



TENDER NO:

**TENDER FOR THE DESIGN AND CONSTRUCTION OF
CATHEDRAL HEADER PIPELINE AND VALVES AT
VEREENIGING PUMPING STATION**

PROJECT SPECIFICATION

SPECIFICATIONS

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PART 1: GENERAL SPECIFICATION

BACKGROUND

System 5 at Vereeniging Pumping Station was installed under the Additional Water Supply (1982) Scheme to augment the then capacity at Vereeniging by 900ml/d and was completed around 1985. The system comprises of: four spiral flocculators; four longitudinal sedimentation tanks; carbonation bays; a filter house; wash water pump house and Engine Room 4. Water from the four reservoirs within Filter House 3 gravitates into Engine Room 4 via two 2500mm diameter pipelines. The isolation valves for the filter reservoirs and the control valves, controlling the flow into the pipelines, and the chlorine injecting points are housed in a common valve chamber called the Cathedral. Water is further drawn off from these pipes through the wash water pump house to wash the 72 filters located in filter house 3.

A recent visual observation by Vereeniging Pumping Station Operations Staff is that the 2500 mm diameter pipe in the Cathedral is 'very' badly corroded. Further inspections undertaken by Rand Water's pipeline and mechanical design sections indicate that the level corrosion is a major risk to Rand Water and that the Header requires replacement as a priority. Failure to timeously replace the header shall result in the whole of System 5 at Vereeniging Pumping Station being unavailable for operation for an extended period. This would result in Rand Water not being able to supply water to the Vanderbijlpark area.

Furthermore, the 2500mm and 1600mm butterfly valves inside the Cathedral are also badly corroded and are leaking. The station is unable to perform routine maintenance of these valves because in order to do maintenance the valves need to be taken out. However due to the leakage of the valves, removing the valves will require a shut-down of System 5 and it is impractical for the station to shut-down this system regularly.

The Chlorine dosing equipment inside the Cathedral that is responsible for injecting chlorine into the Cathedral Header is severely leaking due to age and lack of maintenance. This poses a health risk for operations personnel working inside the chamber. It is impossible for the station to conduct regular maintenance on any of the Process, Mechanical, Electrical and Automation equipment inside the Cathedral because the system is continuously in operation and a shut-down is required in order to carry out maintenance work.

The main design component – pertaining to the structural engineering aspects of the works – of the works is covered by the Engineer (items not designed by the Engineer will be clearly laid out in the Functional Specifications). The Mechanical, Electrical and Automation aspects of the Contract are to be designed and constructed by the Contractor, as per the minimum requirements laid out in this technical specification document.

STATUS OF HEADER

The entire pipeline inside the header is badly corroded with rust flakes as thick as 8 mm being visible. The existing weld beads protrude well above the shell indicating considerable loss in wall thickness. The condition inside the pipe would be a considerable challenge to assess for, structural integrity, without shutting down the whole of System 5, draining the pipe and then getting into the pipe. Removal of the rust is potentially dangerous as it can cause rupture of the pipeline, depending on the removal method, resulting in potential injury to people and also loss of the operation of System 5, being the only supply to Engine Room 4.

The temporary external carbon fibre wrapping of the header was expected to extend the life of the header for five years after installation. The carbon fibre wrapping was installed in February 2011. Thus, it was intended to last until the end of February 2016, with the minimum design life having elapsed, therefore there is an urgent need to design, supply, deliver, install and commission the necessary equipment and to secure shut-downs of System 5 to replace the header.

The main objectives of the project, as per the client, may be summarized as follows:

It is proposed that the following items of work be carried out to remedy the problems being experienced inside and with regards to the Cathedral Header:

- 1.1.1 The 2500mm diameter header inside the Cathedral must be replaced.
- 1.1.2 The three (3) 2500mm diameter butterfly valves on the Cathedral Header must be replaced.
- 1.1.3 The four (4) 1600mm diameter butterfly valves on the incoming lines from the filters must be replaced.
- 1.1.4 The existing monolithic roof of the Cathedral must be replaced with a new removable roof cover (refer to drawing R028765/001). The new cover must incorporate openings for mechanical, civil and automation services.
- 1.1.5 Install a fan for the extraction of chlorine gas from inside the chamber.
- 1.1.6 To ensure possible future isolation of the northern and southern legs of the header pipework to Engine Room 4 from filter 3, for maintenance purposes; Two (2) new 2500mm diameter valves are to be installed on the pipeline – the valves are to be housed in a purpose designed chamber (refer to drawing R028765/100-101).
- 1.1.7 Upgrade the Mechanical, Electrical and Automation equipment (refer to relevant specification documents)

CIVIL SCOPE OF WORKS

Scope of Contract

The Contractor's obligations under this project shall include, but not be limited to the following principal items (the exact extent for the scope of works shall be verified by the contractor with the Engineer prior to tendering):

Cathedral Header

- A. Identification of potential site office area for the Engineer's approval
- B. Fencing off around designated site areas
- C. Surveying and setting out of works
- D. Accommodation of traffic along existing roads, maintaining access for the Employer's staff
- E. Compiling conditions assessment benchmark report for existing structures and services which may be affected by the works
- F. Submission of OHSE documents and construction method statements
- G. Relocation and/or protection of existing services and structures
- H. Removal and stockpiling of existing precast concrete roof panels – existing lifting hooks to be assessed for structural integrity and alternative options explored where the hooks

may not be useable (alternative proposals to ensure may be explored, provided that the proposals still retaining water tight connections to the concrete at the location of the lifting hooks)

- I. Removal and temporary storage of header entrance shed, without interrupting normal operations at the Header
- J. Dismantling, removal, temporary storage, conditional assessment of existing structural steelwork and refurbishing of existing structural steel walkways inside the cathedral header (covered under the Rand Water Mechanical Engineering Specification)
- K. Temporary works design and erection, as part of formwork
- L. Sequential support of existing concrete walls and demolition of existing concrete roof (by sawing or through other methods approved by the Engineer)
- M. Erection of new removable concrete and steel roof system
- N. Dealing with water (pumping to wash water sump), the Contractor is to ensure that they always have back-up pumps available because the area is well known to have high water table. The Contractor is required to have made adequate allowance in their tender bid to deal with water.
- O. Removal and storage of existing steel pipework and valves within the cathedral header (to be done by Rand Water Pipeline installation crew)
- P. Installation of new pipelines and valves (by Rand Water Pipeline installation crew)
- Q. Reinstatement of refurbished steel walkways and handrails (as well as miscellaneous steel elements)
- R. Water tightness testing of concrete roof joints according to SANS 2001 or BS8007, whichever is more conservative
- S. Testing of construction materials at various stages during the construction process
- T. Generation of as-built drawings
- U. Reinstatement of structures damaged or relocated during construction to their preconstruction condition / location.

Valve Chamber

- A. Identification of potential site office area for the Engineer's approval
- B. Fencing off around designated site areas
- C. Surveying and setting out of works

- D. Accommodation of traffic along existing roads, maintaining access for the Employer's staff
- E. Compiling conditions assessment benchmark report for existing structures and services which may be affected by the works
- F. Submission of OHSE documents and construction method statements
- G. Relocation and/or protection of existing services and structures
- H. Removal and stockpiling of existing precast concrete roof panels – existing lifting hooks to be assessed for structural integrity and alternative options explored where the hooks may not be useable (alternative proposals to ensure may be explored, provided that the proposals still retaining water tight connections to the concrete at the location of the lifting hooks)
- I. Removal and temporary storage of header entrance shed, without interrupting normal operations at the Header
- J. Dismantling, removal, temporary storage, conditional assessment of existing structural steelwork and refurbishing of existing structural steel walkways inside the cathedral header (covered under the Rand Water Mechanical Engineering Specification)
- K. Temporary works design and erection, as part of formwork
- L. Sequential support of existing concrete walls and demolition of existing concrete roof (by sawing or through other methods approved by the Engineer)
- M. Erection of new removable concrete and steel roof system
- N. Dealing with water (pumping to wash water sump), the Contractor is to ensure that they always have back-up pumps available because the area is well known to have high water table. The Contractor is required to have made adequate allowance in their tender bid to deal with water.
- O. Removal and storage of existing steel pipework and valves within the cathedral header (to be done by Rand Water Pipeline installation crew)
- P. Installation of new pipelines and valves (by Rand Water Pipeline installation crew)
- Q. Reinstatement of refurbished steel walkways and handrails (as well as miscellaneous steel elements)
- R. Water tightness testing of concrete roof joints according to SANS 2001 or BS8007, whichever is more conservative
- S. Testing of construction materials at various stages during the construction process
- T. Generation of as-built drawings

- U. Reinstatement of structures damaged or relocated during construction to their preconstruction condition / location.

PIPELINE SCOPE OF WORKS

Overview:

The work consists of the isolation and removal of existing Cathedral Header in phases and the manufacturing and installation of pipework, and associated civil works for the Cathedral Header. The Cathedral Header pipework consist of following items namely 2500mm x 1600mm tee pieces with 800mm access manholes and chlorine dosing points, including flanges. The installation will have to be done in accordance with the applicable specifications, variations and additions to the standardized specifications applicable to this contract and the technical specifications of Rand Water for work that falls outside of the standardized specifications. In addition to the works indicated above the Contractor shall also perform installation of the wrappers and support ring indicated on the drawings.

The Contractor to supply, deliver and install pipes, and/or pipe specials, and take delivery and or collect valves and any instrumentation if applicable, by collecting the material from the following destinations;

Valves and any instrumentation from Rand Water's Pipe Plant and/or Store at Central Depot, Zwartkopjes Pump Station or as instructed by the Engineer

The Contractor must supply all resources and equipment needed for the successful implementation of the pipework.

The work to be performed by the Contractor shall not be limited to:

- A. Manufacture pipe specials items as per drawing no. RA17924 (if not already manufactured), and provide Data Pack of all manufactured pipes and specials.

- B. Shutdown of partial of header and drain any excess water and isolation of the Cathedral header in phases.
- C. Remove 2 x 1600mm Butterfly valves through roof openings.
- D. Install spades or blank flanges onto 2 x 1600mm and 1x 2500mm flanges for double isolation
- E. Remove existing tee pieces and other components through roof openings.
- F. Clean up and dry up areas for installations of new pipework and valves
- G. Inspect and collect, unload onto sandbags, install pipe specials and other related parts, support ring and internal wrapper plate. Also install all butterfly valves, within the chamber.
- H. Complete and repair the protective coatings as follows: Rigid Polyurethane external coating and solvent free rigid polyurethane internal lining.
- I. Pressure-test the completed pipeline and specials to required procedures
- J. Conduct CCTV inspections prior to internal handover of the header as specified in the tender document
- K. Submit all required documentation with handover (internal and external) of the header
- L. Once one phase is done repeat process for the second phase (to be informed by the shutdown protocol)
- M. Effect all repair work to concrete plinths and structure that are required.
- N. Minor repair work to concrete surfaces

Other requirements of the Contractor:

- A. Evaluate and comment on the design package when a problem on site during construction occurs, identify possible opportunities to reduce cost and scheduled time while not compromising the integrity, safety and quality of the project
- B. The Contractor shall submit to the Project Manager and or designated Resident Engineer for approval on any proposed design changes
- C. Establishes the risk associated with the implementation of the works
- D. Procures the required labour, services, plant and material
- E. Receive and install the free issue items
- F. Deliver and install all required plant and material to site
- G. The Contractor ensures that he and his Sub-contractors meet the Quality Control Plan (QCP) requirements

Taking over of the Works:

- A. The responsibility for operation and routine maintenance passes to the Employer at Completion. The Contractor ensures clean-up requirements at Completion and ensures that they are implemented
- B. The Contractor transmits a complete set of marked-up drawings/as-built drawings in Rand Water's format to the Employer before the testing of the Works
- C. The Contractor compiles quality control (QC) hand-over documentation files (Data-pack which must be keep up to date as the project progresses) for each piece of material individually which consists of :
 - Notice and acceptance of completion form;
 - Checkout conformation form;
 - Checklist applicable to Equipment;

- Punch / Defects list;
- Certificate of compliance by an accredited person for the portion of installation;
- Tests, calibration, material, SABS and QC certificates;
- Completed data sheets; and
- Accepted for construction drawings
- Relevant drawings;
- Material certificates indicating material compliance and type;
- Engineering and design changes
- Safety requirements for installation and maintenance;
- The detailed maintenance procedure documentation;
- Fabrication and inspection plan;
- List of tagged items for transport and construction;
- Internal verification documents;
- Guarantees that the Contractor and his Sub-contractor's or suppliers provide;
- A list of Equipment to undertake NDE
- Dates of manufacturing, expiry and certificates indicating that coating and lining products are still within specification.

MECHANICAL SCOPE OF WORKS

The Mechanical scope of work shall include the design, supply, installation and putting into service of 7 Butterfly valves with actuator extensions

- A. Design and supply actuators complete with adequately supported extensions
- B. Design and supply platforms to access actuators
- C. Servicing and testing of valves complete with actuators.
- D. Installation and commission of valves complete with actuators and actuator extensions.
- E. Refurbishment and galvanizing access steel platforms and handrails.

F. Design, supply and install a mechanical ventilation system.

G. Design, supply and install and drainage/ sump pumps.

Deliverables

A. Supply, install and commissioning of extended spindles, actuator platforms actuators and gearbox assembly.

B. Service, pressure test and installation of four 1600 diameter valves and three 2500 diameter valves.

C. Supply, install and commissioning of mechanical ventilation system

D. Supply, install and commissioning of sump pump(s) system.

Assumptions

A. The valves, actuators and gearbox assembly exist.

ELECTRICAL SCOPE OF WORKS

Provide for the design, supply, delivery, installation and commissioning of the following items as a minimum:

A. Provision for all circuit breakers and additions in the existing Wash Water 400 V MCC.

B. Provision for new cabling, cable supports and excavations between Wash Water plant MCC, Cathedral Header and new Valve Chamber (at Engine Room 4) installations.

C. Provision for new electrical kiosks at the Cathedral Header and new Valve Chamber.

- D. Provision for all electrical power and control cabling to equipment at the Cathedral Header and new Valve Chamber.
- E. Provision for new cable racking and cable support systems at the Cathedral Header and new Valve Chamber.
- F. Provision for new 400 Volt distribution kiosk at the Cathedral Header.
- G. Provision for new Small Power and Lighting corrosion resistant installation complete with a new distribution board at the Cathedral Header.
- H. Provision for new Small Power and Lighting installation at the new Valve Chamber.
- I. Provision for earthing of all new installations and equipment at Cathedral Header and new Valve Chamber.
- J. Provision for new sump pump control panels complete with flood alarm indication and siren.
- K. Provision for power and control cabling for the new extraction fan at the Cathedral Header chamber.
- L. Provision for pedestal mounted local isolator control panels for each actuator at the Cathedral Header and new Valve Chamber.
- M. Provision for all design drawings, single lines, general arrangement drawings, documentation, manuals, etc.
- N. Provision for all cable and equipment labeling.

Additional electrical works required:

- A. Provision for the decommissioning and removal of all redundant valve cabling, cable supports, electrical equipment, etc. at the Cathedral Header.

- B. Provision for the disconnection and removal of the existing Small Power and Lighting distribution board and installation at the Cathedral Header.
- C. Provision for the decommissioning and removal of the existing electrical equipment for the Cathedral Header chamber sump pump system.
- D. Provision for the decommissioning and removal of the existing emergency sump pump control panel and cabling at the Cathedral Header.

AUTOMATION SCOPE OF WORKS

The Automation Scope of work shall include the supply, installation and putting into service of the following:

PLC

- A. Industrial Ethernet network linking the valve actuator PLC to SCADA in the Control Room with full redundancy.
- B. Interface to the existing Ethernet fibre optic network.
- C. Profibus network linking each valve actuator to the PLC.
- D. Full redundant Fiber Optic Profibus network to each valve actuator.
- E. Programming of the PLC to communicate to the valve actuators.
- F. Programming of the Control Room SCADA to remotely monitor and control the valve actuators.
- G. PLC Panel for Automation equipment.
- H. Linking sump pumps to PLC and SCADA for status monitoring purposes.

PART 2: PROJECT SPECIFICATION

SS 2.1 – PIPELINE SPECIFICATION

SS 2.1.1 – Overview:

The work consists of the isolation and removal of existing Cathedral Header in phases and the manufacturing and installation of pipework, and associated civil works for the Cathedral Header. The Cathedral Header pipework consist of following items namely 2500mm x 1600mm tee pieces with 800mm access manholes and chlorine dosing points, including flanges. The installation will have to be done in accordance with the applicable specifications, variations and additions to the standardized specifications applicable to this contract and the technical specifications of Rand Water for work that falls outside of the standardized specifications. In addition to the works indicated above the Contractor shall also perform installation of the wrappers and support ring indicated on the drawings.

The Contractor to supply, deliver and install pipes, and/or pipe specials, and take delivery and or collect valves and any instrumentation if applicable, by collecting the material from the following destinations;

Valves and any instrumentation from Rand Water's Pipe Plant and/or Store at Central Depot, Zwartkopjes Pump Station or as instructed by the Engineer

The Contractor must supply all resources and equipment needed for the successful implementation of the pipework.

The work to be performed by the Contractor shall not be limited to:

- O. Manufacture pipe specials items as per drawing no. RA17924 (if not already manufactured), and provide Data Pack of all manufactured pipes and specials.
- P. Shutdown of partial of header and drain any excess water and isolation of the Cathedral header in phases.
- Q. Remove 2 x 1600mm Butterfly valves through roof openings.
- R. Install spades or blank flanges onto 2 x 1600mm and 1x 2500mm flanges for double isolation
- S. Remove existing tee pieces and other components through roof openings.
- T. Clean up and dry up areas for installations of new pipework and valves
- U. Inspect and collect, unload onto sandbags, install pipe specials and other related parts, support ring and internal wrapper plate. Also install all butterfly valves, within the chamber.

- V. Complete and repair the protective coatings as follows: Rigid Polyurethane external coating and solvent free rigid polyurethane internal lining.
- W. Pressure-test the completed pipeline and specials to required procedures
- X. Conduct CCTV inspections prior to internal handover of the header as specified in the tender document
- Y. Submit all required documentation with handover (internal and external) of the header
- Z. Once one phase is done repeat process for the second phase (to be informed by the shutdown protocol)
- AA. Effect all repair work to concrete plinths and structure that are required.
- BB. Minor repair work to concrete surfaces

SS 2.1.2 – Other requirements of the Contractor:

- H. Evaluate and comment on the design package when a problem on site during construction occurs, identify possible opportunities to reduce cost and scheduled time while not compromising the integrity, safety and quality of the project
- I. The Contractor shall submit to the Project Manager and or designated Resident Engineer for approval on any proposed design changes
- J. Establishes the risk associated with the implementation of the works
- K. Procures the required labour, services, plant and material
- L. Receive and install the free issue items
- M. Deliver and install all required plant and material to site
- N. The Contractor ensures that he and his Sub-contractors meet the Quality Control Plan (QCP) requirements

SS 2.1.3 – Taking over of the Works:

- D. The responsibility for operation and routine maintenance passes to the Employer at Completion. The Contractor ensures clean-up requirements at Completion and ensures that they are implemented
- E. The Contractor transmits a complete set of marked-up drawings/as-built drawings in Rand Water's format to the Employer before the testing of the Works

F. The Contractor compiles quality control (QC) hand-over documentation files (Data-pack which must be keep up to date as the project progresses) for each piece of material individually which consists of :

- Notice and acceptance of completion form;
- Checkout conformation form;
- Checklist applicable to Equipment;
- Punch / Defects list;
- Certificate of compliance by an accredited person for the portion of installation;
- Tests, calibration, material, SABS and QC certificates;
- Completed data sheets; and
- Accepted for construction drawings
- Relevant drawings;
- Material certificates indicating material compliance and type;
- Engineering and design changes
- Safety requirements for installation and maintenance;
- The detailed maintenance procedure documentation;
- Fabrication and inspection plan;
- List of tagged items for transport and construction;
- Internal verification documents;
- Guarantees that the Contractor and his Sub-contractor's or suppliers provide;
- A list of Equipment to undertake NDE
- Dates of manufacturing, expiry and certificates indicating that coating and lining products are still within specification.

SS 2.2 – CIVIL/STRUCTURAL SPECIFICATIONS

SS 2.2.1 – TERMINOLOGY, ABBREVIATIONS AND APPLICABLE DRAWINGS

The following terminology shall apply (unless specified otherwise in other Contract documents):

Term	Definition
Engineer	As defined in the commercial document.
Employer	Shall mean the same as the “client”, with the client being the owner of the Cathedral Header project
Contractor	Shall mean the legal entity under the employ of the Client who enters into a binding Contract to undertake part of or the entirety of the Works described in this and other Contract documents.

