all mages received on the communication link, and be capable of re-transmitting mages if it is not acknowledged after a pre-determined time-out period. It shall be possible to select or de-select the acknowledge mode of operation. A station shall attempt a user definable re-tries at transmitting a mage, if it is not acknowledged.

3.2 PLC - RTU

- 3.2.1 The contractor shall not propose a conventional PLC solution to be utilised as an "RTU". RTU's are specifically developed for telemetry applications and are very strong in handling variety and marginal communication systems. This over and above the other unique features of RTU's over PLC's.
- 3.2.2 The RTU shall be a robust and well proven device based on a well approved microprocessor system running a multitasking operating system. The RTU System software shall be designed to be completely modular and expandable.

3.3 RTU Programmability

- 3.3.1 The RTU shall fully support industrial standard programming languages such as Ladder and Function blocks.
- 3.3.2 These industrial languages shall be used to program the RTU as an automated control system, such as automatic pump control. The RTU shall be capable to also execute complex control tasks. The control tasks shall not only be limited to local control, but shall also be able to execute Peer-Peer controls directly between remote stations.
- 3.3.3 All other configurable parameters, as described in the foregoing sections, shall also be accessible and settable from the programming language.
- 3.3.4 Control programs can be developed using the RTU programming toolbox. The program(s) shall be remotely downloadable from the master or any other RTU station on the communication network.

3.4 Access Control & Biometrics Readers:

- 3.4.1 The RTU shall seamlessly interface and support a Biometric fingerprint reader.
- 3.4.2 Biometrics is a very important aspect that shall be rolled-out through the telemetry network. The biometrics are/and shall be used for access control as well as the monitoring of client and contractor's personnel activities at site.
- 3.4.3 It is thus important for the contractor to ensure that the proposed RTU can seamlessly support a biometric reader.
- 3.4.4 The biometrics system shall not be a separate operated standalone system operating separately from the RTU and the SCADA system. It shall seamlessly integrate with the station telemetry RTU.

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- 3.7.4 The biometrics reader shall interface directly with the RTU. The RTU shall authenticate the fingerprint. When authentication is successful, the RTU shall:
- It shall disable the alarm, and if available the pepper gas system.
 - It shall unlock the local HMI for local control and data viewing.
 - It shall report to the control room stations the person by name that are present at the station.
 - It shall log the person to the database.
 - It shall display on the SCADA the person or persons authenticated.
- 3.7.5 The system shall have a fingerprint enrolment system at the master station control room. Once the person(s) fingerprint(s) are enrolled and registered, the templates shall be downloadable through the communications network to the remote RTU.
- 3.7.6 The RTU shall be configured and programmed in such a way that up to 10 people can be simultaneously logged into the station. All the authenticated logged-in people shall be listed on the SCADA system where the Control Room operator shall be able to see the people present at site.
- 3.7.7 The people at site must then log-out using the biometric reader. When the last person is logged out, the RTU shall then activate the alarm system and notify the master station control room.
- 3.7.8 A user configurable time-period shall be implemented. If the time-period expires after the first person logged-on, the RTU shall log-out all logged-in people and activate the alarm system. The SCADA system shall then be notified.

TELEMETRY & RTU HARDWARE SPECIFICATIONS

- 4.1 The RTU shall be an intelligent, modular unit capable of data acquisition, local data processing and control program execution. It shall monitor and control local equipment in a stand-alone mode as well as being an intelligent node in a distributed processing network.
- 4.2 It shall be microprocessor based, and allow software reconfiguration and optimisation to occur both on site and remotely via communication channels.
- 4.3 The Telemetry RTU system shall be inherently of modular design. The various components such as CPU, IO Modules, Radios, Power Supplies, etc., shall be individual components designed in such a way that the individual components can be tested individually and replaced individually. A RTU design with CPU, IO Modules, radios, surge protection, etc., all integrated in one unit shall not be acceptable. The RTU system shall be of modular design in order to allow repairs to the various components on-site by suitably trained technicians.

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4.2 RTU Components:

4.2.1 The RTU shall consist of a number of modular units. It shall consist of:

- The RTU Master Controller MODULE.
- Various Input and Output modules.
- Communication ports.

