# TECHNICAL SPECIFICATION

## ED: ROTATING BIOLOGICAL CONTACTORS

**CONTENTS**



### ED 01 SCOPE

This specification covers the requirements for maintenance work related to rotating biological contactors.

The work shall include repair of structural elements, mechanical elements, associated electrical motors, chambers and distribution systems. Repair work on rotating biological contactors shall be aimed at providing an aerobic attached growth wastewater treatment process in a perfect functional condition.

The function of rotating biological contactors shall be the introduction of oxygen into waste water, continuous biological contact to waste water and conversion of ammonia to nitrate.

Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with access to the site. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 36-month Contract period.

The Contractor shall be responsible for maintaining all aspects of the repaired process and associated equipment in a perfect functional condition.

### ED 02 STANDARD SPECIFICATIONS

#### ED 02.01 GENERAL STANDARD SPECIFICATIONS

The latest edition, including all amendments up to date of tender, of the following specifications shall be referred to in conjunction with this Technical Specification and shall be deemed to be part thereof:

SABS 1200 - Standardized specification for civil engineering construction

## ED 02 STANDARD SPECIFICATIONS

### ED 02.02 DEPARTMENT OF PUBLIC WORKS SPECIFICATIONS

PW 371 - Specification of materials and methods to be used

### ED 02.03 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

### ED 02.04 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

### ED 02.05 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

## ED 03 ADDITIONAL REQUIREMENTS

The following specific requirements shall form part of the repair work and maintenance responsibilities, but shall not limit the scope or content of the work and responsibilities.

### ED 03.01 DISTRIBUTION SYSTEM

A rotary contactor system shall be the standard for this specification. It shall consist of a series of disks mounted on a horizontal axle rotated by an electrical motor in the vertical plane.

The rotating system with its associated structural and mechanical elements shall be serviced and repaired. This shall include the following minimum tasks:

(a) Service or replace two side bearings in which horizontal axle rotates and grease both.

(b) Repair pipework and fittings and corrosion protect of all equipment and material, according to the general corrosion protection specification.

(c) Service or replace electrical motor

(d) Replace badly corroded structural elements as required and instructed by the engineer

### ED 03.02 ROTATIONAL SPEED AND DOSING RATE

The specified dosing rate shall be achieved by controlling the rotational speed of the biological contactor unit. The calculation of rotational speed and dosing rate shall be the responsibility of the Engineer, who shall provide the Contractor with the value for the required number of revolutions per minute.

## ED 03.03 DRAINAGE NETWORK

Drainage from the chamber in which the biological contactor unit is rotating shall be cleaned (and de-blocked where necessary) to ensure:

(a) Free outflow of water
(b) Removing humus that settles on the floors of the chamber.

Cleaning shall be done by use of pressurised water sprayed into the emptied chamber to remove all settled materials.

## ED 03.04 ODOURS

A well-maintained rotating biological contactor system does not smell bad. The general aroma in the vicinity of the rotating biological contactor shall be an indication of the microbiological performance. The Contractor shall control odours by maintaining the rotating biological contactor in a perfect functional condition.

## ED 04 MAINTENANCE RESPSONSIBILITIES

Maintenance shall include:

(a) Replacing of components, equipment or material;

(b) Routine checking of rotational speed;

(c) Servicing of bearings, motors and gearboxes;

(d) General corrosion protection;

(e) Maintaining an attached growth slime layer of uniform thickness by adjusting the rotational rate;

(f) Cleaning drain pipework, collection chambers and all other hydraulic structures and units.

Remuneration for the monthly maintenance of rotating biological contactors shall be deemed included in the tendered rate for ten points of the installation of which rotating biological contactors form part.

# TECHNICAL SPECIFICATION

# EE: ACTIVATED SLUDGE TREAMENT

## CONTENTS



## EE 01 SCOPE

This specification covers the requirements for repair and maintenance work related to biological reactors utilised in the activated sludge process.