The following abbreviations shall apply:

Abbreviation	Definition
GA	General Arrangement
SANS	South African National Standards
SABS	South African Bureau of Standards
BS	British Standards

This document shall be read in conjunction with the following drawings:

Drawing Number	Drawing Title
RA 28765/000	Site Plan
R0 28765/001	Cathedral Header – In-situ Concrete Roof System Demolition Procedure - Sheet 1 of 4
R0 28765/002	Cathedral Header – In-situ Concrete Roof System Demolition Procedure – Sheet 2 of 4
R0 28765/003	Cathedral Header – In-situ Concrete Roof System Demolition Procedure –

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	Sheet 3 of 4
R0 28765/004	Cathedral Header – In-situ Concrete Roof System Demolition Procedure – Sheet 4 of 4
R0 28765/100	New Header Chamber for the Header Isolation Valves Sheet 1 of 2
R0 28765/101	New Header Chamber for the Header Isolation Valves Sheet 2 of 2

SS 2.2.2 – General Requirements

Civil and Structural works are to be carried out as per the requirements of the SANS 2001 “Construction Works Standards” and SANS 1200 “The Standardized Specification for Civil Engineering Construction.

All works to be carried out are required to be undertaken without interruptions to the normal operations at the Header (except during scheduled shutdowns). This requirement applies to all existing automation, electrical and mechanical services.

Construction work shall be scheduled such that the roof demolition works and the geotechnical investigations (for the new valve chamber) are either executed concurrently or the geotechnical investigation is concluded first – with the aim of having no standing time caused by the investigations.”

SS 2.2.3 – Service Water Supply

Connection points (water source)

The position of the potable water connections will be pointed out to the contractor on site, by the client or the client’s representatives.

The operating pressure for the existing connection point, are to be confirmed by the Contractor.

The Contractor shall make allowance for installing a water meter connection at the water connection point. Water for construction shall be to the Contractor’s account and shall be deemed to be included in the tendered rates.

SS 2.2.4 – Detailed Civil Scope of Works:

The Contractor’s obligations under this project shall include, but not be limited to, the following principal items (the exact extent of the scope of works shall be verified by the contractor with the Engineer prior to tendering – at the tender briefing or site clarification meeting):

SS 2.2.4.1 – Cathedral Header

- V. Identification of potential site office area for the Engineer's approval
- W. Fencing off around designated site areas
- X. Surveying and setting out of works
- Y. Accommodation of traffic along existing roads, maintaining access for the Employer's staff
- Z. Compiling conditions assessment benchmark report for existing structures and services which may be affected by the works
- AA. Submission of OHSE documents and construction method statements
- BB. Relocation and/or protection of existing services and structures
- CC. Removal and stockpiling of existing precast concrete roof panels – existing lifting hooks to be assessed for structural integrity and alternative options explored where the hooks may not be useable (alternative proposals to ensure may be explored, provided that the proposals still retaining water tight connections to the concrete at the location of the lifting hooks)
- DD. Removal and temporary storage of header entrance shed, without interrupting normal operations at the Header
- EE. Dismantling, removal, temporary storage, conditional assessment of existing structural steelwork and refurbishing of existing structural steel walkways inside the cathedral header (covered under the Rand Water Mechanical Engineering Specification)
- FF. Temporary works design and erection, as part of formwork
- GG. Sequential support of existing concrete walls and demolition of existing concrete roof (by sawing or through other methods approved by the Engineer)
- HH. Erection of new removable concrete and steel roof system
- II. Dealing with water (pumping to wash water sump), the Contractor is to ensure that they always have back-up pumps available because the area is well known to have high water table. The Contractor is required to have made adequate allowance in their tender bid to deal with water.
- JJ. Removal and storage of existing steel pipework and valves within the cathedral header (to be done by Rand Water Pipeline installation crew)
- KK. Installation of new pipelines and valves (by Rand Water Pipeline installation crew)
- LL. Reinstatement of refurbished steel walkways and handrails (as well as miscellaneous steel elements)

- MM. Water tightness testing of concrete roof joints according to SANS 2001 or BS8007, whichever is more conservative
- NN. Testing of construction materials at various stages during the construction process
- OO. Generation of as-built drawings
- PP. Reinstatement of structures damaged or relocated during construction to their preconstruction condition / location.

SS 2.2.4.2 – Valve Chamber

- V. Fencing off around designated site areas
- W. Surveying and setting out of works (including generating survey drawings and supply survey information in native and ".dwg" formats)
- X. Accommodation of traffic along existing road maintaining entry and access for the Employer's staff
- Y. Conduct a geotechnical investigation
- Z. Compiling conditions assessment benchmark report for existing structures and services which may be affected by the works
- AA. Relocation and/or protection of existing services and structures
- BB. Services detection (including detecting the location and depth of services, and generating and issuing of services detection information in native and ".dwg" formats)
- CC. Excavation and Earthworks including dealing with water in excavations, as well as confirmation of founding conditions (Through the Contractor's Professionally Registered Geotechnical Engineer, appointed to oversee the geotechnical aspects of the construction)
- DD. Dealing with water (pumping to wash water sump), the Contractor is to ensure that they always have back-up pumps available because the area is well known to have high water table. The Contractor is required to have made adequate allowance in their tender bid to deal with water.
- EE. Design and construction of a shoring system for vertical excavations
- FF. Construction of water tight chamber
- GG. Water tightness testing of chamber prior to backfill according to SANS 2001 or BS8007, whichever is more conservative
- HH. Design and installation of maintenance walkways with provisions for the dosing points
- II. Backfilling with imported material or as prescribed by the Geotechnical investigation

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- JJ. Construction of paving around structure
- KK. Testing of construction material during the construction process
- LL. Generation of as-built drawings
- MM. Reinstatement of structures or services damaged or relocated during construction to their pre-construction condition / location.

SS 2.2.5 – VARIATIONS AND ADDITIONS TO STANDARDIZED SPECIFICATIONS

The variations and additions to the applicable standardized specifications have been compiled to provide supplemental site and project specific information, and in that regard are intended to supplement or partially replace aspects of the other related specification, most notably: SANS 1200; SANS 10120; SANS 2001 and the Technical Specifications contained in this document.

The variations and additions below are provided, to varying extents, some of the following specifications applicable to this project:

Specification No.	Description
SANS 1200 - A	Standardized Specification for Civil Engineering Construction – General
SANS 1200 - D	Standardized Specification for Civil Engineering Construction – Earthworks
SANS 2001 – BE1	Construction Works – Earthworks (General)
SANS 2001 – BS1	Construction Works – Site Clearance
SANS 2001 – CC1	Construction Works – Concrete Works (Structural)
SANS 2001 – CS1	Construction Works – Structural Steelwork
SANS 2001 – DP1	Earthworks for Buried Pipelines and Prefabricated Culverts
SANS 2001 – DP2	Construction Works Part DP2: Medium Pressure Pipelines

AA GENERAL - (SABS1200AA – 1986)

AA 3 MATERIALS

AA 3.1 QUALITY AND SAMPLES

Substitute the second sentence of the first paragraph of "AA3.1" with the following:

"Materials shall bear the official mark of the appropriate standard."

Also add the following as a second paragraph:

"The Contractor is responsible for the cost of all testing to ascertain that all construction materials comply with the relevant minimum requirements, and all costs associated with testing of the materials shall be deemed to be included in the tendered rates. Samples on which control testing is required by the Engineer, shall be delivered free of charge to an approved laboratory and tested there as per the Engineer's requirements – on the Contractor's account. The cost of control tests done by the Engineer and of which the results do not comply with the minimum requirements shall be for the Contractor's account.

The Contractor shall inform the Engineer of any control testing/site inspections to be done at least 48 hours before such tests/inspections are required, and the contractor must allow in his/her programme for the time necessary for the tests/inspections to be undertaken, and the processing of the results thereof.

The handling, storage, transport and erection of equipment, machinery and materials shall be strictly in accordance with the requirements of the supplier and or manufacturer.

All materials shall be new and of the best quality available unless otherwise specified. Materials must function satisfactorily under prevailing climate and weather conditions at the place of installation.

All materials shall comply with the SANS applicable to them."

AA 3.3 DELAY DUE TO SUPPLY OF MATERIALS

Add new sub-clause "AA 3.3":

"The Contractor shall ensure that the work is not delayed, due to a lack of materials on site, by placing orders with suppliers for the required materials timeously – with the lead times scheduled in programmes submitted to the Engineer for approval"

AA 4 PLANT

AA 4.1 CONTRACTOR'S OFFICE, STORES AND SERVICES

Add the following to "AA 4.2":

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"Security of the Contractor's camp and construction site will be the Contractor's own responsibility and no additional payment will be made if additional security measures (crime prevention, etc.) need to be employed during the contract period (as may be deemed required by the Engineer).

The Contractor shall make his own arrangements for housing his employees and transporting them to and from the site – such housing, shall however; meet relevant legislated requirements for temporary housing, as well as meeting the Contractor's code of ethics. The Contractor is responsible in all respects for the housing and transporting of his employees and for the arrangement thereof, and no extension of time due to any delays resulting from this will be granted."

AA 4.3 HAND TOOLS

Add new sub-clause "AA 4.3":

"The Contractor shall provide and maintain all hand tools required for the execution of the Works and all such costs shall be deemed to be included in the tendered rates and no separate payment will be made for it."

AA 4.4 MEDICAL FACILITIES AND SAFETY EQUIPMENT

Add new sub-clause "AA 4.4":

"The Contractor shall provide a First Aid cabinet fully equipped and maintained with the minimum contents as listed in the Annexure (Regulation 3) to the General Safety Regulations of the Occupational Health and Safety Act (Act 85 of 1993), to deal with accidents and ailments which are likely to occur during the construction period.

The Contractor shall provide personal safety equipment and facilities as required by Regulation 2 of the General Safety Regulations of the Occupational Health and Safety Act (Act 85 of 1993).

The Contractor shall designate his Safety Officer and Qualified First Aider. The Contractor shall give copies of the minutes of the site safety meetings to the Engineer."

AA 5 CONSTRUCTION

AA 5.1 SURVEY

AA 5.1.2 Preservation and Replacement of Beacons and Pegs Subject to the Land Survey Act

Add the following paragraph at the end of sub clause "A 5.1.2":

"Before the commencement of construction work, the Contractor, in consultation and liaison with the Engineer, shall search for plot pegs where boundaries have not been established by the erection of walls or fences (e.g. between two adjacent undeveloped even or on an undeveloped corner erf) and the Contractor shall compile a list of such pegs that are apparently in their correct positions. Where pegs are not in their correct positions this should be noted by the Contractor and the Engineer should be notified immediately".

AA 5.2 WATCHING, BARRICADING, LIGHTING AND TRAFFIC CROSSINGS

Add the following to the end of "AA 5.2":

"Where no minimum requirements for watching, barricading, lighting and traffic crossings for work on public roads are specified in the project or earthworks specifications then the requirements set out in SABS 1200 AA-1986 for 'Watching, Barricading, Lighting and Traffic Crossings' shall apply.

All deep excavations shall be sufficiently barricaded, with barricading complying with the requirements of SANS 10400-B or as per the Engineer's requirements."

AA 5.4 PROTECTION OF OVERHEAD AND UNDERGROUND SERVICES

Add the following to "AA 5.4":

"It can be expected that existing services will be encountered during the course of construction. The Contractor must determine as far as is possible in conjunction with the relevant authorities the location of the various services. Special care must be taken to avoid disrupting these services. The cost of locating and protecting the services shall be deemed to have been included in the tendered rates. All services must be detected and exposed before any bulk excavation may start."

AA 5.5 DEALING WITH WATER ON WORKS

Add the following to the end of "AA5.5":

"Dedicated dewatering measures must be provided for in the event of a high/perched water table.

Over and above his general obligations in regard to dealing with water as specified in SANS 1200 A, the Contractor shall deal with and dispose of all water so as to ensure that the Works are kept sufficiently dry at all times so that they can be properly executed, and he shall protect them against flood damage. For this purpose the Contractor shall provide sufficient pumps, pipes and other equipment that may be necessary. Payment for dealing with water shall be included in the Contractor's rates for foundations, except in so far as special provision for dealing with water may be made elsewhere in the Specifications."

AA 5.6 POLLUTION

Replace "AA 5.6" with the following:

"The Contractor shall take all reasonable measures to minimize any dust nuisance, pollution of streams and inconvenience to or interference with the public (or others) or machinery as a result of the execution of the Works (including excessive vibration of machinery caused by construction equipment)."

AA 5.8 GROUND AND ACCESS TO WORKS

Add the following to "AA 5.8":

"The Contractor shall maintain adequate access to all property at all times unless otherwise sanctioned by the Engineer. Details of the proposed methods of providing access shall be submitted to the Engineer

for approval before such access is restricted. Any claims arising from impeded accesses shall wholly be the responsibility of the Contractor.

Construction along existing roads should be executed in such a manner that both pedestrian and vehicular traffic can be accommodated at all times.

Road traffic signs shall comply with the requirements of the 'South African Road Traffic Signs Manual' and shall be approved by the Engineer before construction commences."

AA 5.9 DETAILED CONDITION AND STRUCTURAL ASSESSMENTS

The purpose of these structural assessments is to assess the condition and structural adequacy of each structure to handle additional loads to be imposed by proposed solar installation and related equipment. The inspection and condition assessments shall include the following, but not limited to:

1. Pre-inspection
 - a. Perusal and assessment of available information pertaining to each structure
 - b. Verification of existing general arrangement drawings and reconstruct structural drawings where they are not available, with the aid of the 3D laser scanning (including reinforcement drawings where applicable).
 - c. Appraisal of the geological conditions.
 - d. Production of assessment drawings.
 - e. Identifying critical areas for inspection.
2. Systematic visual inspection and condition assessment of each structure to identify:
 - a. Signs of deterioration;
 - b. Signs of structural damage, distress or deformation;
 - c. Evidence of instability, movement, settlement, etc.
 - d. Alterations that can adversely affect a structure.
3. Professional assessment
 - a. Assess possible causes, extent and implication of problems identified during visual inspection and condition assessment.
 - b. Assess whether identified problems are defects of structural or non-structural significance.
 - c. Identify apparent deviation from intended use which can result in overloading.
 - d. Structural analysis
 - i. Develop structural model for each structure to determine the current structural capacity of each structure.
 - ii. Assess effects of additional loading (proposed solar installation and related equipment) on each structure
 - e. Durability performance analysis including material integrity analysis, in accordance with applicable standards. These include but not limited to (where applicable):
 - i. Cover Surveys
 - ii. Assessment of surface hardness (Schmitt hammer test)
 - iii. Assessment of voids and delamination (Sounding survey, Ultrasonic pulse velocity testing)
 - iv. Material sampling, assessment and testing.

- v. Tests of material strength (compressive and tensile strength)
 - vi. Durability index tests (water sorptivity, oxygen permeability and chloride conductivity tests)
 - vii. Tests of material chemicals (carbonation depth and chloride content tests)
 - viii. Steel corrosion assessment (Half-cell potential and corrosion rate measurement)
 - ix. Steel thickness measurements
 - x. Timber probing.
 - xi. Other special tests that are deemed necessary by the structural engineer.
- Individual tests shall be appropriately motivated and accepted by Rand Water prior to being implemented. The following must be adhered to:*
- xii. Areas or positions where each test is required shall be marked out on drawings with reference to photographs and agreed to with Rand Water.
 - xiii. Frequency of testing must be such that there is at least one test per discrete concrete element, in accordance with relevant standards.
 - xiv. Material samples shall be extracted in accordance with relevant standards
 - xv. Material samples shall be tested at a South African National Accreditation System approved testing laboratory in accordance to relevant standards.
 - xvi. Areas where samples are extracted shall be repaired in accordance with the method statement as accepted by Rand Water.
- f. Geotechnical investigations where applicable
- The assessments shall be performed using a standardized, documentable inspection process with condition grading that provides accurate, consistent and repeatable results. This process shall be developed by the Structural Engineer and accepted by Rand Water. Defects identified should be numbered and scaled (width, length, etc.). Location of each identified defects should be marked on the assessment drawings and accompanied with an image.

2. Condition assessment report

- a. Introduction
- b. Description of each structure
- c. Description of structural system
- d. Geology of the site and founding conditions
- e. Assessment approach methodology
- f. Visual inspection and condition assessment findings
- g. Recommended field investigations (including type, location, need, etc.)
- h. Aggressiveness of material exposure environment
- i. Detailed analysis of field investigation findings
- j. Overall assessment findings
- i. ReDefects of structural significance
- ii. Defects requiring remedial action and/or monitoring
- iii. Defects requiring immediate action, etc.
- iv. Structural analysis findings
- v. Life expectancy analysis (determination of residual life)
- vi. Proposals and Recommendations
- vii. Proposal for remedial action.
- viii. Proposal for additions, alterations or structural strengthening required to accommodate additional imposed loads due to proposed equipment, including design drawings and calculations.
- ix. Structural health monitoring where necessary
- x. Cost of estimates for proposals

k. Conclusions on the structural condition shall include loading conditions; overall condition, structural integrity, remaining useful life, recommended additions, alterations or structural strengthening.

l. Annexures

i. As-built drawings

ii. Assessment drawings indicating problematic areas

iii. Calculation files

iv. Proposed solution (drawings and calculation)

v. Specification for proposed solution

vi. Bills of quantity of proposed solution

1. Drawings

All drawings shall comply with Rand Water Design Office requirements and shall be subject to the approval of the Civil Asset Manager. Rand Water will not be responsible for any delays, loss or inconvenience to the Contractor(s) through failure to comply with this requirement.

Final drawings shall be on unfolded, untearable transparent film, with a polyester base, having a matt finish on both sides and a thickness of 0.075 mm. These Drawings shall bear Rand Water's contract number. In addition, where drawings have been completed using CAD programme, compact disc copies of each drawing shall be provided either on AUTOCAD or DXF format.

Drawings shall be size A0 in accordance with:

i. SANS 10111-2011 (Engineering drawings).

ii. SANS 10144 (Details of steel reinforcement for concrete)

iii. SANS 282 (Bending dimensions and scheduling of steel reinforcement for concrete)

3. Final Proposal

All work to be executed within confines of condition of existing structure. Final proposals shall take into consideration current condition of each structure.

Commented [JM1]: FIX NUMBERING - JM

AA 7 TESTING

AA 7.1 PRINCIPLES

Add the following to the end "AA 7.1.1":

"The Contractor is expected to anticipate any tests which may be reasonably requested by the Engineer which are not included in the technical specifications or bills of quantities. The rates for the tests and all costs thereof shall be deemed to be included in the contractor's tendered rates. Anticipated tests are to be qualified by the Contractor during the tender stage, failing which the Engineer may decide on what is deemed to be 'reasonable'"

AA 7.4 STATISTICAL ANALYSIS OF CONTROL TESTS

Add sub-clause "AA 7.4" as follows:

"Test results shall not be evaluated by statistical methods. All results shall comply with the specified minimum requirements and SANS Specifications of the materials concerned."

AA7.5 PROCESS CONTROL

Add new sub-clause "AA 7.5":

"All test results obtained by the Contractor in the course of his process control of the Works shall be submitted to the Engineer or his representative prior to requesting inspection of the relevant portions of the Works. Any request for inspection shall be submitted on the prescribed forms which will be provided by the Engineer – any request for inspection shall be sent to the Engineer at least 48 hours before the intended completion date of the works.

The Contractor shall make suitable arrangements for process control prior to commencement with the Works. Should he intend using site personnel for this purpose he shall ensure that suitably trained and competent personnel take charge of the necessary test work and that the necessary equipment is at their disposal prior to commencement of the Works. Failure to comply with these requirements shall be just cause for the Engineer to order suspension of the works without additional remuneration or for the Engineer to recommend termination to the Employer."

AA 8 MEASUREMENT AND PAYMENT

Add the following sub-clauses

"AA 8.7 Provision for Health and Safety Measures (Time Related and or Fixed Charge)

The rate shall cover the cost to provide a health and safety plan as well as any additional safety measures and or appointments. Individual items may be scheduled separately. This item is to comply with all Rand Water Health and Safety Specifications.

.....Unit: Sum"

And;

"AA 8.8 Provision Environmental Measures (Time Related and or Fixed Charge)

The rate shall cover the cost to provide an environmental management plan as well as any additional environmental measures and or appointments. Individual items may be scheduled separately. This item is to comply with all Rand Water Environmental Specifications.

.....Unit: Sum"

BE1 EARTHWORKS - (SUPPLEMENT TO SANS 2001-BE1: 2008)

The following specification is drawn up with SANS 1200 D as a basis and supplements the provisions of SANS 2001-BE1: 2008.

BE1 - 4 REQUIREMENTS

BE1 - 4.1 MATERIALS

BE1 - 4.1.6 Contamination of Suitable Fill Material

Add the following sub-clause to section BE1 sub-clause 4.1:

"The Contractor shall deal with materials from all excavations for structures in such a way as to ensure that usable material is not contaminated with unsuitable material. If usable material is contaminated, such contaminated material shall be removed and replaced with material of a standard at least equal to the usable material, all at the Contractor's expense. No additional payment shall be made in respect of this and all relevant costs shall be deemed to be included in the tendered rates."