4.3 RTU Master Controller Module:

4.3.1 The RTU Master processor module (CPU) of the RTU shall be a real-time processor controller and support:

- Bus communications with IO modules.
- System memory allocation.
- System parameter and logic programming.
- Communication port control.
- As a minimum three RS 232 ports which shall be expandable to 11 x RS-232 ports.
- One Ethernet port.

4.3.2 The Master Controller shall incorporate a Real Time Clock (RTC) with lithium battery backup for both RTC and module RAM. The latest technology shall be used for minimum component count and maximum performance and reliability.

4.4 Expansion Capability:

4.4.1 The RTU System shall be modular based and shall be capable to be expanded during the tender implementation phase, or when otherwise required.

4.4.2 The RTU, IO Modules, communication equipment, and so forth, shall not be integrated in one module. It shall be possible to easily replace any of the modular components in the RTU.

4.4.3 The most basic RTU in the client's telemetry system shall not have less than:

- Eight Analogue Inputs.
- Eight Digital Inputs.
- Eight Digital Control Outputs.

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- 4.4.4 To enable the client to standardize on spare holding, the same RTU shall be utilized throughout the system.
- 4.4.5 The RTU shall thus be scalable and expandable from the minimum IO count as listed above to the following maximum IO count for large, scaled stations:
- 255 Analogue Inputs.
 - 255 Digital inputs.
 - 255 Counter Inputs.
 - 255 Digital Control Outputs.
 - 255 Analogue Outputs.
 - 12 off RS 232 communication ports.
- 4.4.6 Expansion of the RTU IO's shall be done by simply adding more expansion IO modules and connect it to the master controller unit.
- 4.4.7 All IO's statuses shall be indicated on LED's located on the RTU IO modules.
- 4.4.8 The RTU shall address variable IO requirements through the addition of appropriate expansion modules. Each module shall communicate with the RTU Master Controller module via a high-speed data bus. The Tenderer shall state the number of modules that can be supported by one Master Controller Unit.

4.5 Analogue Inputs.

- 4.5.1 The Analogue Module shall have a software controllable / adjustable input port to accept 4-20mA as well as mVolt transducer input levels.
- 4.5.2 All RTU's in the system shall have as a minimum 8 Analogue inputs, which shall be expandable to 255 inputs.
- Resolution : 12 bits
 - Accuracy : 0.1% of FS
 - Input Protection : 10kA fast transient surge and 2.5kV Galvanic isolation
- 4.5.3 See BOQ for detail on the required analogue inputs each station shall require.

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4.6 Digital Input Module

4.6.1 All RTU's in the system shall have as a minimum 8 digital inputs, which shall be expandable to 255 inputs. All digital inputs shall also be configurable to be used as counter inputs.

- Input Isolation : Optical isolation
- Diagnostic : LED Display of status
- Input Protection : 5kV Isolation

4.6.2 See BOQ for detail on the required analogue inputs each station shall require.

4.7 Digital Control Output Module.

4.7.1 All RTU's shall have as a minimum 8 digital output control channels which shall be expandable to 255 outputs.

- Output : 8 relays
- Contact Rating : 10A 250VAC
- Diagnostic : LED display status of relays

4.7.2 See BOQ for detail on the required analogue inputs each station shall require.

4.8 RS-232 Multiplexer.

4.8.1 All RTU shall be capable to expand the number of RS-232 communication ports from three to eleven by adding a RS-232 multiplexer module.

4.8.2 The RTU shall be capable to utilise all these communication ports simultaneously, communicating with local IED's and other RTU's on the network.

4.8.3 The RTU shall be capable to run a different protocol on each of these eleven communication ports simultaneously. This means the RTU shall be capable to support and run all eleven protocols simultaneously.

4.8.4 The RTU shall also be capable, where a RTU serial port is a RS-485, and this RS-485 communications port forms a RS-485 bus connected to multiple IED devices. The RTU shall then be capable to communicate with the various IED devices, through the one RS-485 port utilising different protocols. The RTU shall on the fly change the data rate speeds as well as the protocols on the one RS-485 port.