The work shall include repair and maintenance of aerators, overflow weirs, equipment in nutrient removal zones, waste activated sludge equipment and general reparations to the Biological reactor structure. Repair work on activated sludge Biological reactors shall be aimed at providing an aerobic Biological treatment process in a perfect functional condition.

The activated sludge system at Beitbridge Port of Entry is a simple system consisting only of an aerated zone. A limited anoxic zone can be created by reducing the aeration to the biological reactor.

Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with access to the site. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 36-month Contract period.

The Contractor shall be responsible for maintaining all aspects of the repaired process and associated equipment in a perfect functional condition.

## EE 02 STANDARD SPECIFICATIONS

### EE 02.01 GENERAL STANDARD SPECIFICATIONS

The latest edition, including all amendments up to date of tender, of the following specifications shall be referred to in conjunction with this Technical Specification and shall be deemed to be part thereof:

SANS 1200 - Standardized specification for civil engineering construction

SANS 6049 - Water - suspended solids content, second edition, 1990

Operating manual for biological nutrient removal wastewater treatment works, WRC Report no TT83/97, 1997

Theory, design and operation of nutrient removal activated sludge processes, WRC Report no 15525, 1984

**EE 02.02 OTHER SPECIFICATIONS**

EB Wastewater pump systems
EF Sludge treatment and disposal

**EE 02.03 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

**EE 02.04 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**EE 02.05 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**EE 03 DETAIL OF REPAIR WORK**

The following specific requirements shall form part of the repair work and maintenance responsibilities, but shall not limit the scope or content of the work and responsibilities.

**EE 03.01 AERATORS**

The aeration system consists of 2 Aerzen Blowers and a fine bubble aeration system. At the time of the inspection, the system appeared to be in a good condition, with minor general maintenance items such as painting and corrosion protection of the enclosures were noticed.

**EE 03.02 OVERFLOW WEIRS**

(a) Check and level overflow weirs. Service and repair adjustable overflow weirs.

(b) Apply corrosion protection where applicable.

**EE 03.03 MISCELLANEOUS WORKS**

(a) The biological reactor basin shall be repaired structurally to ensure a safe and general good appearance.

(b) Cat walks and ladders shall be sanded and painted according to the general corrosion protection specification. It shall be secured by fixing brackets and adequate bolting where applicable.

(c) All grit shall be removed from the reactor basin.

(d) All cables shall be securely fixed in accordance with professional workmanship principles.

**EE 03.04 WASTE ACTIVATED SLUDGE SYSTEM**

(a) Wasting sludge from the biological reactor shall be the standard for this specification.

(b) Check and repair all pumps, weirs and sluices that form part of the waste activated sludge system.

(c) Check and repair all supernatant return pumps and decanting valves/sluice gates in the waste activated sludge system.

(d) Desludge sludge lagoons where applicable.

**EE 03.05 RETURN ACTIVATED SLUDGE SYSTEMS**

(a) Returning the underflow of the clarifiers at a rate of 0,5 to 1,5 of the daily flow rate shall be the standard for this specification.

(b) Check and repair all return activated sludge systems. (i.e. Hydro-static head/gravity systems, hydro-static head/pump system and pump return systems)

(c) All pipework needs to be securely fixed in accordance with professional workmanship principles.

**EE 04 MAINTENANCE REPSONSIBILITIES**

Maintenance shall include:

(a) Replacing of components, equipment or material;

(b) Routine checking of aerators and timers to maintain dissolved oxygen levels;

(c) Servicing of bearings, gearboxes and motors;

(d) Aerator shafts and discs;

(e) General corrosion protection;

(f) Cleaning outflow channels, drain pipe work, bypass pipe work, inspection manholes, collection chambers and all other hydraulic structures and units;

(g) Supernatant return from the sludge lagoon on a daily basis and maintain the return pump system.

(h) Maintain adjustable overflow weirs in biological reactors.

(i) Maintain waste activated sludge system

(j) Maintain catwalks and ladders in a safe and serviceable condition.