BE1 - 4.2 METHODS AND PROCEDURES

BE1 - 4.2.2 Excavations

BE1 - 4.2.2.4 Detection, Location and Exposure of Existing Services

Add the following sub-clause to BE1 4.2.2:

"The provisions of Sub-clause 5.2 of SANS 1200 AA shall apply, in addition to the requirements of this sub-clause.

The drawings showing the position of known existing services shall be issued to the contractor by the Engineer. The Contractor shall verify the position of all services and all other obstacles and existing works on the Site. Manholes, valve boxes and the like will be regarded as known services. Prior to the commencement of any construction in any particular area, the Contractor shall verify the positions of services and report to the Engineer any that are missing.

Where any subterranean services are shown on drawings, the Contractor shall have the suitable detection equipment available on Site for as long as it necessary to detect and locate such services. The Engineer may instruct the Contractor to undertake hand excavation to expose services.

If existing services are not shown on the drawings, but the existence thereof can be reasonably expected, the Contractor shall, in conjunction with all relevant authorities, determine the exact path and location of such services before the commencement of construction. After locating the exact position of services, whether indicated on the drawings or not, such services shall be deemed to be known services and the Contractor shall be liable for all costs and subsequent costs arising from the damage thereof as a result of the Contractor's activities. These services must also be indicated on the 'Record drawings'."

BE1 - 4.2.2.5 Protection of cables

Add the following sub-clause to BE1 4.2.2:

"The Contract shall advise the Engineer at least 7 days in advance of the actual date on which he proposes to excavate near any cable. The Contractor shall not use mechanical equipment to excavate within 3 meters of the estimated position of any cable and shall, if necessary, expose the cable by means of hand excavation carried out under proper supervision (complying with all necessary Occupational Health and Safety requirements and standards). When the Contractor is instructed to use hand excavation, the Contractor shall backfill such cable trenches with approved material to the compaction density ordered.

Where a service is damaged due to the Contractor's negligence, the contractor shall bear the cost of the immediate repairs of the service. Any penalty incurred by the Client from the owner/custodian of the damaged service shall be transferred to the Contractor."

BE1 - 4.2.3 Disposal

Substitute the first sentence of sub-clause BE1-4.2.3 with the following:

"All surplus material which is suitable for fill shall be spread and compacted as fill within a designated area of the site. All material unsuitable for fill shall be transported to an approved dumping site (decided upon by the Contractor); the Engineer will not be liable for any materials disposed by Contractor.

Disposal of rubble/surplus material or any other debris/material to be removed from site should be undertaken when said material reaches 10m³ or has been kept on site for a week, whichever is reached first. The Employer/Engineer may impose fines on the Contractor for the late removal of material from site."

BE1 - 4.2.7 Dust

Add the following sub-clause:

"Wherever dust from any of Works or construction activities becomes a nuisance to the public or damages adjacent properties, the Contractor shall, at the instruction of the Engineer, apply sufficient water or take other measures to lay the dust. The cost of dealing with dust (including, but not limited to, suppression) shall be included rates for construction."

BE1 - 4.2.8 Excavated material not to endanger or interfere

Add the following sub-clause BE1-4.2.8 to SANS 2001-BE1:

"All excavated material shall be so deposited as not to interfere with or endanger the Works (for example, by causing the sides of an excavation to collapse), other property or traffic. The Engineer may order the Contractor to remove any material that the Engineer considers liable to endanger or to interfere with the Works, private property, traffic or pedestrians, and to place such material at some other approved location. If the necessity for such removal is, in the opinion of the Engineer, a result of some fault on the part of the Contractor, the cost of removal shall be borne by the Contractor, but otherwise it will be borne by the Employer.

All surplus material not required for backfilling or forming embankments as indicated elsewhere in the Contract or as may be ordered by the Engineer, and material unsuitable for backfilling, forming embankments or topsoiling shall be deposited on a site or sites as described under BE1 4.2.3."

BE1 – 5 – COMPLIANCE WITH THE REQUIREMENTS

BE1 - 5.2 TOLERANCES

BE1 - 5.2.1 Position, dimension and levels

Replace the first sentence of sub-clause 5.2.1 with the following:

“The earthworks shall be finished to within the limits given in table 1 to a degree of accuracy II for both ‘Excavations for structural foundations’ and ‘Terraces and embankments’”.

BE1 - 6 SAFETY

Add the following clause and sub-clauses to SANS2001-BE1: 2008:

“BE1 – 6.1 Barricading and lighting

In terms of the applicable regulation of the Machinery and Occupational Safety Act, 1983 (Act 6 of 1983), every excavation that is accessible to the public or that is adjacent to a public road or thoroughfare or by which the safety of persons may be endangered, shall be

- a) Adequately protected by a barrier or fence (designed to SANS 10400 requirements) of height at least 1 000mm and as close to the excavation as practicable; and
- b) Provided with warning lights at night (which comply with the requirements set out by the Engineer at the time of construction).

The Contractor may NOT provide a watchman for the safeguarding of excavations after hours – and as such all excavations are to be left safely barricaded from the public and from tampering – unless instructed otherwise by the Engineer.

BE1 – 6.2 Safeguarding of excavations

The provisions of SANS 1200 D-1988 sub-clause 5.1.1.2 are applicable.

Insert the following after paragraph (b) (2), before paragraph (c) of sub-clause 5.1.1.2:

“The Contractor or his agent or his representative shall not require or allow any person to work under unsupported overhanging material or in an excavation which is more than 1,5m deep, and any excavation which has not been adequately supported or braced if there is a danger of the overhanging material or the sides of the excavation collapsing. The support, shoring or bracing to be designed and constructed by the Contractor, shall be strong and sturdy enough to support the sides of the excavation in question – and shall comply with the requirements of SANS 10400 and the Occupational Health and Safety Act (latest amendment).

The Engineer may request that trenches must be barricaded due to reasons that he sees fit. The barricade will be at least 1.2 metres high and the distance between wire strands will not exceed 200 mm if a wire fence is erected. If a barricade net is erected the openings in the net will not exceed 100 x 100 mm. The barricade (net or wire fence) will be supported at distances not greater than 1 metres with suitable sturdy supports. After completion of the work(s) the barricades must be removed completely and

no barricading material may be left on site. The barricade will be erected on both sides of the trench with a minimum distance of 5 metres and a maximum distance of 10 metres from the side of the trench."

Add the following to SANS 2001 BE1:

"BE1 - 7 SCHEDULED ITEMS

The entire provisions of SANS 1200 D: 1990 part 8 (Measurement and Payment) shall apply and where reference is made to clauses/sub-clauses in SANS 1200 D: 1990 (Or any other part of SANS 1200) the equivalent clauses in SANS 2001-BE1 shall be applicable instead – where reference is made to other parts of SANS 1200 then the relevant SANS 2001 standard (where applicable) shall be applicable instead."

Also add the following subclause to the end of BE1 – 7:

"BE1-7: 8.3.9: Shoring of Excavations

The rate shall include all costs associated with the design, procurement, delivery and installation of a shoring design – with the excavation activity scheduled under 8.3.1. The rate shall also include complying with the requirements of the technical, occupational health and safety, as well as environmental specifications applicable to the project.....Rate: Sum

"BE1-7: 8.3.10: Additional Soil Testing

This item shall cover the all costs associated with soil testing which may be anticipated to be required, as per the requirements of the technical specification.....Rate: Sum"

BS1 SITE CLEARANCE – (SUPPLEMENT TO SANS 2001-BS1: 2008)

The following specification is drawn up with SANS 1200 C as a basis and supplements the provisions of SANS 2001-BS1: 2008.

The Contractor shall program his work in such a manner that re-clearing will not be necessary. The entire cost of re-clearing shall be borne by the Contractor.

Where suitable topsoil exists within the limits of the area to be excavated, the Contractor shall remove the topsoil to an average depth of 300mm, together with any veld grasses and other similar vegetation as directed by the Engineer. The topsoil shall be transported and deposited in temporary stockpiles in an area which is to be confirmed with the Engineer prior to stockpiling.

Add the following sub-clauses to SANS 2001-BS1: 2008

“BS1 - 6 MEASUREMENTS AND PAYMENT

The items scheduled for clearance and demolition will be classified according to the nature of the materials involved and the methods of their disposal.

Only those areas designated to be cleared as per the guidelines of SANS 2001-BS1: 2008 will be measured for payment. The area of surfaced roads, paved areas, railway formations, and major structures falling within such areas, designated to be cleared, will normally be deducted from such measurement.

Where conservation of topsoil without prior clearing is ordered, the removal of topsoil from the specified area will be measured as excavation and no payment will be made for clearing and grubbing.

BS1 - 7 SCHEDULED ITEMS

The entire provisions of SANS 1200 C (latest amendment) part 8 (Measurement and Payment) shall apply and where reference is made to clauses/sub-clauses in SANS 1200 C (Or any other part of SANS 1200) the equivalent clauses in SANS 2001-BE1 shall be applicable instead – where reference is made to other parts of SANS 1200 then the relevant SANS 2001 standard (where applicable) shall be applicable instead.”

CC1 CONCRETE WORKS (STRUCTURAL) - (SUPPLEMENT TO SANS 2001-CC1: 2012)

The following specification is drawn up with SANS 1200 G as a basis and supplements the provisions of SANS 2001-CC1: 2012:

CC1- 4 REQUIREMENTS

CC1- 4.2 MATERIALS

CC1- 4.2.1 Cementitious binders

Add the following sentence to the end of 4.2.1.2:

"Where the manufacturer of a cementitious binder specifies more stringent storage conditions to those prescribed by this sub-clause then the manufacturer's requirements shall take precedence

Where the cement is supplied in bags, the bags shall be closely and neatly stacked to a height not exceeding 12 bags with different brands and/or types of the same brand stored separately."

Substitute 4.2.1.3 with the following:

"4.2.1.3 Cement shall not be kept in storage on site for longer than eight weeks or the storage time prescribed by the manufacturer, whichever is less."

CC1- 4.2.3 Aggregates

Add the following sentence to the end of 4.2.3.7:

"In addition to the above, sand is to be stored in such a way that contamination by foreign matter is prevented."

CC1- 4.3 FORMWORK

CC1- 4.3.2 Design and Construction of Formwork and Falsework

CC1- 4.3.2.1 General

Add the following sub-clause to the end of 4.3.2.1:

"4.3.2.1.7 The design and construction of formwork and Falsework will be the responsibility of the Contractor; however, the Engineer shall review the design and construction thereof for approval. The design and construction of Formwork and Falsework shall comply with all Occupational Health and Safety Act and accompanying regulatory requirements – in addition to the requirements contained in CC1:2012."

CC1- 4.7 QUALITY OF CONCRETE

CC1- 4.7.8 Mixing

Add the following before section 4.7.8.1:

"The concrete mix shall be designed by a specialist organization. No concrete shall be placed until the Contractor's concrete mix design has been approved by the Engineer. The Contractor shall submit to the Engineer a statement of the mix proportion proposed, together with a report from the specialist organization, showing the 28 day concrete strength obtained when using the material proposed for the work. The cost of the concrete mix design shall be borne by the Contractor and shall be deemed to be included in the rates for concrete work.

Admixtures may be used to increase the workability of the concrete but only with the express approval of the Engineer and when the details of the active ingredients of the admixture and their effects are supplied to the Engineer for approval before use. No additives likely to impair the short or long term low permeability required for the concrete will be approved."

CC1- 4.8 PRECAST CONCRETE

Add the following before section 4.8.1:

"The employer is indemnified against all claims resulting/which may result from or for infringement of patent rights, design or trademarks in respect of any precast system used in connection with the works and the payment of any royalties due, or that might become due, as a result of the use of such a system."

CC1- 4.10 HANDLING AND ERECTION OF PRECAST CONCRETE UNITS

Replace the first sentence of sub-clause 4.10.3.1 with the following:

"4.10.3.1. Temporary supports shall be so designed and arranged, by the Contractor and reviewed by the Engineer for Approval, that account is taken of: ..."

Add the following sub-clause to SANS 2001-CC1:2012:

"CC1 - 6 MEASUREMENTS AND PAYMENT

The entire provisions of SANS 1200 G: 1982 part 8 (Measurement and Payment) shall apply and where reference is made to clauses/sub-clauses in SANS 1200 G: 1982 the equivalent clauses in SANS 2001-CC1:2012 shall be applicable instead – where reference is made to other parts of SANS 1200 then the relevant SANS 2001 standard (where applicable) shall be applicable instead."

Also add the following sub-clauses to the end of CC1-6:

"CC1-6: 8.9 – Concrete Cube Testing

Concrete Cube Testing to be carried out as per the requirements of SANS 2001-CC1 (latest amendment) and as per the requirements of the technical specifications (which take precedence) , with separate items scheduled separately. Testing of concrete shall be undertaken at 7, 14 and 28 day intervals per truck load of concrete delivered to site.....Rate: No."

"CC1-6: 8.10 – Curing

Curing carried out as per the requirements of SANS 2001:CC1.....Rate: Sum"

"CC1-6: 8.11 – Water tightness Testing

Undertake water tightness testing as per the requirements of the Technical Specification. The rate shall include the costs associated with the supply of the water to be used for testing; the actual testing procedure and pumping out and disposal of the water.....Rate: Sum"

CS1 STRUCTURAL STEELWORK - (SUPPLEMENT TO SANS 2001-CS1: 2017)

CS1- 4 REQUIREMENTS

CS1- 4.2 DRAWINGS

CS1- 4.2.5 Erection drawings

Add the following sentence to the end of sub-clause 4.2.5.1:

"All temporary steelwork necessary for erection purposes shall be designed by a relevant competent person, registered as such with the Engineering Council of South Africa as a Professional Engineer or Engineering Technologist, in the employ of the Contractor."

CS1 - 6 MEASUREMENTS AND PAYMENT

The entire provisions of SANS 1200 H: 1990 part 8 (Measurement and Payment) shall apply and where reference is made to clauses/sub-clauses in SANS 1200 H: 1990 the equivalent clauses in SANS 2001-CS1:2017 shall be applicable instead – where reference is made to other parts of SANS 1200 then the relevant SANS 2001 standard (where applicable) shall be applicable instead.

SS 2.2.6 – FUNCTIONAL SPECIFICATIONS

The entirety of the Structural Design aspects of the proposed Works (excluding temporary structures, required for and during construction, as well as any precast concrete units which have to be erected) to be completed are to be designed by the Employer, through their representatives.

The following functional specifications are provided to the Contractor to set a basis for the minimum requirements of elements whose requirements need to be clarified for design and/or pricing and/or construction and/or fabrication purposes. It should be noted that where clarity is given elsewhere in this document on critical elements then such clarity will not be repeated below, but are still applicable.

SS 2.2.6.1 – Preliminary and General

- A. The Contractor's attention is drawn to the fact that works will need to be undertaken in a well sequenced manner. Sequencing shall take into account the required planned plant shut-downs. The sequencing shall be reflected in detailed construction programme. The method statements and detailed programme for sequencing shall form part of the key deliverables required by Rand Water for approval prior to commencement of works. The sequencing shall have as its first key deliverable, the construction of the isolation valve chamber.
- B. It is anticipated that the site for the construction of the valve chamber is underlain by soils with high activity with plastic indices upward of 30. Thus a geotechnical investigation is required to provide recommendation for the construction of the chamber illustrated in drawing R028765/100-101 – the structure is expected to exert a bearing stress of 160 kPa on the ground and as such a solution which would yield a bearing capacity of a minimum of 200 kPa should be provided.
- C. The requirements for the Geotechnical investigation are set out below:
 - i. The Contractor shall employ, following the written notification and written approval by the Engineer, of a competent professionally registered Geotechnical Engineer to conduct a detailed geotechnical investigation of the site onto which the works will be erected.

- ii. The Geotechnical Engineer shall have at least 8 years of experience in the design and construction supervision of similar works.
- iii. The Contractor will be required to effect the recommendations of the approved report.
- iv. The Engineer will peruse the report and finalize their drawings based on the recommendations of the said report.
- v. The Geotechnical Engineer shall be under the employ of the Contractor for the duration of the construction period to inspect the works.

- D. The Cathedral header shall remain in use by the Employer for the duration of construction and as such a temporary structural steel platform with a staircase shall be designed and constructed by the Contractor, to allow the Employer uninterrupted access to the chamber and any equipment therein. The temporary scaffolding design shall be designed by a Competent Person, as described in the relevant provision of SANS 10400, and reviewed for approval by the Engineer prior to erection – the design should be presented to the Engineer in the Rand Water civil design standard design file template.

Design of the temporary works shall comply with all requirements of the Occupational Health and Safety Act (latest amendment relevant at the time of appointment), and the Construction regulations (latest amendment relevant at the time of appointment).

- E. The Contractor is to plan their works so as to allow for the geotechnical investigation to be undertaken before or during the demolition and erection operations of the Cathedral Header roof. This shall be deemed to be included in their programme at appointment.
- F. Equipment and plant selected for use by the Contractor shall be specified in the tender document, and shall be selected on the basis of minimizing on site vibration to existing machinery; approval for the equipment and plant shall be at the discretion of the Engineer during construction.

- G. The Contractor shall provide adequate drainage of excavations and the rates thereof shall be deemed to be included in the tendered rates.

SS 2.2.6.2 – Site Clearance:

- A. Any materials obtained from the removal of vegetation and demolition of structures, that do not form part of the material to be disposed, shall remain the property of the client or the custodian of the service (should it be a municipal service item).

SS 2.2.6.3 – Earthworks:

- A. All haul distances for the duration of construction shall be taken as Freehaul and the Contractor shall include all costs associated with this specification into their earthworks rates.
- B. All existing structures adjacent to where excavations are to be made, which may be affected by Construction operations (SANS 2001 and SANS 10400 shall apply), shall be adequately supported against collapse by the Contractor. Any repairs or replacements for the damage to or collapse of existing boundary walls (and the damage or collapse of other structures resulting from the damage or collapse of the boundary walls) shall be to borne by the Contractor.
- C. The fill adjacent to the valve chamber constructed shall be constructed with sub-soil drainage which shall be design and constructed by a competent person in the employ of the Contractor (including the Contractor's manufacturers or Sub-Contractors). The efficiency of the subsoil drainage system shall be specified in the design pack to be submitted to the Engineer. The Engineer is required to approve the sub-soil drainage system prior to its construction. The basis for the design of the system shall be based on the information presented in drawing R028765/100 and 101.
- D. Due to space constraints the Contractor is expected to implement shoring (or other approved vertical excavation support techniques) to be able to achieve vertical excavations. The shoring design and construction will be undertaken by the geotechnical engineering under the employ of the Contractor, the go ahead for the construction will be sought from the Engineer. A specialist will be required to execute the vertical excavation works.

SS 2.2.6.4 – Concrete Works:

- A. All concrete is to be finished to the specifications contained in this specification document, contract documents or drawings.
- B. All concrete mixes by the Contractor should comply with the minimum requirements set out in SANS 2001-CC1:2012.
- C. All concrete (preparation, deliver and or erection) is required to comply with the requirements of SANS 2001-CC1:2012
- D. All concrete to be at least 35 MPa cube strength at 28 days, unless specified otherwise on the construction drawings.

SS 2.2.6.5 – Structural Steel Works:

- A. All structural steel shall be grade S355JR, unless shown otherwise on the drawings.
- B. All structural steelwork to be hot dip galvanized to SABS 763 after fabrication. All bolts and fasteners shall be corrosion protection.
- C. The Contractor is required to provide workshop drawings to the Engineer for approval prior to commissioning the manufacture of any structural steel elements.

SS 2.2.6.6 – Precast Concrete Roof:

- A. The precast concrete roof shall be designed by a competent engineer – professionally registered Engineering (Pr. Eng.) or Engineering Technologist (Pr. Tech. Eng.) in the employ of the manufacturer of the precast roof – the liability of the design and construction will however rest with the Contractor. The Contractor is to issue, to the Engineer, a design file of the roof elements for the Engineer's approval – prior to manufacture.

The roof is to be designed to the requirements of SANS 10400 and should also meet the minimum requirements set out in the drawing R028765/001.

The Contractor is made aware of the lead time of 21 calendar days required by the Engineer to review and provide feedback on the design to the Contractor. No manufacture may proceed without approval of the design by the Engineer.

SS 2.2.6.7 – Sub-surface Drain (Flo-Drain):

The sub-surfaced drain shall meet the following minimum requirements set out by Kaypipe Geopipe; a similar approved system may also be used, pertaining to both the flo-drain membrane and the geopipe.

SS 2.2.6.8 – General Requirements:

- A. The contractor shall satisfy themselves that the lifting hooks on existing structures are of adequate structural integrity for lifting purposes. Where an alternative means of lifting is required – such as cores through existing concrete panels – then the alternatives shall be deemed to be included in the tendered rates.

The Contractor may be required to support existing cables and other services on site during construction – to accommodate such services during excavation activities. The costs associated with such work (as well as the design and erection of necessary temporary works) shall be deemed to be included in the rates for excavation works.

- B. The Contractor is required to comply with the requirements of the Occupational Health and Safety Act (latest amendment) and its accompanying Construction Regulations (latest amendment) – and is also required to prepare and submit all documents pertaining with the requirement of the said Act and regulations.