4.8.5 The tenderer's attention is drawn to the fact that this RTU feature has and shall be be utilised extensively in the telemetry system

4.8.6 See BOQ for detail on the required multiplexer modules.

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4.9 RTU Power Supply/Battery Charger

- 4.9.1 The RTU & station Power Supply shall neatly form part of the RTU form and fit. The power supply shall neatly and seamlessly integrate with the RTU and IO modules.
- 4.9.2 The RTU power supply shall only be of the Switch mode type with a minimum rating of 100Watts. Power Supplies using Linear technologies shall not be acceptable.
- 4.9.3 The Power Supply shall have two dedicated outputs. The one output dedicated for charging the station battery and the second output for powering the RTU and the rest of the station.
- 4.9.4 The PSU shall have a dedicated battery charging circuit to ensure the batteries are charged during 220 V AC power. A normal DC Power Supply output modified for battery charging shall not be acceptable.
- 4.9.5 The PSU shall also have a DC power output voltage to power the RTU and the rest of the station.
- 4.9.6 The RTU shall also be capable to communicate with the PSU through the high-speed communications bus. Power Supply shall internally monitor the following:
- The Battery Voltages
 - The Load Voltages
 - The charging current to the battery
 - The load current from the PSU to the rest of the station load
 - Power Failures
- 4.9.7 These values shall then be extracted by the RTU from the PSU through the high speed communications bus. These values shall then be mapped into the RTU internal data structures for eventing, logging, reporting, etc.
- 4.9.8 The PSU shall operate over an ambient temperature range of -10°C to +60°C with relative humidity < 95% @ 50°C.
- 4.9.9 The PSU shall operate from 230 VAC +/- 15%, 50Hz primary power. A suitably sized battery that shall maintain the station for at least 48 hours during power failures.
- 4.9.10 The power supply shall include a load-shed functionality to cut power when the battery voltage reaches a critical pre-set low value after a mains power failure thereby preventing the equipment from completely depleting the batteries.
- 4.9.11 The power supply shall have overheated and short circuit protection.
- 4.9.12 The power supply shall also include a minimum of 5A 12V-to-24V converter to operate 24V instrumentation equipment.

4.10 Outstation Enclosure

- 4.10.1 All RTU equipment, as well as surge protection, Radio units and other station equipment shall be mounted inside vandal resistant enclosure
- 4.10.2 The enclosure shall be designed in such a way that the enclosure door shall have no hinges that can be vandalised or broken off to get access to the equipment inside the enclosure.

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- 4.2.1 The enclosure shall be lockable. The enclosure door shall be totally hidden away and shall not be accessible to be broken open.

4.3 SURGE Protection

- 4.3.1 The telemetry system shall be installed in an area with a high lightning strike rate. It is thus compulsory to protect the station with reliable surge protection units
- 4.3.2 The following surge protection shall be supplied and installed:
- 4.3.3 All IO's shall be protected by industry graded well proven surge protection units that shall have the similar protection levels than a Blitzducter units. The IO surge protection shall be capable to handle surges up to 10 KA and 3 kVolt.
- 4.3.4 The station antenna feeder cables shall also be protected by a RF surge protector unit equal or similar to the Webb Polyphaser.
- 4.3.5 The 220V AC power lines shall also be equipped with a 10 Kamp surge protection unit.

4.4 Access Control & Biometrics Readers

- 4.4.1 The RTU shall be able to interface with a Biometric Reader system located at the remote site.
- 4.4.2 The RTU shall be manufactured to withstand very harsh industrial out-door environments. A large number of the readers shall be installed at sewage sites which is a very corrosive environment.
- 4.4.3 The reader shall be IP 67.
- 4.4.4 Commercial standard readers shall not be allowed on the system. Only industrial graded readers that shall be able to withstand extremely harsh outdoor corrosive environments.
- 4.4.5 The reader in conjunction with the RTU shall be capable to execute access control by controlling heavy duty door locks.
- 4.4.6 Also, it shall interface with the alarm and pepper gas systems.