The Contractor's attention is drawn to the following risks which may arise on site:

- i. The presence of medium voltage cables within the anticipated working area of the valve chamber.
- ii. Vertical excavations and excavations surface support required for the valve chamber.

- iii. Working at heights and deep excavations (for the cathedral header and valve chamber respectively).
 - iv. Falling debris during demolition operations.
 - v. Potentially heaving soils and the use of cranes next to open excavations.
- C. The Contractor is required to accompany their priced documents with a proposed, high level, construction method statement, in line with Occupational Health and Safety, as well as, Construction Regulation standards. The method statement should include a programme highlighting the critical activities anticipated for the proposed works.
- D. The Contractor is required to issue to the Engineer, prior to the use of intended construction materials, test certificates issued by an accredited, independent testing authority (Accredited by the South African Bureau of Standards or other equivalent accreditation body) to confirm that the respective materials comply with the specified requirement, or a certificate by the patent holder or designer, certifying that the manufactured item complies in all respects with relevant product specifications.
- E. The construction of the Cathedral roof and associated works will be undertaken in an environment that may have certain concentrations of chlorine vapour or gas and, as such, the Contractor shall make suitable allowance for this in their tender – temporary extraction fans to be provided. Oxygen level sensors may be required during construction.
- F. Owing to the potential high activity of the soil, the geotechnical investigation and the recommendations thereof will inform the final solution to be implemented for the Valve Chamber. The Contractor should bear in mind that this process may be undertaken during construction and should be factored into the construction programme.
- G. A Degree of Accuracy II shall be applicable to all structural works under this project.
- H. The Contractor's Attention is drawn to the fact that this is a multi-disciplinary project and as such Construction work will require adequate integration.

- I. The Contractor shall make allowance in his tendered rates for hiring and keeping in his employ, for the duration of the construction activity, a Professional Registered Engineer (Pr. Eng.) to assist him with the design of the temporary works. The design of the works is to be issued to the engineer in design file for approval – the design of the works shall be deemed to be included in the tendered rates for formwork.
- J. The Contractor's attention is drawn to the fact that a handover of the Cathedral after the demolition of the header roof may need to take place during construction and as such, the Contractor's programme will need to reflect a construction sequence which would work best with the RW Pipework Construction team's programme – to ensure seamless integration.
- K. The new Valve chamber, designed to be water tight, will be water tightness tested to the requirements of BS 8007 sub-clause 9.2 and the new roof should be tested to the requirements of sub-clause 9.3 of the same code.
- L. The review time of 21 days (for reviews to be undertaken) shall apply to all individual submissions. Therefore where a contractor is aware of items requiring multidiscipline integration then the Contractor should aim to submit all documents at once – otherwise separate submissions shall be treated as individual submissions.

The review time of 21 days shall not be deemed to include comments on the submissions made. Receipt of comments shall trigger a new review cycle.

The above applies to all design submissions issued to the Engineer.

SS 2.2.6.9 – Project Risk:

Below are the identified project risks, which include but not limited to:

- A. Working at height (Cathedral Header and Isolation valve chamber)
- B. Excavations around medium voltage electrical power lines (Isolation valve chamber)
- C. Working in deep excavations (Isolation valve chamber)
- D. Working in areas where structural elements are under demolition (Cathedral Header)

SS 2.3 – MECHANICAL SPECIFICATIONS

SS 2.3.1 – CONTRACT SCOPE OF WORK

The mechanical works shall comprise of design, manufacture, supply, delivery, installation, commissioning and put into service of mechanical ventilation system, sump pump system, and extended spindles, the refurbishment, installation and commissioning of valves, gears and removal, refurbish, reinstallation of access steel platforms at Rand water Vereeniging Pumping Station Cathedral Header.

The mechanical works to be performed shall include but not limited to the following:

- Design, supply and delivery of mechanical ventilation system.
- Design, supply and delivery of sump pump system.
- Design, supply and delivery of actuator extended spindles and spindles/ sleeve supports.
- Transport, refurbish, test and delivery of four Ø1600mm, five Ø2500mm butterfly valves together with their gearbox and actuator assemblies.
- Removal, transport, refurbishment, delivery and reinstallation of access steel platforms.
- Installation and commissioning of mechanical ventilation system.
- Installation and commissioning of sump pump system.
- Installation and commissioning of extended spindles and spindles supports.
- Installation and commission refurbish access steel platforms.

SS 2.3.2 – Design Criteria and Requirement:

The contractor shall design, supply and install low maintenance mechanical equipment. The system(s) shall fully comply with requirements listed in this document. The system(s) shall have a minimum life span of 30 years. Construction drawings shall be submitted to the Engineer for approval prior to manufacturing or procuring of any equipment.

The minimum requirements for the mechanical design specialist shall be as follows:

The specialist who will be undertaking design/ execution work shall be a professionally registered person in the mechanical engineering field. The individual should be in good standing, has a minimum of ten (10) years in designing and constructing similar systems and has a good track record. The name and registration number of the professional engineer certifying the designs or works execution shall be supplied.

SS 2.3.2.1 – Mechanical ventilation system

The mechanical ventilation system shall be designed in accordance with SANS 10400-part O. The system shall be manufactured, installed, tested, commissioned and put into service in accordance with SANS 10173 and SANS 1238. The system shall be as typical shown on drawing RA-29162/02.

SS 2.3.2.1.1 – Fan

- The ventilation fan shall extract chlorine gas from the cathedral header chamber and will be located as typical shown on drawing RA-29162/02.
- The fan shall be selected to perform on the stable part of the curve and shall be in accordance with SANS 10400-part O on artificial ventilation requirements.
- The critical speed of the fan shall be at least 50% higher than selected operating speed.
- The fan shall be of an axial direct drive fan connected with a motor inside fan casing and fan assembly shall be suitable for vertical and horizontal mounting.
- The housing shall be sheet metal coated with a chlorine gas and hydrochloric acid resistant polymer approved by the engineer.
- The fan shall be all weather protected to IP 58 or higher.
- The impeller blades shall be of corrosion resistant aluminium and pressed for strength and rigidity.
- During operation the ventilation fan shall not exceed noise levels above 35dBA in accordance with SANS 10103.
- The fan motor shall be in accordance with Rand Water specification document RW-00320-AS-492 LV MOTORS REV-1.

SS 2.3.2.1.2 – Ductwork

- Ductwork shall be designed, manufactured, tested, installed and commissioned to convey chlorine gas from the bottom of the cathedral header chamber through the ventilation fan. Refer to drawing RO for typical layout.
- The ductwork shall be in accordance with SANS 10173 and SANS 1238.
- The ductwork shall be of corrosion resistant aluminium sheet metal coated with a chlorine gas and hydrochloric acid resistant polymer approved by the engineer.
- Support and fixing of duct work shall be by bracing fixed on concrete chamber with chemical raw bolts. Refer to drawing RA-29162/02 for typical layout.

SS 2.3.2.1.3 – Hangers and Supports

The structural integrity of the building shall be assessed and verified if it is capable of withstanding additional loading of the new mechanical equipment (HVAC etc.).

All necessary support steelwork, steelwork modifications, baseplates etc. shall be designed, supplied, placed, aligned and leveled.

Support brackets shall be fixed to overhead construction by an approved system. "Shot firing" of supports into the concrete will not be accepted. Proposed detail designs of supports system shall be forwarded to the Engineer for approval.

All new steelwork, support rods and clamps shall be hot dip galvanized. All modifications to steelwork shall be made good with protective zinc coating.

Where overhead construction does not permit fastening at support, additional approved framing shall be provided.

SS 2.3.2.1.4 – Noise and Vibration

Installation of all mechanical equipment shall be such that they comply with SANS 10103 standard requirements. In any location where installed equipment has residual noise level exceeding the maximum desired residual sound level as per SANS 10103 and the Contractor shall make adequate provision for the proper mounting of equipment and minimize vibration levels of equipment and in reasonably practicable manner, put in measures to minimize unacceptable noise levels.

Proper provisions shall be made in the mountings of all equipment capable of transmitting vibration forces, whether local or remote for vibration isolation.

SS 2.3.2.1.5 – Instrumentation

Rand Water shall be informed of equipment alarm trip setting required and control requirements for all mechanical equipment.

SS 2.3.2.2 – Sump pump system

The sump pump system shall be used to dewater accumulated water inside the valve chamber(s). The sump pump system(s) shall drain water from the valve chamber to the storm water drainage and recovery wash water sump. The sump pump system(s) shall be in accordance with Rand Water specification RC 01100- Rev 2. Refer to drawings RA-29162/02, RA-29162/00 for typical layout.

SS 2.3.2.2.1 – Piping

- Pipework shall be welded HDPE pipe and shall conform to SANS 4427 requirements.
- No use galvanized pipe steel shall be allowed /accepted.
- Buried pipes shall be installed and commissioned in accordance with SANS 1200 L.

SS 2.3.2.2.1.1 – Welding of HDPE Pipe

The HDPE pipe shall be joined by means of heat fusion using approved butt-welding equipment in order to construct a leak proof joint and in accordance with SANS 1671.

The Contractor shall undertake the following steps prior to the commencement of welding on site: -

- Provide welding tables applicable to HDPE 12.5 pipe as applicable and the welding plant to be used.
- Provide a certificate of calibration for the welding plant to be used. The certificate shall bear the model number of the welding machine to be used on site, the name and address of the certifying agent, the date of the test and a statement as to the accuracy of the temperature and pressure gauges on the machine in question.
- A certificate of calibration dated prior to the date on the letter from the Employer, instructing the Contractor to commence work, is not acceptable.
- Provide certification that the welder/operator has successfully completed an approved training course and is qualified to weld the size and class of HDPE pipe to be used on this Contract.
- A test weld is to be undertaken on site in the presence of the Engineer for approval prior to the commencement of welding proper.
- Under no circumstances will welding be permitted to commence prior to the provision of the above certificate and the test weld, and any delays resulting from the failure to timeously undertake the above – mentioned steps shall be borne by the Contractor.
- The Contractor shall ensure that the required gap spacing is constant over the total weld length and that the weld temperatures specified by the manufacture are attained throughout the weld length.
- Once the welding of a joint has been completed, both the internal and external beads shall be removed by an approved method. Each joint shall be carefully examined to ensure that the welded joint is capable of withstanding the tensile force to which it will be subjected during pipe cracking/slip lining operation. In addition, all shall be watertight.

SS 2.3.2.2.1.2 – Fittings and Flanges

Flanges and fittings shall be in accordance to SANS 1123 steel, cast iron and copper alloy flanges, for connecting steel pipes, copper pipes, valves and combination valve. All flange connections that will be buried underground shall be wrapped with self-adhesive bitumen tape once the building Water and Fire Services system pressure test/s have been undertaken and accepted. No flange connections are to be buried prior testing.

SS 2.3.2.2.1.3 – Pipe Test

The part of the system under test shall be filled with water and subjected to a sustained pressure of 150% of the operating pressure of that part of the system.

The piping shall be tested in sections, thereby testing each valve for secure closure.

While the system is being filled, air shall be carefully and completely exhausted. If permanent air vents or service connections are not located at all high points, the Contractor shall install corporation stops or fittings air valves at such points so the air can

be expelled as the pipe system is slowly filled with water. After ensuring that the pipeline is fully charged with water, all air vents must be closed.

SS 2.3.2.2.2 – Valves

Isolation valves and non-return valves ("Fittings") shall be installed as typical shown on the drawing RA-29162/01.

- Manufacture, test and inspection of cast iron valves shall be in accordance with SANS 664.
- Fittings shall be installed and commissioned in accordance with SANS 10252.
- Provision shall be made to allow ease of access to the Fittings.
- The nominal pressure of the valves shall be identifiable by the appropriate regulatory colour marking.

SS 2.3.2.2.3 – Submersible Sump Pumps

Sump pumps shall be designed, supplied, installed and put into operation in both Cathedral and the new valve chambers. Sump pumps will be installed as typically shown on drawings RA-29162/00 and RA-29162/02

SS 2.3.2.2.3.1 – Pump

- The sump pumps shall be sized, supplied, tested, installed and commissioned in accordance with Rand Water specification RC 01100- Rev 2.
- The pumps shall be installed as typical shown on drawing RA-29162/00 and RA-29162/02
- The pumps shall comprise of a float switch allowing stop and start depending on sump level.

SS 2.3.2.2.3.2 – Pump Motor

- The pump motor shall be adequately sized and designed to run under submerged conditions. Motors shall be in accordance with IEC 600034-30.
- The motor rating for water ingress shall be at least IP68 and shall operate at least 8 meters under water.
- Power cables shall be with grommet and washer. Cable entry shall be epoxy sealed to ensure no liquid gets inside the motor even if the cables are deeply below water level.
- A built-in terminal overload protector shall protect the motor against overload. The body of the motor shall be water tight. The power supply cable shall be waterproof to prevent water

infiltration into the motor and the cable ends shall be effectively sealed.

SS 2.3.2.3 – Scour Valves

The contractor shall supply, install four (4) scour valves. The valves shall be knife gate type and shall be installed as typical shown on the drawing RA-29162/01.

- Manufacture, test and inspection of cast iron valves shall be in accordance with SANS 664.
- The flanges shall be in accordance with SANS 1123 class 1600.
- The valves Fittings shall be installed and commissioned in accordance with SANS 10252.
- The nominal pressure of the valves shall be identifiable by the appropriate regulatory colour marking.

SS 2.3.2.4 – Cathedral header Butterfly valves, gearboxes, actuators and spindles

SS 2.3.2.4.1 – Butterfly Valves

Valves exist and shall be collected from Vereeniging Pumping Station. Four (4) Ø1600 mm and five (5) Ø2500mm butterfly valves shall be collected, transported, inspected, refurbished, tested and delivered to site by the tenderer.

- Refurbishment of the valves shall be in accordance with RW-12/1/4 – 0925 requirements.
- A visco-elastic coating resistant to chlorine gas and hydrochloric acid shall be applied externally in addition to coating referred to on RW-12/1/4 – 0925.

SS 2.3.2.4.2 – Gearboxes and Actuators

- The gearboxes and actuators assemblies exist for all valves mentioned in 1.3.1.
- The gearboxes and actuators shall be transported, inspected, reconditioned, installed and commissioned in accordance with original equipment manufacturer specifications.
- The Contractor shall supply and install Profibus DP cards on all actuators.
- The actuator and gearbox assemblies shall be installed/ mounted on the valves as typical shown on drawing RA-29162/01 and RA-29162/00.

SS 2.3.2.4.3 – Actuator spindles and Mounts/ Sleeve

- The contractor shall design, supply and install actuator spindle shaft, sleeve, support system and fittings as typical shown on drawing RA-29162/01 and RA-29162/00.
- Actuators have a torque range of 400 Nm to 1000 Nm.
- The spindles shall be capable transferring the torque without deformation.

- The actuator mount shall be capable of supporting the actuator and spindle loads. No load shall rest on the gear box/ transfer case.

SS 2.3.2.5 – Access steel platforms

- The existing access steelwork/ platforms shall be dismantled, transported, stripped and re-galvanized and reinstalled at the cathedral header chamber. Refer to drawing RA-29162/01 and RA-29162/03 for typical details.
- The galvanised coating, testing, installation and commissioning of the steel work shall be in accordance with Rand Water specification document RC 1065.
- The contractor shall provide new bolts and fasteners; none of the existing fasteners shall be used.

SS 2.3.3 – GENERAL

SS 2.3.3.1 – Thrust Blocks

20 MPa concrete thrust blocks shall be cast to provide satisfactory resistance of unbalanced lateral and vertical forces in the system. The block shall be cast under a pipe T-piece or where a bend is encountered. Thrust blocks shall be buried underground. Adequately designed clamps shall be used to restrict pipe movement on outlet valve pipe that are not installed underground. The thrust block shall be adequately designed to support the ring main when the building or fire water is in operation.

SS 2.3.3.2 – Excavation, Laying of Pipe, Backfilling of Trenches

Precaution shall be taken to avoid damaging existing services. Services detection shall be conducted prior to conducting any excavations.

All pipe excavations/ trenches, lying of pipes, backfilling and backfilling materials shall comply with suitable SANS 1200 standards as well as Rand Water Technical Specification for pipeline excavation, Backfilling and pipe trenches, pipe lying, special and testing and investigation.

SS 2.3.3.3 – Bolts and Nuts

Except for special bolts and nuts, the design of which shall be such that they ensure durable, watertight, and neat joint(s), and bolts and nuts shall comply with the following:

All bolts and nuts shall be threaded in accordance with BS 4190: 2014 or equivalent.

The length of the bolts shall be such that when the bolt is in position and fully tightened the bolt shall project beyond the nut; this projection shall be no more than three threads.

Two washers shall be provided with each bolt and nut.

Each bolt shall be screwed into the parent flange to a depth equal to the full thickness of such flange

All nuts and bolts will be gauged by the Engineers Representative and nuts or bolts not complying BS 4190: 2014 will be rejected.

Bolts when tightened shall project not more than 12 mm nor less than 4 mm beyond the nut. All bolts shall be tightened by hand to the torque limit which can be applied using BS 4190:2014 standard.

All bolts and nuts shall be threaded in accordance with BS 4190: 2014 or equivalent.

SS 2.3.4 – ADDITIONAL REQUIREMENTS

All equipment and installation detailed in this scope of work document shall comply with the requirements of the Occupational Health and Safety Act 85 of 1993 and any amendments thereof.

All materials and equipment used shall be new, free from rust, defects, undamaged and suitable for the purpose for which will be used. Materials shall comply with the latest issue of the relevant SANS specifications where applicable.

If any material is not to the satisfaction of the Client or Engineer, it shall be rectified and/or replaced at the Contractor cost and all rejected material shall immediately be removed from site.

The Contractor shall be responsible for the correct and complete erection/installation of the system(s) and inspection executed by the Engineer.

All equipment shall be able to work within the rated capacity as determined by the manufacturer's requirements. The Contractor shall indicate the rated capacities of all equipment on the returnable schedules section document. Descriptive literature of equipment can also be handed in with the Tender document.

Contractors are at liberty to offer any other equipment and/or material which comply with the system specification provided they are approved by the Engineer and meet technical requirements such material will only be allowed to be ordered if approved by the Engineer.

A common alpha-numeric designation system for the codification of all items of plant, equipment and components is being used by Rand Water (WKS Plant Codification requirements). Rand Water shall supply the Contractor with WKS No. the Contractor shall be responsible for requesting these WKS No.

Reasonable attempt has been made to document the exact extent of the existing site conditions. The Contractor shall be responsible for verifying the exact site conditions before design and installation. The Contractor shall be knowledgeable in working on this type of

building and make all allowances.

Installation of mechanical equipment shall conform to the relevant specifications and manufactures requirements.

SS 2.3.5 – LIST OF APPLICABLE STANDARDS AND SPECIFICATIONS

NO	SPECIFICATION NO.	DESCRIPTION
1.	SANS 10252-1:2012	Water supply and drainage for buildings Part 1
2.	SANS 10252-2	Water supply and drainage for buildings Part 2
3.	SANS 664	Wedge gate and resilient seal valves for waterworks
4.	SANS 1123	Pipe flanges
5.	SANS 10173	The installation, testing and balancing of air-conditioning ductwork
6.	SANS 1238	Air-conditioning ductwork
7.	SANS 10103	The measurement and rating of environmental noise with respect to annoyance and to speech communication
8.	SANS 1200	Civil Engineering Standards and Publications
9.	SANS 12944-4	Paints and varnishes — Corrosion protection of steel structures by protective paint systems
10.	BS 4190	ISO metric black hexagon bolts, screws and nuts. Specification
11.	RC 01100-REV 2	Rand Water system specification for eclectic-motor driven submersible pumps not exceeding 20l/s at Rand Water sites
12.	RW-00320-AS-492-LV Motors Rev-1	Rand Water standard electrical specification for low voltage (less than 1 000 v) asynchronous squirrel cage induction motors
13.	RW-12/1/4-0925	Rand Water specification for refurbishment of sluice, reflux, butterfly, diaphragm and Larner Johnson control valves.
14.	RC 1065	Rand Water system specification for access steelwork in building/ structures at various Rand Water sites

SS 2.3.6 – LIST OF APPLICABLE DRAWINGS

NO	DRAWING NUMBER	DRAWING TITLE
1.	RA-29162/00	Vereeniging Pumping Station Cathedral Header typical arrangement of electric motor driven submersible pumps in valve chambers.
2.	RA-29162/01	Vereeniging Pumping Station Cathedral Header general arrangement of access platforms, valves, actuators with gearbox assembly and extended spindles.
3.	RA-29162/02	Vereeniging Pumping Station Cathedral Header general arrangement of ventilation system and sump pump details.
4.	RA-29162/03	Vereeniging Pumping Station Cathedral Header typical details of access ladders and platforms.

SS 2.4 – ELECTRICAL SPECIFICATIONS

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SS 2.4.1 – ELECTRICAL SCOPE OF WORK

SS 2.4.1.1 – General requirements

The Contractor scope shall be for the provision of all the labour, materials and services and also be responsible for the design, supply, delivery, offloading, installation, testing and commissioning of all electrical equipment as per the tender document, typical Single Line Diagrams, schematic diagrams, general arrangement, P&IDs, relevant standards and Rand Water specifications.

Where applicable in the documents, standards and drawings, the words LOCAL/OFF/REMOTE may be substituted/interchanged with the wording MANUAL/OFF/AUTO.

SS 2.4.1.2 – Electrical Scope of Work

The works shall include for the design, delivery, installation, testing and Commissioning of the following as a minimum and not limited to:

- SS 2.4.1.2.1 – Provision for new power supply cabling for kiosk no. 1 & kiosk no. 2 complete with anti-theft type copper coated clad steel earth conductors
- SS 2.4.1.2.2 – Provision for power distribution kiosks complete with hot dipped galvanized steel mounting pedestals
- SS 2.4.1.2.3 – Provision for individual valve isolation panels for each actuator complete with hot dipped galvanized steel mounting pedestals
- SS 2.4.1.2.4 – Provision for sump pump control panels complete with hot dipped galvanized steel mounting pedestals
- SS 2.4.1.2.5 – Provision of an extraction fan control panel complete with hot dipped galvanized frame
- SS 2.4.1.2.6 – Provision for power and control cabling installation complete with all excavations, engraved concrete cable markers cable ladders and supports
- SS 2.4.1.2.7 – Provision for all panel and cable labelling in accordance with the Rand Water requirements
- SS 2.4.1.2.8 – Provision for an electrical test certificate of compliance for the electrical installation.
- SS 2.4.1.2.9 – Strip, remove and make safe old redundant and decommissioned equipment at the Cathedral Header Chamber
- SS 2.4.1.2.10 – Provision for earthing at each chamber
- SS 2.4.1.2.11 – Provision for all documentation and as built drawings.
- SS 2.4.1.2.12 – Provision for all design deliverables

SS 2.4.1.3 – Small Power and Lighting Scope

The electrical contractor shall design, supply, deliver, install, test and commission the following items as part of the electrical SP&L scope of works forming part of the tender:

- SS 2.4.1.3.1 – The contractor shall decommission, make safe and remove the existing small power and lighting installation in the Cathedral Header Chamber.
- SS 2.4.1.3.2 – The contractor shall design, deliver, install, test and commission a new complete small power and lighting installation as per the approved design drawings at the Cathedral Header Chamber.
- SS 2.4.1.3.3 – The contractor shall provide for a new small power and lighting distribution board complete with all supply and earth cabling at the Cathedral Header Chamber.
- SS 2.4.1.3.4 – Provision for a hot dipped galvanized steel frame pedestal for the small power and lighting distribution board at the Cathedral Header Chamber.
- SS 2.4.1.3.5 – The contractor shall design, deliver, install, test and commission a new complete small power and lighting installation as per the approved design drawings at the new Engine Room 4 Valve Isolation Chamber.
- SS 2.4.1.3.6 – The contractor shall provide for a new small power and lighting distribution board complete with all supply and earth cabling at the new Engine Room 4 Valve Isolation Chamber.
- SS 2.4.1.3.7 – Provision for a hot dipped galvanized steel frame pedestal for the small power and lighting distribution board at Engine Room 4 chamber.
- SS 2.4.1.3.8 – Provision for labelling all small power and lighting equipment and cabling in accordance with the Rand Water requirements.
- SS 2.4.1.3.9 – Provision for an electrical certificate of compliance for the small power and lighting installation.
- SS 2.4.1.3.10 – Provision for all documentation and as built drawings.

SS 2.4.2 – ELECTRICAL DESIGN

SS 2.4.2.1 – The Contractor shall execute the electrical design requirements as follows:

SS 2.4.2.1.1 – Minimum requirements of the Electrical Design Engineer shall be specified as per FIDIC Yellow Book clause 5.1 and are:

Criteria	Requirements
Project Experience:	Sufficient number of separate industrial projects with electrical value > R 5 m each completed in the last three years.
Electrical equipment experience and knowledge as per list below:	
Product or service (in alphabetical order)	Experience required

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Criteria	Requirements
Batteries & 110V DC Battery chargers	
Medium Voltage Cabling	
Low Voltage and Instrumentation Cabling	Compulsory
Control desks	
Control panels with PLC equipment	Compulsory
Earthing	Compulsory
Emergency generators	Compulsory
Lightning protection	Compulsory
Mimics	
Motor Control Centers	Compulsory
Motors (LV and MV)	Compulsory
Power factor correction	
Power Quality Assessment	
Protection systems and testing thereof	Compulsory
Profibus or similar instrumentation networks	Compulsory
Soft starters	
Substations	
Switchgear LV (400V) with fault rating > 20kA	Compulsory
Switchgear MV (11kV, 6,6 and 3,3kV)	
Oil Transformers	
Uninterruptible Power Supplies (UPS)	
Variable speed drives (LV and MV)	
OHS Act and electrical regulations	Compulsory
Ancillary equipment:	
Area Lighting	
Building wiring	Compulsory
Distribution boards with fault rating < 20kA	Compulsory
Energy metering with communication protocol	Compulsory
Energy management	
Fire Detection	
Lighting and small power in buildings	Compulsory
Low voltage electricity supply	Compulsory
Low voltage reticulation	Compulsory
Miniature substations	

- a) The Design Specialist employed by the Contractor shall deliver the following at the time of tendering:
- i. Completion of the Bill of Quantities to carry out the design philosophy, design calculations, interfacing with all stakeholders, and to produce all drawings and schedules required by Rand Water as described in this document and in the Bill of Quantities.
 - ii. Completion of all returnable schedules in the tender document relating to project design experience with verifiable references, electrical engineering

equipment knowledge, profiles of staff to be employed on the project, details of office infrastructure and quality and PMI® based project execution systems employed.

b) The Consultant employed by the Contractor shall deliver the following after award of the work:

- i. A design philosophy and calculations work package for each main item as set out in the Bill of Quantities and the Detail Engineering Package Deliverables Document, read in conjunction with Rand Water functional design criteria, Rand Water generic design drawings, Rand Water specifications, legal requirements and national and international specifications (SANS/IEC/IEEE).
- ii. Rand Water technical specifications and requirements review.
- iii. Detail design drawings and schedules, suitable to be issued for the construction of equipment and installations for each main item as set out in the Bill of Quantities and the Detail Engineering Package Deliverables Document, read in conjunction with Rand Water functional design criteria, Rand Water generic design drawings, Rand Water specifications, legal requirements and national and international specifications (SANS/IEC/IEEE).
- iv. Hard copies and software copies of all final deliverables.

c) Deliverables by Rand Water

Rand Water will provide the following:

- i. Typical drawings and documents as per the list elsewhere in the document.
- ii. Comments on all proposed work and final approvals of revised work.

d) The Consultant employed by the Contractor shall execute the works generally as follows:

- i. Preparation and compiling a design philosophy and calculations work package for main item as set out in the Bill of Quantities and the Detail Engineering Package Deliverables Document, read in conjunction with Rand Water design criteria, Rand Water generic design drawings, Rand Water specifications, legal requirements and national and international specifications (SANS/IEC/IEEE). The Contractor shall allow for extensive consultation with responsible Rand Water Design Office personnel, Rand Water Vereeniging site personnel, all engineering personnel from other applicable disciplines e.g. Electrical, Civil, Structural, Architectural, Pipelines, Mechanical and Process, and applicable vendors of equipment and shall allow for a minimum of two draft submissions to be presented to Rand Water before the final philosophy and design document is submitted for approval by the Rand Water Design Office Manager.
- ii. Review Rand Water technical specifications and requirements to which each system shall be manufactured and bring any anomalies and inconsistencies to Rand Water's attention.

- iii. Preparation of compiling all required detail design drawings and schedules, suitable to be issued for the construction of equipment and installations, as indicated in the Bill of Quantities and the Detail Engineering Package Deliverables Document. The Contractor shall allow for consultation with responsible Rand Water Design Office personnel, Rand Water Vereeniging site personnel, all engineering personnel from other applicable disciplines e.g. Electrical, Civil, Structural, Architectural, Pipelines, Mechanical and Process, and applicable vendors of equipment in the preparation of the drawings and schedules. The Contractor shall allow for a minimum of two draft submissions of drawings and schedules for each equipment set, to be presented to Rand Water before the final drawings and schedules are submitted for approval by the Rand Water Design Office Manager for manufacture by appointed vendors of the equipment.
- iv. Supply hard copies and software copies of all final deliverables. Software copies shall be delivered in MS Office 2010 or Auto Cad 2016 or later format.
- v. Liaise extensively with appointed vendors to ensure that technical, financial and contractual variations from equipment offered at tender stage (if any) are negotiated and accepted by the vendors of the equipment and approved by the Rand Water Design Office Manager.

SS 2.4.2.1.2 – Preparation and compiling a design philosophy and calculations work package for main items as set out in the Functional Specification and the Detail Engineering Package Deliverables Document, read in conjunction with Rand Water design criteria, Rand Water generic design drawings, Rand Water specifications, legal requirements and national and international specifications (SANS/IEC/IEEE). This item shall be priced as part of the design portion in the BOQ.

SS 2.4.2.1.2.1 – The contractor shall allow for extensive consultation with responsible Rand Water Design Office personnel, Rand Water Vereeniging site personnel, all engineering personnel from other applicable disciplines e.g. Electrical, Civil, Structural, Architectural, Automation and Process, and applicable vendors of equipment and shall allow for one draft submissions to be presented to Rand Water before the final philosophy and design document is submitted for approval by the Rand Water Design Office Manager.

SS 2.4.2.1.2.2 – Review Rand Water technical specifications and requirements to which each system shall be manufactured and bring any anomalies and inconsistencies to Rand Water's attention.

SS 2.4.2.1.2.3 – Preparation of compiling all required detail design drawings and schedules, suitable to be issued for the construction of equipment and installations, as indicated in the System Specification and the Detail Engineering Package Deliverables Document. The Contractor shall allow for consultation with responsible Rand Water Design Office personnel, Rand Water Vereeniging site personnel, and all engineering personnel from other applicable disciplines e.g. Electrical, Civil, Structural, Architectural, Automation and Process, and applicable vendors of equipment in the preparation of the drawings and schedules. The Contractor shall allow for one draft submissions of drawings and schedules for each equipment

set, to be presented to Rand Water before the final drawings and schedules are submitted for approval by the Rand Water Design Office Manager for manufacture by appointed vendors of the equipment.

SS 2.4.2.1.2.4 – Liaise extensively with appointed vendors to ensure that technical, financial and contractual variations from equipment offered at tender stage (if any) are negotiated and accepted by the vendors of the equipment and approved by the Rand Water Design Office Manager.

SS 2.4.2.1.2.5 – Detail Electrical Engineering Design Package Deliverables

The Contractor shall provide the following design deliverables:

1.1.1	Low Voltage Switchgear and Motor Control Centers
	Final LV MCC/Switchgear Single Line Diagram Update indicating kiosk 1 and 2 power supplies on emergency section of 400 V MCC
	Final LV MCC/Switchgear General Arrangement Update
	Low Voltage Distribution Kiosk and Distribution Boards
	LV Load Flow analysis (Current flows)
	LV Short Circuit Analysis (Fault levels: Three phase symmetrical, Single phase to earth)
	Final LV system operating basis/philosophy. (Example: paralleling, diversity etc.)
	Final LV system future expansion requirements and allowance thereof
	Final LV Distribution Board design basis, requirements and equipment specification as per SANS IEC 60439 and 60947
	Final LV Distribution Kiosk and Board General Arrangement
	Final LV Distribution Kiosk and Board Single Line Diagram
	Final LV Distribution Kiosk and Board Schematic and Wiring Diagrams of each circuit
	Final LV Distribution Kiosk and Board Construction Requirements
1.1.2.	Earthing and Lightning Protection(Existing Cathedral Header and Engine Room 4 Isolation Valve Chamber)
	Plant earthing and lightning protection philosophy and tie-in with existing system
	Soil resistivity surveys
	Earthing System Design Requirements
	Earth electrode design and tie-in to earthing system
	Station Earth Bar requirements
	Earthing and lightning protection layout (Plan, Elevations)
	Building Small Power and Lighting System
	Requirements (Socket Outlets, Water Heaters, HVAC isolators, Surface/Built in installation)
	Lighting philosophy: Final design including lux calculation (Daylight switching, selection of fitting type per application)
	Emergency lighting (Operational and OHS Act requirements)
	Conduiting requirements (Built-in/Surface mount)
	Exterior Building Lighting if applicable
	Interface to data, communication, access control and fire detection systems
	Fault Level Requirements

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	Conductor Design and Specification
	Small Power and Lighting Layout (Plan and Elevation, Interior and Exterior)
	Small Power and Lighting Conduiting Layout (Plan and Elevation), Cable Access Requirements
	Distribution Board Design (Rating, Fault Level, Circuits, Balancing of Loads, Cascading, Sections)
	HVAC requirements to meet the environmental specification within the buildings where required
1.1.3.	Sump Pumps
	Panel requirements specification (control and indication, construction requirements)
	Sump pump operating philosophy
	Control panel general arrangement
	Control panel schematic and wiring diagrams
1.1.4.	Actuator Valve Isolation Panel
	Panel requirements specification (control and indication, construction requirements)
	Panel schematic and wiring diagrams
	Panel layout and general arrangement (floor standing)
1.1.5.	Extraction Fan Panel
	Panel requirements specification (control and indication, construction requirements)
	Extraction Fan operating philosophy
	Control panel general arrangement
	Control panel schematic and wiring diagrams
	Cable reticulation and plant cabling
	Normal and essential service supply points from within the existing reticulation in the plant, including available capacity
	Assessment of reliability of existing supplies and operational requirements e.g. effect of new plant when supply is shut down for maintenance
	LV reticulation design
	Cable route philosophy
	Cable installation philosophy (ducts, trenches, sleeves, protection from other services, cable transit system, road crossings)
	Interface to other services (buildings, pipes, roads, valve chambers, sewerage lines, telecommunications and data)
	Cable support system philosophy and specification (Cable Basement and plant cable support systems)
	Cable support system design calculations (mechanical loading)
	Requirements for ancillary equipment (Pushbutton stations, junction boxes, welding plugs, isolator panels)
	Cable Design Schedules for Power Cables (Voltage, Size, De-Rating, Volt Drop, Fault Withstand etc.)
	Cable Schedules (Detailed Design with full cable termination details of each core of the cable in the approved Rand Water format)
	Cable Support System Drawings (Cable Basement, Chambers, Switchgear Rooms)
	Cable Trench/Duct Cross- Sectional Layout Drawings
	Reticulation Cable Access into buildings, structures (Ducts, cable racking, slots, sleeves, cable transit systems etc.)

SS 2.4.3 – EXISTING WASHWATER 400V MOTOR CONTROL CENTRE (MCC) WORKS

Function: The emergency power section in the Wash Water plant 400 Volt MCC room shall be utilized for distributing power to kiosk 1 and kiosk 2

Applicable typical RW drawings: RA_20154, RA_28841 & RB_20064

Specific requirements:

An existing emergency section panel exists, complete with spare circuit breakers. Circuit breaker Q0605 rated at 63 Amps shall be used for the supply to kiosk no. 2 and the contractor shall replace circuit breaker Q0602 with the same type as installed, rated at 125 Amp 36 kA to provide power to kiosk no.1. The contractor shall ensure the existing jumper cabling between the bus bar, circuit breaker and termination blocks in the wire way is adequately rated for the current.

The breakers shall be labeled by means of an engraved type label as per Rand Waters' requirements. The contractor shall ensure the existing single line diagram is updated with the latest additions and provide an as built drawing to this effect.

SS 2.4.4 – DISTRIBUTION KIOSK NO.1 AND KIOSK NO.2

Function: Distribution of power to valve isolation panels, small power and lighting DB's, sump pump panels and extraction fan panel.

Applicable typical RW drawings: RA_20154, RA_28841 & RB_20064

Specific requirements:

Description	Preferred	Alternative
Kiosk supply voltage	400VAC	N/A
Kiosk control voltage	231VAC	N/A
Kiosk current rating	125% of calculated installed load	
Kiosk IP rating	IP65	>IP65
Kiosk material	3 CR12 stainless steel	N/A
Kiosk painting system details.	Powder coated B26,structured, to SANS 1091	N/A
Kiosk short circuit rating (3 sec) kA	15kA	>15kA
Kiosk location	Outdoors	N/A
Kiosk access	Front double door	N/A
Kiosk mounting location	Pedestal mounted	N/A
Cable entry location	Bottom	N/A

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Certification required	Assembly assessors certification	N/A
Circuit Breakers and Equipment Complete	SABS approved and Similar to type used in MCC	N/A
400 Volt 32 amp IP 65 rated welding plug mounted on kiosk	Yes	N/A

SS 2.4.5 – SMALL POWER AND LIGHTING DISTRIBUTION PANEL

Function: Provide power to small power and lighting circuits and equipment.

Applicable typical RW drawings: RA_20154, RA_28841 & RB_20064

Specific requirements:

The contractor shall provide for a small power and lighting distribution board mounted on the outside of the Cathedral Header and Engine Room 4 Isolation Valve chambers respectively by means of a hot dipped galvanized frame. The socket outlets and lighting circuits entering the chambers shall be by means of an adequately rated armoured cable up to the first switch or socket outlet from where galvanized conduit shall be used for the rest of the installation. The contractor shall confirm all entries required into the concrete chambers with the Civil contractor prior to construction.

The contractor shall allow for a minimum of 4 x IP65 rated 230 Volt 16 Amp socket outlets inside the Cathedral Header Chamber and one at the distribution board. At the Engine Room 4 Isolation Chamber allow for one socket outlet at the distribution board.

An adequately sized and rated surface mounted galvanized conduit system shall be installed to cater for the small power and lighting installation in both chambers.

Lighting shall be done to ensure adequate and SANS compliant lighting on all stairs, walkways and equipment to be maintained. All luminaires shall be safely accessible for maintenance.

Description	Preferred	Alternative
DB supply voltage	400VAC	N/A
DB control voltage	231VAC	N/A
DB current rating	125% of calculated installed load	
DB IP rating	IP65	>IP65
DB material	3 CR12 stainless steel	N/A

DB painting system details.	Powder coated B26, structured, to SANS 1091	N/A
DB short circuit rating (3 sec) kA	5kA	>5kA
DB location	Outdoors	N/A
DB access	Front double door	N/A
DB mounting location	Pedestal mounted	N/A
Cable entry location	Bottom	N/A
Certification required	Assembly assessors certification	N/A
Circuit Breakers and Equipment	SABS approved and Similar to type used in MCC	N/A

SS 2.4.6 – VALVE ISOLATION PANEL

Function: To provide means for electrical power isolation of valve actuators.

Applicable typical RW drawings: RA_20154, RA_28841 & RB_20064

Specific requirements:

The contractor shall provide for valve isolation panels at each actuator mounted on the outside of the Cathedral Header chamber by means of a hot dipped galvanized frame. At the Engine Room 4 Isolation Valve Chamber the panel shall be installed next to the actuator that will be installed on top of the chamber also by means of a hot dipped galvanized frame. The contractor shall confirm all entries required into the concrete chambers with the civil contractor prior to construction.

Description	Preferred	Alternative
DB supply voltage	400VAC	N/A
DB current rating	125% of calculated installed load	
DB IP rating	IP65	>IP65
DB material	3 CR12 stainless steel	N/A

DB painting system details.	Powder coated B26, structure d , to SANS 1091	N/A
DB short circuit rating (3 sec) kA	5kA	>5kA
DB location	Outdoors	N/A
DB access	Front	N/A
DB mounting location	Pedestal mounted	N/A
Cable entry location	Bottom	N/A
Lockable isolator	Door mounted	N/A
Certification required	Assembly assessors certification	N/A
Circuit Breakers and Equipment	SABS approved and Similar to type used in MCC	N/A

SS 2.4.7 – SUMP PUMP CONTROL PANEL

Function: To provide power and control to the sump pumps.

Applicable typical RW drawings: RA_20154, RA_28841 & RB_20064

Specific requirements:

The contractor shall provide for sump pump control panels mounted on the outside of the Cathedral Header and Engine Room 4 Isolation Valve chambers respectively by means of a hot dipped galvanized frame. The cabling entering the chambers shall be by means of an adequately rated armoured cable. An IP65 rated termination box shall be used for the level switch terminations. IP65 rated isolators shall be installed at each sump pump. The contractor shall confirm all entries required into the concrete chambers with the civil contractor prior to construction. The control circuit for the level switches shall be 24volt DC and the system shall be provided with a flood alarm siren. The panels shall consist of an amp meter on the inner door indicating the sump pump running current. Run, stop and trip indications shall also be mounted on the inner door. An isolator shall be installed close to the actual sump pump.