4.5 HMI Screens

- 4.5.1 All telemetry stations with RTU's where necessary shall also be equipped with high resolution 9" HMI display screens, safely mounted on the door of a steel enclosure for in-door stations.
- 4.5.2 For outdoor stations, the HMI screens shall be mounted inside a steel enclosure.
- 4.5.3 The display shall be equipped with an Ethernet as well as a RS-232/485 communication port.
- 4.5.4 The display shall interface and fully integrated with the station RTU.
- 4.5.5 The display shall display the local as well remote station parameters in a neat colour display. The RTU shall provide all local and remote data to the display.

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- 4.2.1 The display shall also be capable to change set-point and other control parameters utilised by either the local or any remote RTU connected on the communication network.
- 4.2.2 The setpoint parameters shall only accessible after the person has been authenticated by the RTU and the HMI display.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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**SUPPLY AND INSTALLATION OF A TELEMETRY
SYSTEM AT RESERVOIRS UNDER THE VONDO RWS**

TELEMETRY AND ASSOCIATED WORK

PART 3

SCHEDULE OF INFORMATION TO TENDERER

Contractor's Paraph

Witness
Paraph

Witness
Paraph

Client Paraph

Witness
Paraph

Witness
Paraph

PART 3
SCHEDULE OF INFORMATION TO TENDERER

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SCHEDULE 1**SCHEDULE OF DRAWINGS**

NO	DRAWING NUMBER	DESCRIPTION
1	PJ64-01	Reservoir Satellite Image General Layout
2	12T1201/01	Reservoir Water System Layout
3	PJ64-02	Vondo RWS – Schematic Diagram
4	PJ64-03	Telemetry Solar PV Schematic Diagram
5	ASPT11-001A	Typical Solar PV Steel Structure and Enclosure

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SCHEDULE 2

TELEMETRY I/O SCHEDULE

					Version 1	2020-01-30	
Tag Number	Description	Pulsed	Binary	Analogue	Analogue	Binary	Serial
		Input	Input	Input	Output	Output	Comms
INSTRUMENTATION							
Reservoir R1	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			5			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir R2	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			4			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir R3	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			4			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir R4	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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VHEMBE DISTRICT MUNICIPALITY

Construction of Demand Management Equipment, Flow Meters and
a Telemetry System at Reservoirs under the Vondo RWS

Contract No **VDM/TECH/13/05/2025/01**

Tag Number	Description	Pulsed	Binary	Analogue	Analogue	Binary	Serial
		Input	Output	Input	Output	Output	Comms
INSTRUMENTATION							
Reservoir R4A	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir R5	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			2			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir R6	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			2			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir R7	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			2			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				

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VHEMBE DISTRICT MUNICIPALITY

Construction of Demand Management Equipment, Flow Meters and
a Telemetry System at Reservoirs under the Vondo RWS

Contract No **VDM/TECH/13/05/2025/01**

Tag Number	Description	Pulsed	Binary	Analogue	Analogue	Binary	Serial
		Input	Output	Input	Output	Output	Comms
INSTRUMENTATION							
Reservoir R8	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir R10	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			2			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir R14	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			2			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir R15	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			2			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				

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VHEMBE DISTRICT MUNICIPALITY

Construction of Demand Management Equipment, Flow Meters and
a Telemetry System at Reservoirs under the Vondo RWS

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Tag Number	Description	Pulsed	Binary	Analogue	Analogue	Binary	Serial
		Input	Output	Input	Output	Output	Comms
INSTRUMENTATION							
Reservoir R16	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			2			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RD1	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			2			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RD2A	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			3			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RD2B	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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VHEMBE DISTRICT MUNICIPALITY

Construction of Demand Management Equipment, Flow Meters and
a Telemetry System at Reservoirs under the Vondo RWS

Contract No **VDM/TECH/13/05/2025/01**

Tag Number	Description	Pulsed	Binary	Analogue	Analogue	Binary	Serial
		Input	Output	Input	Output	Output	Comms
INSTRUMENTATION							
Reservoir RD3	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			3			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RD4	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RD5	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			3			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RD6	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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VHEMBE DISTRICT MUNICIPALITY

Construction of Demand Management Equipment, Flow Meters and
a Telemetry System at Reservoirs under the Vondo RWS

Contract No **VDM/TECH/13/05/2025/01**

Tag Number	Description	Pulsed	Binary	Analogue	Analogue	Binary	Serial
		Input	Output	Input	Output	Output	Comms
INSTRUMENTATION							
Reservoir RD7	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			3			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RD8	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RD9	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RD11	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			2			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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VHEMBE DISTRICT MUNICIPALITY

Construction of Demand Management Equipment, Flow Meters and
a Telemetry System at Reservoirs under the Vondo RWS

Contract No **VDM/TECH/13/05/2025/01**

Tag Number	Description	Pulsed	Binary	Analogue	Analogue	Binary	Serial
		Input	Output	Input	Output	Output	Comms
INSTRUMENTATION							
Reservoir RDF	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RL1A	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RL1B	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			2			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RL2	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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VHEMBE DISTRICT MUNICIPALITY

Construction of Demand Management Equipment, Flow Meters and
a Telemetry System at Reservoirs under the Vondo RWS

Contract No **VDM/TECH/13/05/2025/01**

Tag Number	Description	Pulsed	Binary	Analogue	Analogue	Binary	Serial
		Input	Output	Input	Output	Output	Comms
INSTRUMENTATION							
Reservoir RL3	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			2			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RL4	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RL4B	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RL5	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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VHEMBE DISTRICT MUNICIPALITY

Construction of Demand Management Equipment, Flow Meters and
a Telemetry System at Reservoirs under the Vondo RWS

Contract No **VDM/TECH/13/05/2025/01**

Tag Number	Description	Pulsed	Binary	Analogue	Analogue	Binary	Serial
		Input	Output	Input	Output	Output	Comms
INSTRUMENTATION							
Reservoir RV1	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RV2	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RV3	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir RV14	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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VHEMBE DISTRICT MUNICIPALITY

Construction of Demand Management Equipment, Flow Meters and
a Telemetry System at Reservoirs under the Vondo RWS

Contract No **VDM/TECH/13/05/2025/01**

Tag Number	Description	Pulsed	Binary	Analogue	Analogue	Binary	Serial
		Input	Output	Input	Output	Output	Comms
INSTRUMENTATION							
Reservoir RV15	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir NR6	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			4			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir NR6A	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			1			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
Reservoir MILITARY	Reservoir water level			1			
	Reservoir high-high water level		1				
	Reservoir low-low water level		1				
	Reservoir flow Meter(s) (with loop isolator -galvanic isolation)			2			
	Telemetry Enclosure Tamper Alarm		1				
	Low Power Warning		1				
TOTAL FOR TELEMETRY AND SCADA		0	160	107	0	0	0
ALLOW 20% SPARES ON ALL INPUTS AND OUTPUTS		0	192	129	0	0	0

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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**SUPPLY AND INSTALLATION OF A TELEMETRY
SYSTEM AT RESERVOIRS UNDER THE VONDO RWS**

TELEMETRY AND ASSOCIATED WORK

PART 4

SCHEDULE OF INFORMATION BY TENDERER

Contractor's Paraph

Witness
Paraph

Witness
Paraph

Client Paraph

Witness
Paraph

Witness
Paraph

PART 4
SCHEDULE OF INFORMATION BY TENDERER

CONTENTS

SCHEDULE NO	DESCRIPTION	PAGE
1	TENDERERS EXPERIENCE	1
2	PROPOSED SUBCONTRACTORS	2
3	MATERIAL AND EQUIPMENT OFFERED FOR ELECTRONIC INSTALLATION	3-4
4	SCHEDULE OF RECOMMENDED SPARES FOR ELECTRONIC EQUIPMENT	5

BURO TECH	PART 4 SCHEDULE OF INFORMATION BY TENDERER	REV 1 03/97	PAGE 1 of 5
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Tenderers Experience**SCHEDULE 1****TENDERERS EXPERIENCE**

The Tenderer is required to give evidence of his experience and he must state in the schedules hereinafter:

- (a) Work of a similar nature to that contained in this Contract which had been successfully executed by him during the past five years and/or
(b) (b) which is at present being carried out by him.