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Description	Preferred	Alternative
DB supply voltage	400VAC	N/A
DB control voltage	231VAC / 24VDC	N/A
DB current rating	125% of calculated installed load	
DB IP rating	IP65	>IP65
DB material	3 CR 12 SS	N/A
DB painting system details.	Powder coated B26, structured, to SANS 1091	N/A
DB short circuit rating (3 sec) kA	5kA	>5kA
DB location	Outdoors	N/A
DB access	Front double door	N/A
DB mounting location	Pedestal mounted	N/A
Cable entry location	Bottom	N/A
Indications on inner door	Run, stop, tripped and current	
Certification required	Assembly assessors certification	N/A
Circuit Breakers, 30mA earth leakage and Equipment	SABS approved and Similar to type used in MCC	N/A

SS 2.4.8 – EXTRACTION FAN CONTROL PANEL

Function: To provide for extraction of the chlorine vapour in the Cathedral Header Chamber.

Applicable typical RW drawings: RA_20154, RA_28841 & RB_20064

Specific requirements:

The contractor shall provide for an extraction fan control panel mounted on the outside of the Cathedral Header chamber by means of a hot dipped galvanized frame. The cabling entering the chambers shall be by means of an adequately rated armoured cable. IP65 rated isolator shall be installed at the fan. The contractor shall confirm all entries required into the concrete chambers with the civil contractor prior to construction. The control circuit for the fan shall incorporate a timer allowing timed starts. The control circuit shall include for

an amp meter, run, stop and trip indications on the inner door. An isolator shall be installed at the extraction fan.

Description	Preferred	Alternative
DB supply voltage	400VAC	N/A
DB control voltage	231VAC	N/A
DB current rating	125% of calculated installed load	
DB IP rating	IP65	>IP65
DB material	3 CR 12 SS	N/A
DB painting system details.	Powder coated B26, structured, to SANS 1091	N/A
DB short circuit rating (3 sec) kA	5kA	>5kA
DB location	Outdoors	N/A
DB access	Front double door	N/A
DB mounting location	Pedestal mounted	N/A
Cable entry location	Bottom	N/A
Indications on inner door	Run, stop, tripped and current	
Certification required	Assembly assessors certification	N/A
Circuit Breakers and Equipment	SABS approved and Similar to type used in MCC	N/A

SS 2.4.9 – SMALL POWER AND LIGHTING INSTALLATION

Function: To provide for a complete small power and lighting installation as per SANS 10142-1 and Rand Water specification RW320-AS-500 for Building small power and lighting installations with reference to schematics and drawings mentioned.

Applicable typical RW drawings: RA_20154, RA_28841 & RB_20064

Specific requirements:

General

The contractor shall ensure that the design and installation is done as per Rand Water specifications. Functional design drawings are provided as guideline only and for tender purposes. Best practice principles shall be followed. Once the design drawings are

approved, no deviations will be allowed unless approved by the Rand Water design section electrical representative. No Norse or Surfix type cabling shall be accepted.

Conduit and wiring channel requirements

The contractor shall be responsible to determine the conduit requirements, termination boxes, routes and layouts in conjunction with the civil, process, automation, and other relevant contractors prior to commencement of construction. All conduits and termination boxes shall be of the galvanized metal type.

Conduit routes and support systems to be verified on site with civil contractor. The contractor shall ensure that the quality requirements as specified on the drawing legend sheets off all equipment are adhered to.

Small power and lighting distribution boards (covered in item 5)

The contractor shall make provision for a factory acceptance test of the main Small Power and Lighting DB prior to delivery to site. The contractor shall provide for a manufacturer's certificate for the Distribution boards complete with GA drawings to be approved by Rand Water prior to construction.

IP65 rated socket outlets, light switches and isolators

The contractor shall allow for all the outlets at the chambers. These outlets shall be IP65 rated and also be rated to withstand the corrosive effects of chlorine vapour. All outlets shall be positioned in such a manner for ease of operation and maintenance.

Lighting

The contractor shall ensure that the legislative minimum average lux levels are achieved in all areas. A detailed lux level report shall be provided complete with calibration certificates for the equipment used during the test. The contractor shall ensure that provision is made for adequate IP65 rated LED type lighting at and around the stairs, walkways and equipment. All lights shall be positioned for ease of maintenance.

Others

The following items shall form part of the works under this contract:

- a) Contractor shall provide for an electrical certificate of compliance for the installation. The contractor shall inform the Rand Water execution engineer when this test will be conducted as he needs to witness the test. The COC will be deemed invalid if no electrical Rand Water representative is present during the test.
- b) The contractor shall provide for engraved labels on all equipment and outlets. The details of the wording will be confirmed on site with the Rand Water design engineer. The contractor shall provide for a laminated legend sheet inside the small power and lighting DB.

SS 2.4.10 – CABLE RACKING

Function: Utilized for cable support

The Contractor shall be responsible for a cable racking systems. The prices quoted in the bill of quantities shall include for the design, supply and delivery, as well as the erection of the required rack or tray system which shall include uni-strut supports, straight lengths,

bends, elbows, tees, reducers, fixing brackets, fixing materials and touch up cold galvanizing painting.

All cables shall be installed on a cable racking system. Cables installed in cable ducts or exiting cable sleeves or cable ducts, whether internal or external to a building, shall be installed on a cable racking system. No cable shall be installed directly into a cable duct.

Specific requirements:

All cable racking utilized shall be SABS approved hot dipped galvanized units resistant to chlorine vapour in low concentrations. No drilling or welding shall be allowed on any cable racking and all sections, bends, joints, etc. shall be pre drilled before it is galvanized. All cable racks/ladders installed externally shall consist of a cover on the front of the rack to cover the cables.

If alternative cable racks are offered the Contractor shall supply full details with the tender document.

When installing cable racking within cable ducts, a vertical installation mounted on the side wall of the cable duct, as opposed to a horizontal installation, is preferred.

The Contractor shall produce a detailed cable racking design detailing: racking types, layout, orientation, sizes, cable layout on the rack and routes, for approval, before purchasing any racking material.

SS 2.4.11 – CABLE TRENCHING

Function: Utilised for cable installation and cable protection.

The Contractor shall be responsible for providing cable trenches in all soil conditions, ducts, etc. as per the requirements.

Specific requirements:

All cable trench excavations, compaction, backfilling and concrete cable markers with engraved aluminium information plates shall be installed in accordance with the Rand Water requirements. The contractor shall allow for the reinstatement of any damaged surfaces. 110mm PVC sleeves shall be installed at road crossings.

SS 2.4.12 – CABLE SEALING SYSTEM

Function: To eliminate ingress of water through cable entry and exit points.

The contractor shall design, supply and install a cable sealing system at all locations where cables enter and exit the concrete chambers below ground level, expanded foam will not be accepted.

Specific requirements:

The system shall be water tight, UV, corrosive chlorine vapour resistant and of the Roxtec modular system or equivalent. A minimum of 15% spare capacity shall be incorporated in the final installation. The contractor shall allow for concrete core drilling of 5 x 100mm hole to accommodate the cables required to enter the chambers from outside.

SS 2.4.13 – CABLE INSTALLATION

Function: To provide power to all electrical and instrumentation items internal and external to the plant.

Applicable typical RW drawings: RA_20154, RA_28841 & RB_20064 and All other drawings as listed in the drawings register.

The Contractor shall be responsible for the supply, delivery, installation and commissioning of ALL low voltage power and control cabling, including earthing. All electrical equipment shall be earthed utilizing Anti –theft type copper coated metal clad steel wire. No bare copper earth wire will be accepted unless for the function of earth mat. The Contractor shall pay particular attention to the cabling interfaces between the various types of equipment and shall ensure that ALL cables have been included in the tendered rates.

The work shall include terminations, joints, glands, shrouds, etc. No PVC type glands shall be accepted. The Contractor shall issue test certificates for the tests performed. No joining of cables shall be accepted and all cable runs shall be continuous.

Specific requirements:

The table below highlights some of the equipment cabling interfaces that the Contractor shall be responsible for installing and the rest can be identified on the Drawings provided complete with earth conductors:

Origin	Destination
Wash Water 400volt MCC emergency power section	Kiosk no.1
Kiosk no.1	Valve actuator isolation panels(X7)
Valve actuator isolation panels(X7)	Actuators X 7
Kiosk no.1	SP&L distribution panel
SP&L distribution panel	Light switch and socket outlet
Kiosk no.1	Sump pump control panels (X2)
Sump pump control panels (X2)	Sump pump isolator (X2)
Sump pump isolator (X2)	Sump pump (X2)
Sump pump control panels (X2)	Sump pump level switches
Kiosk no.1	Extraction fan control panel
Extraction fan control panel	Extraction fan isolator
Extraction fan isolator	Extraction fan
Wash Water 400volt MCC emergency power section	Kiosk no.2
Kiosk no.2	SP&L distribution panel
SP&L distribution panel	Light switch and socket outlet
Kiosk no.2	Sump pump control panel

Sump pump control panel	Sump pump isolator
Sump pump isolator	Sump pump
Sump pump control panel	Sump pump level switches
Kiosk no.2	Valve actuator isolation panel
Valve actuator isolation panel	Actuator

It is the Contractor's responsibility to produce the entire plant design and thereafter to complete a cable schedule based on this overall design. The cable schedule shall incorporate the required cable interfaces between all electrical items associated with the plant.

The Contractor shall then utilize the cable schedule to price for the entire plant cabling installation, as a sum, in the tendered rates.

SS 2.4.14 – EARTHING OF EQUIPMENT

Function: to provide adequate earthing for all equipment.

Specific requirements:

The Contractor shall ensure all electrical equipment e.g. 400V MCC, Valve Control Distribution Boards, PLC panels, cable racking, 400V motors, steel structures, etc. are adequately earthed. All electrical equipment shall be earthed utilizing Anti-theft type copper coated metal clad steel wire. **No bare copper earth wire will be accepted unless used for earth mat applications.**

SS 2.4.15 – DECOMMISSIONING AND REMOVAL OF REDUNDANT EQUIPMENT

Function: To ensure that all redundant equipment is cleared from site. The area where all the redundant equipment will be taken out must be made good.

Specific requirements:

- a) Decommission, strip out and remove the following equipment at the Cathedral Header Chamber, once all the loads have been transferred:
 - Existing valve actuator control panels,
 - Existing SP&L distribution board,
 - Existing sump pump control panels, and
 - Existing emergency sump pump control panel
- b) Decommission, strip out and remove the existing small power and lighting installation.

The contractor is note that all redundant equipment once striped out must be taken to a location to be indicated by the project manager. The area where all the equipment was taken out must be rehabilitated and made good.

SS 2.4.16 – OPERATING AND MAINTENANCE MANUALS

Function: To ensure returnable documentation and drawings of the highest standard.

The contractor shall produce draft operating and maintenance manuals for approval. Details of all electrical equipment supplied under this contract shall appear in the manuals.

The following drawings and information shall be supplied by the Contractor for approval by the Engineer within the required time period specified elsewhere in the contract documents, but before manufacture of the plant commences and after approval these drawings shall be supplied as final drawings. Should the Contractor fail to provide the drawings and information by the due date, the penalty described in the Special Conditions of Contract will be imposed and the progress payments will be delayed.

- General arrangement drawings of all applicable equipment to be supplied and installed.
- Outline and foundation drawings for all the equipment to be supplied.
- Full schematic diagrams of all circuits of all equipment to Rand Water RW-EES-002-Rev 0 standard, based on tender drawings.
- Complete wiring and connection diagrams of all circuits.
- Proposed details of all labels (engraved labels).
- All technical information on the equipment to be supplied.
- Full details of configuration software for the programmable equipment and full details of calculations for the protection settings where applicable. Electronic and hard copies of all software shall be provided.
- Equipment schedules of all components coded to Rand Water's WKS numbering systems.
- Full QA plan for the testing of the equipment at the factory and on site prior to the putting into service of the plant. No manufacturing shall start without Rand Water approved QCP's.

The Contractor shall provide three copies of the operating and maintenance manuals within the required time specified elsewhere in the contract documents after the draft copy has been approved.

- Three approved sets of all technical information/manuals including test and calibration data and detailed operating instructions necessary for the correct operation and maintenance of all equipment being supplied under the Contract. Unique manuals shall be compiled to cover this contract only and all extraneous material shall be omitted.
- Approved test certificates and detailed test reports for all equipment shall be supplied.
- Approved factory test, cold and hot commissioning certificates, inclusive of all test results.

- Accredited assembly assessor's relevant certification for each low voltage electrical distribution board or motor control centre
- Certificates of Compliance to the OHS Act for all installations
- Commissioning documentation to Rand Water standards and requirements
- Approved "as built" schematic diagrams of all circuits of all equipment in hard and electronic copy (AutoCAD dwg format) to Rand Water template standards, and approved by an ECSA registered Professional Engineer
- Approved as built detailed cable schedules with all core connections, installed cable lengths and full cable type and size details
- Detailed cable test certificates with all test results
- Earthing protection installation results and certificates
- Approved configuration and settings for all programmable equipment with hard copies approved by an ECSA registered Professional Engineer.
- Approved "as built" general arrangement drawings approved by an ECSA registered Professional Engineer.
- Full details of all labels and WKS numbers of all equipment
- Layouts and sizes of equipment
- Recommended spares and suppliers' contact details
- Detailed operating and maintenance instructions for all equipment and systems
- Special tools requirements
- Installation instructions

After approval of the draft manuals the contractor shall issue 3 paper sets of final approved operating and maintenance manuals and shall transfer the same to 3 sets of CDs or DVDs in '.pdf' format.

SS 2.4.17 – LIST OF APPLICABLE ELECTRICAL DRAWINGS

Drawing No	Description
RA_20154	VG Cathedral Header site Layout and Cable Routes
RA_28841	Engine Room 4 Valve Chamber Electrical Layout
RB_20064	400 Schematics

SS 2.4.18 – LIST OF APPLICABLE RAND WATER ELECTRICAL STANDARDS

ITEM	DESCRIPTION	NUMBER
Electrical Standards		
1.	Rand Water Electrical Standard Specifications:	
1.1.	Medium Voltage Switchgear and Ancillary Equipment	RW/00320/AS/978
1.2.	Standard for Electrical Drawings	RW EES 002
1.3.	Standard for Earthing and Suppression	RW_00320_AS_116
1.4.	Standard Specification for control panels	RW_00320_AS_493
1.5.	Standard Specification for the design and selection of electrical plant and equipment	RW_00320_AS_001
1.6.	General Electrical specification for the installation of electrical plant and equipment	RW_00320_AS_496
1.7.	Rand Water General Specification for the Installation of Electrical Plant and Equipment	RW_00320_AS_496
1.8.	Standard Specification for Instrument Transformers for Protection and Metering in Medium Voltage Systems	RW_00320_AS_909
1.9.	General Specification for the Design & Selection of Electrical Equipment	RW_00320_AS_001
1.10.	Rand Water Standard Specification for Medium Voltage Switchgear and Ancillary Equipment	RW_00320_AS_978
1.11.	The wiring code	SANS 10142-1
1.12.	Labels Standard Specification	RW_AES_00011_AS

SS 2.4.19 – APPLICABLE NATIONAL AND INTERNATIONAL ELECTRICAL STANDARDS

SS 2.4.19.1 – GENERAL

No	Standard No	Description
1	SANS 1019	Standard voltages, currents and insulation levels for electricity supply
2	SANS IEC 60529	Degrees of protection provided by enclosures (IP code)
3	SANS 60050	International Electro technical vocabulary. Chapter 441: Switchgear, controlgear and fuses
4	SABS ISO 9001, Parts I, II and III.	Quality systems
5	SANS 1091	National colour standard for paint
6	BS 4190	Specification for ISO metric black hexagon bolts, screws and nuts
7	OHS Act	Occupational Health and Safety Act (Act 85 Of 1993)
8	SANS 60909-1:2010	Short-Circuit Currents In Three-Phase A.C. Systems Part 1: Factors For The Calculation Of Short-Circuit Currents According To IEC 60909-0 Use With: SANS 60909-0:2010
10	SANS 60909-3:2010	Short-Circuit Currents In Three-Phase A.C. Systems Part 3: Currents During Two Separate Simultaneous Line-To-Earth Short Circuits And Partial Short-Circuit Currents Flowing Through Earth Use With: SANS 60909-0:2010
9	SANS 60909-2:2010	Short-Circuit Currents In Three-Phase A.C. Systems Part 2: Data Of Electrical Equipment For Short- Circuit Current Calculations Use With: SANS 60909-0:2010
1	SANS 10142-1:2012	The wiring of premises Part 1: Low-voltage installations
2	SANS 10142-2:2009	The wiring of premises Part 2: Medium-voltage installations above 1 kV a.c. not exceeding 22 kV a.c. and up to and including 3 000 kW installed capacity

SS 2.4.19.2 – CABLES AND CABLE INSTALLATION (LV, MV & EARTHING)

No	Standard No	Description
1	SANS 97:2001	Electric cables - Impregnated paper-insulated metal-sheathed cables for rated voltages 3,3/3,3 kV to 19/33 kV (excluding pressure assisted cables)
2	SANS 1339	Electric cables - Cross-linked polyethylene (XLPE) insulated cables for rated voltages 3,8/6,6 kV to 19/33 kV
3	SANS 1507:2002	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V)
4	SANS 1507-1:2002	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) Part 1: General
5	SABS 1507-2:2002	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) Part 2: Wiring cables
6	SANS 1507-3:2002	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) Part 3: PVC distribution cables
7	SANS 1507-4:2002	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) Part 4: XLPE cables
8	SANS 1507-5:2002	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) Part 5: Halogen free distribution cables
9	SANS 1507-6:2002	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V) Part 6: Service cables
10	SANS 10198-1:2004	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 1: Definitions and statutory requirements
11	SANS 10198-2:2004	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 2: Selection of cable type and methods of installation
12	SANS 10198-3:2004	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 3: Earthing systems - general provisions
13	SANS 10198-4:2005	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 4: Current ratings

**TENDER FOR THE DESIGN AND CONSTRUCTION OF CATHEDRAL HEADER PIPELINE UPGRADE
AT VEREENIGING PUMPING STATION**

13	SANS 5:2004	10198-	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 5: Determination of thermal and electrical resistivity of soil
14	SANS 6:2004	10198-	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 6: Transportation and storage
	SANS 7:2004	10198-	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 7: Safety precautions
15	SANS 8:2004	10198-	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 8: Cable laying and installation
16	SANS 9:1988	10198-	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 9: Jointing and termination of extruded solid dielectric-insulated cables up to 3,3 kV
17	SANS 10:1988	0198-	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 10: Jointing and termination of paper-insulated cables
18	SANS 11:1988	0198-	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 10: Jointing and termination of screened polymeric-insulated cables
19	SANS 12:1988	0198-	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 12: Installation of earthing system
20	SANS 13:1995	0198-	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 13: Testing, commissioning and fault location
21	NRS 012		Enclosures for cable terminations in air - For rated voltages of 7,2 kV and up to and including 36 kV - Preferred requirements for applications in the electricity supply industry
22	NRS 011		Pilot cables - Preferred requirements for applications in the electrical supply industry
23	NRS 013		Medium-voltage cables - Preferred requirements for applications in the Electricity Supply Industry
24	NRS 028		Cable lugs and ferrules for copper and aluminum conductors - Preferred requirements for applications in the electricity supply industry
25	NRS 053		Accessories for medium-voltage power cables (3,8/6,6 kV to 19/33 kV)

**TENDER FOR THE DESIGN AND CONSTRUCTION OF CATHEDRAL HEADER PIPELINE UPGRADE
AT VEREENIGING PUMPING STATION**

26	VC 8075	Safety of electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)
28	SANS 10142-2	The wiring of premises Part 2: Installations above 1 kV not exceeding 33 kV
29	SANS 1574	Electric cables- Flexible cords and flexible cables

SS 2.4.19.3 – LOW VOLTAGE SWITCHGEAR

No	Standard No	Description
1	SANS IEC 60439- 1	Low voltage switchgear and controlgear assemblies Part 1: Type-tested and partially type-tested assemblies
2	SANS IEC 60439- 2	Low voltage switchgear and controlgear assemblies Part 2: Particular requirements for busbar trunking systems (busways)
3	SANS IEC 60439- 3	Low voltage switchgear and controlgear assemblies Part 3: Particular requirements for low voltage switchgear and controlgear assemblies intended to be installed in places where unskilled persons have access to their use- Distribution boards
4	SANS IEC 60439- 4	Low voltage switchgear and controlgear assemblies Part 4: Particular requirements for assemblies for construction sites (ACS)
5	SANS IEC 60439- 5	Low voltage switchgear and controlgear assemblies Part 5: Particular requirements for assemblies intended to be installed outdoors in public places- Cable distribution cabinets (CDC's) for power distribution in networks
6	BS 5486-12:1989	Low-voltage switchgear and controlgear assemblies. Specification for particular requirements of type tested miniature circuit- breaker boards
7	SANS IEC 60947-1	Low Voltage Switchgear and Control Gear Part 1: General Rules
8	SANS IEC 60947-2	Low Voltage Switchgear and Control Gear Part 2: Circuit Breakers
9	SANS IEC 60947-3	Low Voltage Switchgear and Control Gear Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units
10	SANS IEC 60947-4-1	Low Voltage Switchgear and Control Gear Part 4: Contactors and motor-starters Section 1: Electromechanical contactors and motor-starters