Failure to complete this statement may prejudice the Tender as being submitted by an inexperienced Contractor.

Schedule (a): SIMILAR WORK COMPLETED IN THE PAST FIVE YEARS

For Whom Done (Give reference person with telephone number)	Nature of Works	Value of Works	Date Completed

Schedule (b): CURRENT COMMITMENTS

For Whom Done (Give reference person with telephone number)	Nature of Works	Value of Works	Value of Work outstanding	Completion date

I/We undertake and declare that I/we am/are prepared and in readiness, if required at any time during the period of validity of my/our Tender, to present the Engineer with further details of my/our experience and commitments as may be required and of my/our preparedness to enter into a Contract.

Direct enquiries to : at Tel. (Code) (No)
(Name in capitals)

Date :

Signature:

TENDERER

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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SCHEDULE 2

PROPOSED SUBCONTRACTORS

(Note: All proposed subcontractors for electronic and other works must be listed)

[illegible]

Date :.....

Signature of Tenderer :

BURO TECH	PART 4 SCHEDULE OF INFORMATION BY TENDERER	REV 1 03/97	PAGE 3 of 5
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Material & Equipment offered**SCHEDULE 3****MATERIAL AND EQUIPMENT OFFERED FOR ELECTRICAL & ELECTRONIC
INSTALLATION****15. ELECTRONIC EQUIPMENT****15.1 Telemetry**

Make

Model(s).....

15.2 Control Panel

Manufacturer of PANEL

Type of Construction

15.3 Hydrostatic Level Transmitters

Make

Model No

15.4 Ultrasonic Level Transmitters – Not Applicable

Make

Model No

Working principle

15.5 Load cell type Weigh Transmitters – Not Applicable

Make

Model No

15.6 PC's – Not Applicable

Make

Model No

15.7 Printer – Not Applicable

Make

Model No

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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BURO TECH	PART 4 SCHEDULE OF INFORMATION BY TENDERER	REV 1 03/97	PAGE 4 of 5
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Material & Equipment offered**15.8 Pressure Transmitters- Not applicable**

Make

Model No

Range

Accuracy

15.9 Pressure gauges- not applicable

Make

Model No

Range

Accuracy

15.10 Surge protection devices

Make

Model No

Degree of Protection

15.11 Instrumentation cables

Manufacturer

Core cross section for 2, 4, 8 & 16 pair cable

15.12 Communication cables

Manufacturer

Type of cable

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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BURO TECH	PART 4 SCHEDULE OF INFORMATION BY TENDERER	REV 1 03/97	PAGE 5 of 5
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Recommended Spares**SCHEDULE 4****SCHEDULE OF RECOMMENDED SPARES FOR ELECTRONIC EQUIPMENT**

This Schedule **must** be completed by all Tenderers or the recommended spare parts to be kept in stock by the Employer for the equipment mentioned below:

1. **ESSENTIAL SPARE PARTS**

ITEM	DESCRIPTION	QUANTITY	RATE	TOTAL PRICE DELIVERED TO EMPLOYER'S STORES
TOTAL AMOUNT FOR ESSENTIAL SPARE PARTS (CARRIED FORWARD TO SCHEDULE OF QUANTITIES)				R.....

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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**SUPPLY AND INSTALLATION OF A TELEMETRY SYSTEM AT
RESERVOIRS UNDER THE VONDO RWS**

TELEMETRY AND ASSOCIATED WORK

PART 5

SCHEDULE OF QUANTITIES

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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PART 5

SCHEDULE OF QUANTITIES

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SCHEDULE	DESCRIPTION	PAGE
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2	OCCUPATIONAL HEALTH & SAFETY REQUIREMENTS	5
3	TELEMETRY INSTALLATION	6 - 9
4	DAYWORKS	10
5	SUMMARY PAGE	11

BURO TECH	PART 5 SCHEDULE OF QUANTITIES ELECTRICAL & ELECTRONICAL WORK	PAGE 1 of 11
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PREAMBLE

- This preamble to the Schedule of Quantities provides the tenderer with **guidelines and requirements** with regard to the completion of the Schedule of Quantities. The Schedule has to be completed in **black ink** and the tenderer is referred to the Tender Requirements in regard to the correction of errors.
- This Schedule of Quantities **forms part of the Contract Documents** as listed in the Schedule of Documents and shall be read in conjunction with the General Conditions, the Specifications and the Drawings.
- For the purpose of this Schedule of Quantities, the following words shall have the **meanings** hereby assigned to them:

Unit	:	The unit of measurement for each item of work as defined in the Specifications.
Quantity	:	The number of units of work for each item
Rate	:	The payment per unit of measurement at which the Tenderer tenders to do the work.
Amount	:	The product of the quantity and the rate tendered for an item.
Sum	:	An amount tendered for an item, the extent of which is described in the Schedule of Quantities, the specifications or elsewhere but the quantity of work of which is not measured in any units.

- The short description of the items in the Schedule of Quantities are for **identification purposes only**, the work covered by the items being fully specified in the Specifications.
- The units of measurements indicated in the Schedule of Quantities are **metric units**.

The following **abbreviations** are used in the Schedule of Quantities.

XLPE	-	Three dimensional "cross linked" polyethylene		
PILCSTA	-	Paper insulated lead covered steel tape armoured		
PILCDSTA	-	Paper insulated lead covered double steel tape armoured		
PILCSWA	-	Paper insulated lead covered steel wire armoured		
PILCDSWA	-	Paper insulated lead covered double steel wire armoured		
PVC	-	Polyvinyl chloride		
SWA	-	Steel wire armoured		
A	-	Amp	mA	- milli-amp
kV	-	kilo-volt	kA	- kilo-amp
V	-	Volt	W	- Watt
kW	-	kilo-watt	kVA	- kilo-volt-amp
%	-	per cent	kPa	- kilopascal
mccb	-	moulded case circuit breaker	mm	- millimeter
mm ²	-	square millimeter	m	- meter
m ²	-	square meter	m ² -pass	- square meter-pass
m ³	-	cubic meter		
m ³ -km	-	cubic meter-kilometer	km	- kilometer
km-pass	-	kilometer-pass	ha	- hectare
l	-	litre	kl	- kilolitre
kg	-	kilogram	t	- ton
No	-	number	PC sum	- prime cost sum
Prov sum	-	provisional sum	R/only	- Rate only
W/day	-	Work day		

- Unless otherwise stated, items are **measured nett** in accordance with the drawings, and the **Contractor must allow in his rate for waste**.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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BURO TECH	PART 5 SCHEDULE OF QUANTITIES	PAGE 2 of 11
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7. All rates and sums of money quoted in the Schedule of quantities shall be in **Rands** and whole cents. Fractions of a cent shall be discarded.
8. Except for Sum Amounts the quantities set out in the Schedule of Quantities are **approximate** and do not necessarily represent the actual amount of work to be done. The quantities of work accepted and certified for payment, and not the quantities given in the Schedule of Quantities, shall be used for determining payments to the Contractor.
9. Excepting where Sum Amounts are required or where Provisional Amounts have been indicated, the Tenderer shall enter an **applicable rate** in the Rate Column of the Schedule of Quantities of each scheduled item. He shall also enter an **applicable sum** in the Amount column for each scheduled item. The Contractor will not be paid for items against which no rate or lump sum has been entered in the tender, as it is assumed that the Contractor does not wish to receive payment for any such work.

Should the Tenderer **group a number of items** and tender one lump sum for such group of items, this single lump sum shall apply to that group of items and not to each individual item.

Should the Tenderer indicate against any item that compensation for such item is included in another item, the rate for the item included in another item shall be deemed nil.

The Tenderer shall **fill in a rate** against all items where the words “**rate only**” appear in the Amount column which rate will constitute payment for work which may have be done in terms of this item. Such “rate only” items are used where it is estimated that little or no work will be required under the item or where the item is to be considered as an alternative to another item for which a quantity is given.

A tender may be rejected if any rates or lump sums in the Schedule of Quantities are, in the opinion of the Employer, **unreasonable or out or proportion**.