**TENDER FOR THE DESIGN AND CONSTRUCTION OF CATHEDRAL HEADER PIPELINE UPGRADE
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11	SANS 60947-4-2	IEC	Low Voltage Switchgear and Control Gear Part 4: Contactors and motor-starters Section 2: A C semiconductor motor controllers and starters
12	SANS 60947-4-3	IEC	Low Voltage Switchgear and Control Gear Part 4: Contactors and motor-starters Section 3: A C semiconductor controllers and contactors for non-motor starters
13	SANS 60947-5-1	IEC	Low Voltage Switchgear and Control Gear Part 5: Control Circuit devices and switching elements- Electromechanical control circuit devices
14	SABS 763-1988		Hot dip (galvanized) zinc coating
15	SABS 1473-1		Low-voltage switchgear and controlgear assemblies Part 1: Type-tested and partially type-tested assemblies
16	SABS 1473-2		Low-voltage switchgear and controlgear assemblies Part 2: Busbar trunking systems
17	SABS 1973-3		Safety of assemblies with a rated prospective short-circuit current of up to and including 10 kA
18	SANS 1:2007	1973-	Low-Voltage Switchgear And Control Gear ASSEMBLIES Part 1: Type-Tested ASSEMBLIES With Stated Deviations And A Rated Short-Circuit Withstand Strength Above 10 kA Use with: SANS 60439-1:2004
19	SANS 3:2008	1973-	Low-Voltage Switchgear And Control Gear ASSEMBLIES Part 3: Safety Of ASSEMBLIES With A Rated Prospective Short-Circuit Current Of Up To And Including 10 kA
20	SANS 7:2008	1973-	Low-Voltage Switchgear And Control Gear ASSEMBLIES Part 7: Requirements For Testing Under Conditions Of Arcing Due To Internal Fault Use with: SANS 60439-1:2004

SS 2.4.19.4 – BUSBARS

No	Standard No	Description
1	SANS 1195	Busbars and Busbar Connections

SS 2.4.19.5 – CIRCUIT BREAKERS & EARTH LEAKAGE PROTECTION

No	Standard No	Description
1	VC 8035	Compulsory Specification for Earth Leakage Units
2	VC 8036	Compulsory Specification for Circuit Breakers
3	SANS 156	Molded-case Circuit-Breakers
4	SANS 767-1	Earth leakage protection units Part 1: Fixed earth leakage protection circuit-breakers
5	SANS 767-2	Earth leakage protection units Part 1: Single phase, portable units

SS 2.4.19.6 – SURGE ARRESTORS AND PROTECTION

No	Standard No	Description
1	SANS 60099-4:2009	Surge Arresters Part 4: Metal-Oxide Surge Arresters Without Gaps For A.C. Systems
2	SANS 61643-1:2006	Low-voltage surge protective devices Part 1: Surge protective devices connected to low-voltage power distribution systems - Requirements and tests
3	SANS 61643-11:2011	Low-voltage surge protective devices Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods
4	SANS 61643-12:2009	Low-voltage surge protective devices Part 12: Surge protective devices connected to low-voltage power distribution systems - Selection and application principles
5	SANS 61643-21:2009	Low voltage surge protective devices Part 21: Surge protective devices connected to telecommunications and signaling networks - Performance requirements and testing methods
6	SANS 61643-22:2005	Low-voltage surge protective devices Part 22: Surge protective devices connected to telecommunications and signaling networks - Selection and application principles
7	SANS 61643-321:2004	Components for low-voltage surge protective devices Part 321: Specification for avalanche breakdown diode (ABD)
8	SANS 61643-341:2004	Components for low-voltage surge protective devices Part 341: Specification for thyristor surge suppressors (TSS)
9	SANS 60099-1:1999	Surge Arresters Part 1: Non-Linear Resistor Type Gapped Surge Arresters For A.C Systems

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	SANS 60099-5	Surge arresters Part 5: Selection and application recommendations
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SS 2.4.19.7 – EARTHING

No	Standard No	Description
1	SANS 10200	Neutral earthing in medium voltage industrial power systems
2	SANS 0292	Earthing of low-voltage (LV) distribution systems
3	SANS 0199	The design and installation of an earth electrode
4	SANS 1063	Earth rods and couplers

SS 2.4.19.8 – LIGHTING

No	Standard No	Description
1	SANS 0114-1	Interior lighting Part 1: Artificial lighting of interiors
2	SANS 0114-2	Interior lighting Part 2: Emergency lighting

SS 2.4.19.9 – BUILDING ELECTRICAL INSTALLATIONS

No	Standard No	Description
1	SANS 10142-1	The wiring of premises Part 1: Low-voltage installations
2	SANS 1239	Plugs, socket outlets and couplers for industrial purposes

SS 2.4.19.10 – UNINTERRUPTIBLE POWER SUPPLIES

No	Standard No	Description
1	SANS 62040-1	Uninterruptible power systems (UPS) Part 1: General and safety requirements for UPS
2	SANS 62040-1	Uninterruptible power systems (UPS) Part 2: Electromagnetic compatibility (EMC) requirements
3	SANS 62040-3	Uninterruptible power systems (UPS) Part 3: Method of specifying the performance and test requirements

SS 2.5 – AUTOMATION SPECIFICATIONS

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SS 2.5.1 – SCOPE

The following Cathedral Header valves; 178, 177, 176, 175, 174, 180, and 179 are to be replaced with new butterfly valves on Vereeniging Cathedral Header system. Two new butterfly isolation valves; 261 and 262 shall also be installed on the pipeline between Cathedral Header and Engine room 4.

The automation scope of work shall include the design, supply, delivery, offloading, installation, testing and commissioning of a plant wide communication network to display the Cathedral Header valves and sump pumps status on the existing Engine Room 4 SCADA system. The communication network shall be for monitoring purposes only.

SS 2.5.1.1 – Terminology

SS 2.5.1.1.1 – The following terminology shall apply:

Table 1: Terminology

Term	Definition
put into operation	Shall mean “Design, supply, deliver, offload, install, terminate, test, and commission safely.”

SS 2.5.1.2 – Abbreviations

SS 2.5.1.2.1 – The following abbreviations shall apply:

Table 2: Abbreviations

Abbreviation	Definition
AAM	Automation Asset Management
DB	Distribution board
ECSA	Engineering Council of South Africa
FDU	Fiber Distribution Unit
FAT	Factory Acceptance Test
GA	General Arrangement
HMI	Human Machine Interface
I/O	Input / Output
JB	Junction Box
MV	Medium Voltage
OSI	Open System Interconnection
OS	Operating System
OLM	Optic Link Module
ODTR	Optical Time-Domain Reflector
PRM	Profibus Remote Master Module

PLC	Programmable Logic Controller
RW	Rand Water
SCADA	Supervisory Computer And Data Acquisition

SS 2.5.2 – APPLICABLE DOCUMENTS AND REFERENCES

The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the text of this specification and the documents cited herein, the text of this specification shall take precedence; nothing in this specification supersedes applicable laws and regulations. Failure to list a cited document in section 2 does not mean that it is not include1d in this specification. Listing a document in section 2 without a citation elsewhere does not include the cited document in this specification.

SS 2.5.2.1 – Applicable Documents

SS 2.5.2.1.1 – These documents are contractually enforceable to the extent specified herein.

SS 2.5.2.1.2 – The following drawings are applicable:

Table 3:

No.	Drawing No.	Title
1	RA 20272	Vereeniging Pumping Station Cathedral Header Upgrade Automation Network.
2	RA 28785/001	Vereeniging Pumping Station Cathedral Header Automation Kiosk
3	RA 28785/002	Vereeniging Pumping Station Valve and Sump Pump Automation Kiosk
4	RA 20154	Vereeniging Pumping Station Proposed New Valve Chamber Cable Routes for Automation and Electrical
5	RA 20235/001	Industrial Ethernet Automation Network
6	RA 22585	Engine Room 4 Upgrade Automation Network Layout

SS 2.5.2.1.3 – The following specifications are applicable:

Table 4:

Item	Code	Title	Date	Author	REV
1	RW AAM 00001	Automation Asset Management Standard Specification	July 2015	Automation Asset Manager	B
2	RW AAM 00002	Tag naming Convention	12-10-2015	Automation Asset Manager	C
3	RW AAM 00100	Design Package Standard Specification	Aug 2015	Automation Asset Manager	B
4	RW AAM 07000	Industrial Ethernet Standard Specification	May 2015	Automation Asset Manager	B
5	RW AAM 00001 spec	Spec Fiber Optic Cable Standard Specification.	June 2018	Automation Asset Manager	01
6	RW_00320 AS_491	Factory Built Assemblies for LV switchgear	Feb 2012	Electrical Asset Manager	E
7	RW_EES_002	Drawings	20-08-2012	Electrical Asset Manager	0.0
8	RW_00320_AS_493	Control Panels Standard Specification.	11-04-2011	Electrical Asset Manager	D
9	RW_00320_AS_494	UPS Standard Specification	16-04-1998	Electrical Asset Manager	D
10	IEC 61131-3	IEC Programming Standard	02-2013	IEC	
11	IEEE 518	IEEE Cable Standard	1982	IEEE	

SS 2.5.2.2 – Applicable References

These documents are not contractually enforceable and are merely listed for convenience.

SS 2.5.3 – REQUIREMENTS

SS 2.5.3.1 – DESIGN PACK

SS 2.5.3.1.1 – The Contractor shall provide all design drawings and documentation necessary to complete the scope of work as defined in the tender.

SS 2.5.3.1.2 – The drawings shall be generated according to RW_EES_002.

SS 2.5.3.1.3 – The design pack shall comply with RW AAM 00100 *Design Package Standard Specification Rev B*.

SS 2.5.3.1.4 – The design pack shall be according to RW AAM 00001 Automation Asset Management Standard Specification Rev B

SS 2.5.3.1.5 – All drawings shall be done with the Rand Water border

SS 2.5.3.1.6 – All drawings shall bear the drawing number as allocated by Rand Water.

SS 2.5.3.1.7 – Sufficient information shall be given on the drawings to enable easy reading of the drawing without referencing of other drawings

SS 2.5.3.1.8 – The Contractor shall supply data sheets indicating the part numbers, supplier, necessary installation dimensions, weights, materials and performance information as a minimum

SS 2.5.3.1.9 – The Contractor shall produce all wiring, cabling, panels, and equipment labels that conform to WKS code of standards.

SS 2.5.3.1.10 – The Contractor shall label all terminated wires including spare ones at both ends of the cable.

SS 2.5.3.1.11 – The spare wires shall be label to indicate the wire is in fact a spare one.

SS 2.5.3.1.12 – In case there is more than one (1) spare wire in the cable, the label on the wire shall carry that information (e.g. spare 1, spare 2, spare 3, etc.).

SS 2.5.3.1.13 – The Contractor shall label all cables at both ends of the cable.

SS 2.5.3.1.14 – The Contractor shall, when pricing for the work, provide a detailed breakdown of part numbers, suppliers and local technical agents

SS 2.5.3.1.15 – A complete set of wiring diagrams, cable block diagrams and/or network drawings shall be printed on plastic and placed in the respective panels.

SS 2.5.3.1.16 – All design and quality documents including, but not limited to all items in the table below, shall be required to provide a fully functional plant as intended for in this tender

Table 4: Design Deliverables

ITEM	DESCRIPTION
1	Detailed Network Diagram
2	Detailed Panel GA(s)
3	Detailed Internal Panel Layout
4	Detailed Cable Route Layout Per System
5	Detailed Cable Route Layout for Entire Site
6	Trench Design
7	Cable Tray Route & Layout
8	Detailed Loop Drawings, Wiring Diagrams & Cable Block Diagrams
9	Power Distribution Drawings
10	PLC Layout
11	I/O List
12	Detailed Design Specification
13	Detailed Cable Schedule
14	Detailed Fibre Termination Schedule
15	Fibre Tube Layout Drawing
16	Detailed Equipment List
17	Switch Configuration
18	SCADA Software
19	PLC Software
20	HMI Software
21	Quality Control Plan
22	Installation Plan
23	Cold Commissioning Plan
24	Hot Commissioning Plan
25	Testing Procedure
26	Manuals and Data Books
27	O&M Manuals
28	Spares List

SS 2.5.3.1.17 – All designs submitted for approval shall be signed off by an ECSA approved professionally registered engineer electrical engineer (light current) / electrical Technologist (light current).

SS 2.5.3.1.18 – The Contractor who is responsible for the PLC software development shall ensure that they are certified by the OEM, of the equipment supplied, for

programming of the PLC.

SS 2.5.3.1.19 – The Contractor who is responsible for the SCADA software development shall ensure that they are certified by the OEM, of the equipment supplied, for programming of the SCADA.

SS 2.5.3.1.20 – The Contractor who is responsible for the configuration of the managed industrial Ethernet switches, both layer 2 and 3, shall be certified by the OEM, of the equipment supplied, for configuration of the switch.

SS 2.5.3.1.21 – The certification shall be supplied with the tender offer. Should the Contractor fail to supply proof of accreditation the Employer reserves the right to reject the tender offer.

SS 2.5.3.1.22 – A copy of all installation guidelines shall form part of the O&M manual Please refer to specification RW AAM 00001 Automation Asset Management Standard Specification Rev A

SS 2.5.3.1.23 – The Contractor shall supply the following plans:

SS 2.5.3.1.24 – Quality Control Plan (QCP)

- Within 21 (twenty one) days after the date of the signing of the Contract, the Contractor shall submit a comprehensive proposal for a quality assurance plan. The program shall have facility for the Engineer to indicate hold and witness points as required. The Engineer shall then issue his requirements for quality assurance which shall be based on the Contractor's proposals provided these are adequate and shall be finally subject to the approval of the Engineer. A QCP check shall be submitted to the Engineer for approval prior to any commencement of the works.

SS 2.5.3.1.25 – Installation Plan

- An installation plan shall be submitted to the Engineer for approval prior to any commencement of the installation works
- Due to the tight time frames for installation, the installation plan shall consist of the following as a minimum:
 - Completed signed off design for the affected plant area
 - Installation procedure
 - Installation schedule (broken down per days activity)
 - Installation personal
 - Standby personal
 - Equipment required
 - Specialist equipment required

- Risks
- Risk mitigation plan
- Approved PLC software (If applicable)
- Approved HMI software (If applicable)
- Approved SCADA software (If applicable)
- Daily activity log

SS 2.5.3.1.26 – Cold Commissioning Plan

- A cold commissioning plan shall be submitted to the Engineer for approval prior to any cold commissioning work being undertaken.

SS 2.5.3.1.27 – Hot Commissioning Plan

- A hot commissioning plan shall be submitted to the Engineer for approval prior to any hot commissioning work being undertaken

SS 2.5.3.1.28 – Testing Plan

- A testing procedure shall be submitted to the Engineer for approval prior to any testing work being undertaken.

SS 2.5.3.1.29 – The Contractor shall submit an asset register as indicated in specification *RW AAM 00001 Automation Asset Management Standard Specification Rev B* for approval prior to any procurement and manufacturing

SS 2.5.3.1.30 – The Contractor shall update and submit the Asset Register as per specification *RW AAM 00001 Automation Asset Management Standard Specification Rev B* and also including the following information:

- Equipment serial number
- Equipment part number
- Equipment rating
- Equipment size
- Equipment setting

SS 2.5.3.1.31 – All communications, pamphlets and technical literature shall be in English.

SS 2.5.3.1.32 – Draft copies of the Operating & Maintenance Manuals and the Data Books shall be submitted to the Engineer for approval 4 (four) weeks before the plant is put into service. Four (4) hard copies and four (4) soft copies of the approved manuals shall be supplied to the Engineer within 4 (four) weeks of the draft copy being approved.

SS 2.5.3.1.33 – For ease of reference and handling, the documents may be divided into separate

volumes each relating to specific sections of the work.

SS 2.5.3.1.34 – After testing of the equipment, full test results with curves as applicable shall be provided for inclusion in the manual. This requirement covers works and/or site tests.

SS 2.5.3.1.35 – All data included in the manual shall be produced on standard A4 size sheet. An exception shall be made for drawings that require larger sized sheets. However, the sheets must be folded to A4 size.

SS 2.5.3.1.36 – Each document shall bear the title specified.

SS 2.5.3.1.37 – In addition to the hard-copies, all manual contents shall be provided as soft-copies on compact disks (CDs) or digital video disc (DVD) in each manual. Four (4) CDs or DVDs are to be supplied and placed in each manual.

SS 2.5.3.1.38 – Documentation shall be treated as a high priority component of the project. Rand Water requires documentation to be done in a particular way.

SS 2.5.3.1.39 – The Contractor shall provide a fully indexed, illustrated Data Book for all equipment. The Data Book shall contain all information pertaining to quality assurance, testing and certification of the plant, including the following:

- Quality assurance documentation, including signed off Quality Control Plans (QCP's)
- Instrument calibration certificates
- Flow and pressure measuring equipment calibration certificates, where applicable
- OTDR certificates for the fibre optic cable/ blown fibre optic cable installation
- Commissioning test results

SS 2.5.3.1.40 – The Contractor shall provide all PLC, HMI and SCADA software in their native format to the Engineer after final handover of the plant.

SS 2.5.3.2 – Cathedral Header

SS 2.5.3.2.1 – PLC

Sections below have the 'SS 2.5.' omitted before the number for easy of reading:

3.2.1.1 The Contractor shall put into operation two (2) latest generation PLCs complete with all modules including Profibus module and ancillary items.

3.2.1.1.1 The PLC shall have the following PLC cards:

- Central processing unit (CPU)
- Profibus module card
- Digital input card
- Analogue input card
- Power supply Module card

3.2.1.1.2 The PLCs shall be installed:

- In the Cathedral Header Control Panel kiosk as shown in RA 28785/002
- In the valve and sump pump kiosk as shown in RA 28785/001.

3.2.1.1.3 The valves on the field shall communicate in Profibus protocol.

3.2.1.1.4 The sump pump in the chamber shall communicate in Ethernet protocol.

3.2.1.1.5 The PLC shall be interfaced to the network as shown in RA 20272.

3.2.1.1.6 The PLC hardware supplied shall be the latest generation on offer by the OEM.

3.2.1.1.7 The PLC shall be supplied with a battery as specified by the supplier for the PLC selected.

3.2.1.1.8 The processors shall have an internal memory so that it can be used without any additional memory cartridge. However, they shall have a slot reserved for a removable cartridge so that the execution memory can be extended without the need for any dismantling.

3.2.1.1.9 All modules (except processor and power supply modules) shall be hot-swappable, i.e. they can be inserted and removed while powered up.

3.2.1.1.10 All modules shall have a visual display screen for identifying module and channel faults, input, output, bus device, axis, etc.

3.2.1.1.11 The modules shall be fully configurable by setting parameters in the development and runtime software. The parameters, along with comments, shall be stored in the PLC application and shall be automatically reloaded by the CPU if a module is exchanged.

3.2.1.1.12 The system shall not be affected by micro-breaks of less than 10ms.

3.2.1.1.13 It shall be possible to perform a functional update of the processor by simply downloading the firmware.

- 3.2.1.1.14 However, it shall also be possible to use a more recent version of the programming software without having to update the firmware of the processor.
- 3.2.1.1.15 The PLC rack layout shall make allowance for 20% spare capacity.
- 3.2.1.1.16 The 220V AC PLC system shall be protected by a 3 pole circuit breaker and the 24V DC PLC system by a fast blow fuse.
- 3.2.1.1.17 The PLC program shall be implemented in the manufacturer latest software.
- 3.2.1.1.18 The PLC program shall be according to RW AAM 00002.
- 3.2.1.1.19 The PLC program shall be according IEEE 61131-3.
- 3.2.1.1.20 The PLC shall be wired according to RW_00320_AS_491.
- 3.2.1.1.21 I/O cards shall have a 20% spare capacity.
- 3.2.1.1.22 A detailed software operational philosophy consisting of flow charts shall be developed according to RW AAM 00100.
- 3.2.1.1.23 The PLC shall diagnose, monitor and alarm on the isolation valves Profibus DP fiber ring, if one segment breaks, the PLC shall trigger warning on SCADA.
- 3.2.1.1.24 The Contractor shall put into operation all necessary interface requirements to allow all required field equipment to be monitored by the PLC and to allow PLC to PLC communications, PLC to HMI communications and PLC to SCADA communications; as per tender designs. This includes any special connection cables and or termination kits.
- 3.2.1.1.25 The Contractor shall put into operation all necessary components for a complete fully working system, according to the specifications. All such items shall be deemed as already priced in the bill of quantities. If these items are not explicitly listed in the bill of quantities these items shall be quantified in the tender offer.
- 3.2.1.1.26 The PLC shall conform to the following:

Table 5:

REQUIREMENTS	
Referral international standard for FDS	ISA 5.06.01
DETAILED REQUIREMENTS PLC	
CPU module requirements	IEC61131 standard
	Minimum of 64MB total non-volatile memory for Data, Program and IOs.
	Slot for removable backup

	Ethernet RJ45 ports supporting remote IOs and distributed IOs.
	Modbus TCP/IP protocol
	Ethernet IP protocol
	HART protocol
	SNMP compatible
	Embedded HTTP web server showing diagnostic and network information without compromising scan time.
	Web client shall be able to auto-update.
	RSTP on multiple port modules
	NTP server.
	Cyber security access control
	IEC61131 standard.
	IP20 rated.
	PID serial parallel loops for process control.
	Cascade loops for process control.
	Autotune for process control.
	Two actuator controllers for process control.
	Pulse Width Modulation for process control.
	Split-range for process control.
	Feed forward for process control.
	2 or 3 step controllers.
	Set Point programmer.
	Remote scanning via Modbus TCP/IP by other PLC.
	Achilles level 2 certified.
	Secured communication between Engineering Station and PLC.
	Secured communication between SCADA and PLC.
	Log security events into any database.
	Digitally signed and encrypted firmware.
	Check integrity of firmware before download and at startup.
	Ability to disable FTP/TFTP/HTTP/EIP/DHCP/BOOTP/SNMP.
	Access control list for each protocol and connected IP address.
	Authentication of operation mode (Run, Stop, Program modifications).
Communication modules	Ethernet RJ45 ports supporting remote IOs and distributed IOs.

requirements	Modbus TCP/IP protocol
	Ethernet IP protocol
	RSTP on multiple port modules
	Prioritization of traffic using QoS.
	Embedded HTTP web showing server diagnostic and network information without compromising scan time.
	Web client shall be able to auto-update.
	SNMP compatible
	IEC61131 standard.
	IP20 rated.
	In rack fiber optic converters.
	Remote scanning via Modbus TCP/IP by other PLC.
	Modbus RTU.
IO modules requirements	Hot swappable.
	Configuration automatically loaded by CPU during replacement.
	4-20mA with wire break detection alarm for analogue input channels.
	4-20mA cards shall have built in resistor.
	Minimum 10bit resolution for analogue channels.
	Minimum 0.92µA conversion resolution for analogue channels.
	Maximum 0.3% error at 25°C full scale for analogue channels.
	A display screen for discrete input cards.
	Minimum 64 IO High density 24VDC discrete cards.
	IEC61131 standard.
	Isolated channels.
	PLC Programming tool shall be used for IO channel range, calibration and filtering configurations.
	Analogue IO modules shall support HART protocol.
	IP20 rated.
Backplane	The PLC backplane shall have a minimum of 12 lots.
	The PLC backplane shall be IP20 rated.

SS 2.5.3.2.2 – Profibus Networks

Sections below have the ‘SS 2.5.’ omitted before the number for easy of reading:

Profibus Network

3.2.2.1 The Contractor shall put into operation one (1) PRM.

3.2.2.1.1 The PRM shall convert between Profibus DP copper and Modbus TCP/IP.

3.2.2.1.2 The PRM shall be installed in the Cathedral Header Control panel.

3.2.2.2 The Contractor shall put into operation two (2) OLMs (Profibus Optic Link Module) including connectors.

3.2.2.2.1 The OLM convert between electronic pulses and light pulses.

3.2.2.2.2 The OLMs shall be installed:

- In the Cathedral Header Control Panel
- In the valve and sump pump kiosk.

3.2.2.2.3 The OLM used shall be compatible with Actuators on site.

3.2.2.2.4 The OLM's shall be connected according to drawings RA 20272.

3.2.2.3 The Contractor shall put into operation complete length of Profibus cable including connectors and accessories.

3.2.2.3.1 The Profibus cable shall be according to drawing RA 20272.

3.2.2.3.2 The following minimum information shall be read from valve actuators:

- Local Selected feedback
- Auto Selected feedback
- Manual Selected feedback
- Maintenance Selected feedback
- Opened feedback
- Closed feedback
- Transition Feedback
- Healthy Feedback
- Failed to open/ Close feedback
- Faulty thermal feed back
- Faulty mains fail feedback
- Faulty Torque close feedback

- Faulty Torque open feedback
- DC fail feedback
- Potentiometer fault feedback
- Opening feedback
- Closing feedback
- Position feedback

3.2.2.3.3 The Contractor shall put into operation all ancillaries for Profibus DP.

3.2.2.3.4 The entire Profibus cable shall be installed in a galvanised steel conduit.

3.2.2.3.5 Sprague tubing shall be installed between the galvanised conduit and the instrument.

SS 2.5.3.2.3 – Fibre Optic Network - Blown Fibre Tubes

Sections below have the ‘SS 2.5.’ omitted before the number for easy of reading:

3.2.3.1 The contractor shall put into operation complete length of seven way configured fibre tubes.

3.2.3.1.1 The Profibus signals and Ethernet signals from valve and sump pump kiosk shall be interfaced to the Cathedral Header Control panel via the seven way configured fibre tubes.

3.2.3.1.2 The seven way configured fibre tubes shall be installed:

- Between fibre optic splice box in Cathedral Header Control Panel and valve and sump pump kiosk.
- Between Cathedral Header Control Panel and fibre optic splice box in Recovered Wash Water 3.

3.2.3.1.3 Installation shall be according Industrial Ethernet Network drawing no RA 20235/001.

3.2.3.1.4 The Fibre Optic cable shall comply with RW AAM 00001 Spec.

SS 2.5.3.2.4 – Category 6 STP Cable

Sections below have the ‘SS 2.5.’ omitted before the number for easy of reading:

3.2.4.1 The Contractor shall put into operation complete length of category 6 STP cable.

3.2.4.1.1 The category 6 STP cable shall be installed between:

- The PLC and Profibus Remote Master in the Cathedral Header Control Panel

3.2.4.1.2 Category 6 STP cable shall be installed according to drawing RA 20272.

SS 2.5.3.2.5 – Instrumentation cable

3.2.5.1 The contractor shall put into operation complete length of control and instrumentation wiring for sump pump signals.

3.2.5.1.1 The new instrumentation cable shall be installed:

- Between the PLC in valve and sump pump kiosk and the sump pump in the valve chamber.

3.2.5.1.2 All wiring shall be done in accordance with RW 00320_AS_491 Rev E.

3.2.5.1.3 All spare cores of cables shall be terminated.

3.2.5.1.4 All cores shall be fitted with lugs.

3.2.5.1.5 No cores shall be terminated without a lug.

3.2.5.1.6 Power circuits shall be colour coded or else shall be identified L1, L2, and L3 for red, white and blue phases respectively and black for the neutral

3.2.5.1.7 Control circuits shall be colour coded.

3.2.5.2 The Contractor shall put into operation surge protection system on instrumentation cables.

SS 2.5.3.2.6 – Power Supplies and Din Rail UPS

3.2.6.1 The Contractor shall put into operation two (2) din rail UPS.

3.2.6.1.1 The din rail UPS shall be installed:

- In the Cathedral Header Control panel galvanized kiosk.
- In the valve and sump pump galvanized kiosk.

3.2.6.1.2 The din rail UPS shall be installed as shown in drawing RA28785/001/ RA28785/002

3.2.6.2 The Contractor shall put into operation two (2) 10A, 24VDC power supplies.

3.2.6.2.1 The power supplies shall be installed:

- In the Cathedral Header Control panel galvanized kiosk.
- In the valve and sump pump galvanized kiosk.

3.2.6.3 The Contractor shall put into operation one (1) diode bridge rated at 10A.

- 3.2.6.3.1 The power supplies shall be installed as shown in drawing RA28785/001/RA28785/002.
- 3.2.6.3.2 The Contractor shall strictly adhere to manufacturer's technical specification when putting these power supplies into operation.
- 3.2.6.3.3 The following minimum specifications shall be used as a guideline:

Table 6:

CATEGORY	REQUIREMENT
Supply Voltage	230 VAC
Output Voltage	24 VDC
Power Supply	24VDC Regulated Power Supply
Current Rating	10 Amps
Circuit Breaker	Single Pole Circuit Breaker
Mounting	DIN Rail mounted in panel

- 3.2.6.3.4 The minimum specifications were not verified with calculations, hence, the Contractor shall verify with load calculations as to the best power supply to be used.
- 3.2.6.3.5 The Contractor shall strictly adhere to manufacturer's technical specifications when putting these power supplies into operation.

SS 2.5.3.2.7 – Galvanised kiosks - Control Panel

- 3.2.7.1 The Contractor shall deliver, off load, install, test, and commission two (2) galvanized kiosks from Central Depot stores to Vereeniging Pumping Station.
- 3.2.7.1.1 The first galvanized kiosk shall be installed:
- Next to the valve and sump pump chamber.
 - Next to the Cathedral header
- 3.2.7.1.2 The galvanized kiosks shall accommodate equipment such as fibre optic splice boxes, OLMs, PRM, power supplies and the PLC systems according to drawings RA 20272, RA 28785/001 AND RA 28785/002.
- 3.2.7.1.3 The Contractor shall supply and install backplanes.
- 3.2.7.1.4 The Contractor shall supply and install a fluorescent lights and door limit switches in each galvanized kiosk.
- 3.2.7.1.5 The galvanized kiosks shall consist of a shaved 3 pin plug UPS powered 230 V AC

connection.

3.2.7.1.6 Each galvanized kiosk shall consist of an anti – condensation heater.

3.2.7.1.7 The Contractor shall earth the galvanized kiosks according to SANS 10313.

3.2.7.1.8 The Contractor shall protect the galvanized kiosks against lightning according to SANS 10199.

SS 2.5.3.2.8 – Fibre Optic Splice box

3.2.8.1 The Contractor shall put into operation three (3) fibre optic splice boxes.

3.2.8.1.1 The fibre optic splice boxes shall be installed:

- In Wash Water 3 plant PLC panel.
- In the Cathedral Header Control panel
- In the Valve and sump pump kiosk

3.2.8.1.2 The fibre optic splice boxes shall be according to drawing RA 20272.

SS 2.5.3.2.9 – 150mm Heavy Duty Mesh Cable Trays

3.2.9.1 The Contractor shall allow for complete length of 150mm heavy duty mesh cable trays, complete pieces of 150mm heavy duty mesh T pieces, complete pieces of 150mm heavy duty mesh 90 degree bends, complete length of 150mm heavy duty mesh droppers, complete length of 150mm heavy duty mesh risers and complete pieces of 150mm heavy duty mesh 4 way cross overs.

3.2.9.1.1 The cable trays shall be installed in Wash Water 3 from the entry point of the fibre optic cable into the building to the patch panel junction box within the building.

3.2.9.1.2 Cable trays shall also be installed in the new valve chamber.

3.2.9.1.3 Cable trays shall be proposed on a cable tray layout design before any commencement of work.

3.2.9.1.4 Mesh cable trays shall include straight runs, T pieces, 90 degree bends, droppers, risers and 4-way crossovers.

3.2.9.1.5 Mesh cable trays shall be hot dipped galvanized mild steel

3.2.9.1.6 All supports for the mesh type cable trays shall also be provided

SS 2.5.3.2.10 – COMMISSIONING SPARES

3.2.10.1 The Contractor shall supply all commissioning spares necessary to test and commission the installation.

SS 2.5.3.2.11 – MAINTENANCE SPARES

- 3.2.11.1 The Contractor shall supply all the maintenance spares necessary to maintain the installation done for a year i.e. during the defects liability period.
- 3.2.11.1.1 The Contractor shall also supply a list of all the maintenance spares necessary to maintain the plant to Rand Water.
- 3.2.11.1.2 The Contractor shall also supply all maintenance spares as part of the contract that is listed on the recommended maintenance spares list

SS 2.5.3.2.12 – PLC Software

- 3.2.12.1 The Contractor shall develop the new PLC software.
- 3.2.12.1.1 The software development shall be done on the new PLCs in the field.
- 3.2.12.1.2 The PLC shall be programmed and configured to monitor the sump pumps and Cathedral Header valves as shown in drawing RA 20272.
- 3.2.12.1.3 The PLC program shall be implemented in the manufacturer latest software.
- 3.2.12.1.4 The PLC program shall be according to RW AAM 00002.
- 3.2.12.1.5 The PLC program shall be according IEEE 61131-3.
- 3.2.12.1.6 The PLC shall be wired according to RW_00320_AS_491.
- 3.2.12.1.7 I/O cards shall have a 20% spare capacity.
- 3.2.12.1.8 A detailed software operational philosophy consisting of flow charts shall be developed according to RW AAM 00100.

SS 2.5.3.2.13 – SCADA Software

- 3.2.13.1 The contractor shall modify, test and commission the existing Engine room 4 Orchestra based SCADA program to cater for the new Cathedral header isolation valves and sump pumps system installed.
- 3.2.13.1.1 The SCADA shall display all the equipment shown in RA 20272.
- 3.2.13.1.2 The software program shall be according to RW AAM 00002 tag naming Convention Rev C for all tag names defined.

SS 2.5.3.2.14 – Historian (Vereeniging Pumping Station)

- 3.2.14.1 The Contractor shall log all selected tags as may be directed by the Engineer into an Historian server.
- 3.2.14.1.1 The Historian server is located at Shift Supervisor's office (i.e. better known as Shifties office).

3.2.14.1.2 The Contractor shall ensure that all information from each isolation valve and sump pump including equipment's statuses is configured in the Orchestra based SCADA data base for historical purposes.

SS 2.5.4 – VERIFICATION

SS 2.5.4.1 – Detailed Design Verification and Validation

SS 2.5.4.1.1 – The Contractor shall submit detailed physical designs to Rand Water for acceptance.

SS 2.5.4.1.2 – Rand Water shall use this System Specification to verify the detailed physical designs.

SS 2.5.4.1.3 – Rand Water shall also use the project Scope of Work to validate the detailed physical design.

SS 2.5.4.1.4 – The Contractor shall submit HAZOP Study results to Rand Water for acceptance.

SS 2.5.4.2 – Factory Acceptance Test

SS 2.5.4.2.1 – Rand Water shall issue FAT SCADA software, PLC software, PLC panel and instrumentation checklists to the contractor during the first kick off meeting.

SS 2.5.4.2.2 – Each item in FAT checklists shall be signed off by both Rand Water and contractor representatives after all snags have been addressed.

SS 2.5.4.3 – Commissioning

SS 2.5.4.3.1 – The Contractor shall include at least one Rand Water representative to check all the tests done during commissioning.

SS 2.5.4.3.2 – The Contractor shall perform acceptance tests of all the instruments.

SS 2.5.4.3.3 – The Contractor shall perform acceptance tests of all the communication networks between instruments and controllers.

SS 2.5.4.3.4 – The Contractor shall perform acceptance tests of all the PLC and SCADA software logic.

SS 2.5.4.4 – Automation System Requirements Verification Index

The following table shows the Requirement Verification Index:

Requirement Verification Index

Verification Methods: <ol style="list-style-type: none"> 1. Inspection – visual and measurement inspection. 2. Demonstration – operate the item and observe its performance without the use of test equipment or instrumentation. 3. Analysis – use generally acceptable scientific and technical principles. 4. Test – use an instrument test to collect data while item is operated under certain conditions. 5. Similarity – use a similar item's prior verification and transfer verification status to present item. 	Verification Events: <ol style="list-style-type: none"> A. Detailed physical design verification and validation B. FAT C. Commissioning
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Section 3 (of Automations Specifications)	Verification Method					Verification			Section 4 (of Automation Specification)
	1	2	3	4	5	A	B	C	
3.1.1.	X	X				X	X	X	4.1, 4.2, 4.3.
3.2.1.1	X	X		X		X	X	X	4.1, 4.2; 4.3
3.2.2.1	X	X		X		X	X	X	4.1, 4.2; 4.3
3.2.2.2	X	X		X		X	X	X	4.1, 4.2; 4.3
3.2.2.3	X	X		X		X	X	X	4.1, 4.2; 4.3
3.2.3.1	X	X		X		X	X	X	4.1, 4.2, 4.3.
3.2.4.1	X	X						X	4.3.
3.2.5.1	X	X		X		X	X	X	4.1, 4.2, 4.3.
3.2.6.1	X	X		X		X	X	X	4.1, 4.2, 4.3.
3.2.6.2	X	X		X		X	X	X	4.1, 4.2; 4.3
3.2.6.3	X	X		X		X	X	X	4.1, 4.2; 4.3
3.2.7.1	X	X						X	4.3.
3.2.8.1	X	X					X	X	4.2, 4.3.
3.2.9.1	X	X					X	X	4.2, 4.3.
3.2.10.1	X							X	4.3.
3.2.11.1	X							X	4.3.
3.2.12.1	X	X				X	X	X	4.1, 4.2, 4.3.
3.2.13.1	X	X				X	X	X	4.1, 4.2, 4.3.

Requirement Verification Index									
Verification Methods: 1. Inspection – visual and measurement inspection. 2. Demonstration – operate the item and observe its performance without the use of test equipment or instrumentation. 3. Analysis – use generally acceptable scientific and technical principles. 4. Test – use an instrument test to collect data while item is operated under certain conditions. 5. Similarity – use a similar item's prior verification and transfer verification status to present item.					Verification Events: A. Detailed physical design verification and validation B. FAT C. Commissioning				
Section 3 (of Automations Specifications)	Verification Method					Verification			Section 4 (of Automation Specification)
	1	2	3	4	5	A	B	C	
3.2.14.1	X	X				X	X	X	4.1, 4.2, 4.3.

SS 2.5.5 – NOTES

SS 2.5.5.1 – Abbreviations

The following abbreviations shall be applicable:

Term	Definition
PLC	Programmable Logic Controller
SCADA	Supervisory Control And Data Acquisition
HMI	Human Machine Interface
QCP	Quality Control Plan
FAT	Factory Acceptance Test
RW	Rand Water
AAM	Automation Asset Management
EAM	Electrical Asset Management
IP	Interior Protection
V	Volts
A	Current

HAZOP	Hazard Operability
I/O	Input/output
GA	General Arrangement
P&ID	Process and Instrument Diagram
LED	Light Emitting Diode
DP	Distributed Peripheral
FBA	Factory Built Assembly
IEEE	Institute of Electrical and Electronic Engineers
IEC	International Electro technical Commission
IT	Information Technology
QoS	Quality of Service

SS 2.5.5.2 – INSPECTION OF WORKS

Section below have the prefix 'SS 2.5.' omitted from their numbering for easy of reading

- 5.2.1 The Engineer shall inspect the manufacturers, Contractors, Sub-Contractor's and any other supplier of works during manufacture.
- 5.2.2 Full information regarding the progress of manufacture shall be provided to the Engineer.
- 5.2.3 The Contractor shall make available his expertise, tools, facilities and equipment to the Engineer for examination of the work. Rand Water reserves the right to reject any item which has not been presented for such test and/or inspection
- 5.2.4 The Contractor shall produce a quality assurance report on any component within 7 (seven) days of being so requested. The method of obtaining the samples shall be decided during manufacture. The Engineer shall, if necessary make further checks on the quality of the work and require the removal of the components for tests and measurements at a place to be selected by him.
- 5.2.5 Certificates of all tests on materials and components shall be forwarded to the Engineer immediately on completion of the tests.
- 5.2.6 The Engineer, during the course of installation, shall inspect the work and every reasonable facility is to be afforded by the Contractor for such inspection.
- 5.2.7 The Engineer shall notify the Contractor in writing of any imperfect or unsound work or of any inferior material which has been supplied and the Contractor shall within 3 (three) working days, proceed to alter, reconstruct or remove such work or supply new material to the standard required by the specification.
- 5.2.8 The plant shall undergo performance tests to ensure that they comply with the specifications.

- 5.2.9 If the performance tests on site prove that the control system does not perform to the satisfaction of the Engineer, who shall be guided by the specification, then Rand Water shall reject the defective components and the Contractor shall take steps immediately to carry out such modifications as may be necessary to make the plant comply with the specification and functional requirement, or, failing this, to replace certain components of the system. Rand Water shall then carry out further acceptance tests to determine if the system complies with the specification at a cost to be borne by the Contractor.

SS 2.5.5.3 – APPENDIXES

This section is not applicable to this project.



PART 3 - SHE SPECIFICATION

Please refer to Project SHE specifications provided separately as;

Project Number: P.03341 **SPECIFICATION NUMBER:** SHER.09.08.18

And

The Basic Risk Assessment **SPECIFICATION NUMBER:** SHER09.08.18



TENDER NO. RW01491/18
TENDER FOR THE DESIGN AND CONSTRUCTION OF CATHEDRAL HEADER PIPELINE UPGRADE
AT VEREENIGING PUMPING STATION

**PART 4 - ENVIRONMENTAL MANAGEMENT PLAN ("EMP") & ENVIRONMENTAL
AUTHORISATION ("EA") (WHERE APPLICABLE)**

Please refer to the Environmental Specification on Form No.: SAM EAC 0001 Spec Rev 01



PART 5 – QUALITY SPECIFICATION

Please refer to the Quality Specification **DOC NO: SAM QA 00030 PR Rev 01**