10. The Tenderer is at liberty to insert **a rate of his own choosing** for each item in the schedule and in this regard his attention is drawn to the fact that the Contractor has the right, under various circumstances, to payment for additional works carried out and that the Engineer is obliged to base his assessment of the rates to be paid for such additional work on the rates inserted in the schedules by the Contractor.
11. **Errors of extension** as entered in the tender shall be corrected by the Employer or Engineer but rates will be binding.
12. Payment based on the rates tendered in this Schedule shall **cover all the services and incidentals** included in the works covered by the Contract and shall be made in accordance with the General Conditions of the Contract, the Special Conditions of the Contract, the Specifications and Drawings and the Agreement pertaining to the Contract.
13. The **Contract Price** for the completed Contract shall be computed from the **actual quantities of authorised work** done to the satisfaction of the Engineer, valued at rates tendered against the respective items in the Schedule of Quantities, and shall include such authorised **provisional sums** and items of **extra work** as have become payable in terms of the Contract Documents.
14. Where the Contractor is required to **furnish detailed drawings and designs** or other information in terms of the Contract Documents, all costs thereof shall be deemed to have been **provided for and included in the unit rates** and sum amounts tendered for the items scheduled in the Schedule of Quantities and separate additional payments will not be made.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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BURO TECH	PART 5 SCHEDULE OF QUANTITIES	PAGE 3 of 11
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Tenderers shall price the **Preliminary and General** under any or all of three groups, i.e.:

- (a) A **fixed amount**,
- (b) An amount varied in **proportion to the final contract value** as compared to the tender price.
- (c) An amount varied in **proportion to the final contract period** as compared to the originally specified contract period.

The allocation of prices to the three categories listed above must be realistic and the Contractor may be required to justify the allocation of the prices. Attention is particularly drawn to the right reserved in terms of Clause 9.

16. All tender prices and all rates in the Schedule of Quantities, where applicable, Lump Sum Prices, Schedules of Rates, etc. **shall exclude the VAT payable by the Client**. The latter VAT shall be indicated as a separate item in the Tender Form and shall be added to give the total Tender Amount.
17. **Descriptions** with the under mentioned phrases, shall, unless otherwise stated therein, include the following and shall be priced as such:
 - 17.1 Excavations: to include excavation, barricading, prevent collapsing of sides, strutting or shoring if necessary, keeping excavations dry e.g., with pumping, backfilling, and compaction.
 - 17.2 Termination of cables: making off, glands, shrouds and lugs.
 - 17.3 Distribution boards including sheet metal work: all internal wiring, conduit terminations but excluding cable terminations, earthing.
 - 17.4 Conduit: cutting, threading and reaming, bending, couplings, sockets, bends, and T-pieces.
 - 17.5 Conduit built into brickwork or cast into concrete: rough cutting in brickwork and cast in concrete.
 - 17.6 Conduit surface mounted: surface fixing including saddles.
 - 17.7 Conduit chased into brickwork or concrete: chasing and making good of all finishes.
 - 17.8 Conduit laid in ground or filling: excavation, backfill and compaction.
 - 17.9 Outlet and draw boxes: fixing to conduits with lock nuts and brass bush nuts.
 - 17.10 Cable ladders and trays, wire trunking: cutting, bonding, jointing and fixing.
 - 17.11 Lighting tracks and power skirting: cutting, bonding, jointing and fixing, blank and cover plates.
 - 17.12 PVC copper conductors: PVC insulated copper conductors in correct colours.
 - 17.13 Copper earth conductors: bare stranded copper earth conductors.
 - 17.14 Switch socket outlets, light switches, etc: cover plates, chromium-plated screws and all necessary fittings and equipment.
 - 17.15 Luminaires or light fittings: all lamps and necessary fittings and equipment.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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BURO TECH	PART 5 SCHEDULE OF QUANTITIES	PAGE 4 of 11
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**SUPPLY AND INSTALLATION OF A TELEMETRY
SYSTEM AT RESERVOIRS UNDER THE VONDO RWS**

TELEMETRY INSTALLATION

PART 6

DRAWINGS

The Electrical Drawings are also bound into Volume 2 – Book of Drawings.

Contractor's Paraph	Witness Paraph	Witness Paraph	Client Paraph	Witness Paraph	Witness Paraph
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