(k) Maintain sludge return system to ensure continuous sludge return at the correct ratio.

Remuneration for the monthly maintenance of biological trickling filters shall be deemed included in the tendered rate for ten points of the installation of which biological trickling filters form part.

**EE 05** **MEASUREMENT AND PAYMENT**

Remuneration for the monthly maintenance of activated sludge reactors shall be deemed included in the tendered rate for ten points of the entire installation of which activated sludge reactors form part.

The installation of which activated sludge reactors form part shall consists of units and services as specified in Additional Specification SA: General Maintenance, and the mechanical flow diagram.

**EE.05.01** **SUPPLY INSTALLATION OF POSITIVE DISPLACEMENT BLOWERS**
Unit: PC Sum

Remuneration shall include full compensation for supply, commissioning the units as a whole and for all costs and expenses related to labour and testing.

01. Supply, installation, testing and commissioning of blower units with three-lobe rotors and internal pulsation cancellation. Intake volumes from 30m3/hr to 15.000 m3/hr..... Unit: PC Sum
02. Profit and attendance on item .....Unit: %

**EE.05.02** **SUPPLY AND INSTALLATION OF AERATION DISCS.....Unit: No**

Remuneration shall include full compensation for supply, Installation, testing and commissioning of the units as a whole and for all costs and expenses related to labour.

**EE.05.03** **SUPPLY AND INSTALLATION OF HAND RAILS .....Unit: m**

Remuneration shall include full compensation for supply and Installation, off the rails as a whole and for all costs and expenses related to labour.

# TECHNICAL SPECIFICATION

## EF: SLUDGE TREATMENT AND DISPOSAL

### CONTENTS



### EF 01 SCOPE

This specification covers the requirements for repair and maintenance of anaerobic sludge digesters and sludge drying beds as a means of sludge treatment, as well as responsibilities for safe disposal of sludge.

The work shall include repair and maintenance of all pipework, valves, fittings, drains, channels and manholes related to anaerobic sludge digestion, sludge drying and sludge disposal.

The function of anaerobic digesters is the biological conversion of a mixture of sludge to various end products, including methane ($CH_4$) and carbon dioxide ($CO_2$) in the absence of air or oxygen. The sludge mixture may consist of primary settled (raw) sludge, scum and settled humus. A secondary function of digesters shall be gravity separation of digested sludge from supernatant liquor.

The function of sludge drying beds is dewatering of digested sludge. After drying, the sludge shall be removed and either disposed of in a landfill, or used as resource for the production of compost.

The maintenance responsibilities for sludge treatment and disposal systems shall commence on practical completion of repair work on the installation of which the sludge treatment and disposal system forms part. The Contractor shall be responsible for maintaining all aspects of the repaired process units and associated systems or services in a perfect functional condition.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

## EF 02 STANDARD SPECIFICATIONS AND ADDITIONAL SPECIFICATIONS

### EF 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

EK - Valves and sluice gates

### EF 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

### EF 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

### EF 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

## EF 03 ADDITIONAL REQUIREMENTS FOR REPAIR WORK AND MAINTENANCE

The following specific requirements shall form part of the repair work and maintenance responsibilities, but shall not limit the scope or content of the work and responsibilities.

### EF 03.01 ANAEROBIC SLUDGE DIGESTION

Anaerobic sludge digestion depends on the process microbiology to convert a mixture of sludge into various end products that include methane ($CH_4$) and carbon dioxide ($CO_2$). The process can be described as three biochemical steps:

(a) Hydrolysis involves enzyme-mediated transformation of high-molecular mass compounds into compounds suitable for use as a source of energy and cell carbon.

(b) Acidogenesis involves bacterial conversion of compounds, transformed in the first reaction, into organic fatty acids and alcohols (such as methanol) and other intermediate compounds that are more readily digested by the end users.

(c) Methanogenesis involves bacterial conversion of intermediate compounds to methane and carbon dioxide.

To maintain the process briefly described above, the "acid production stage" must not proceed faster than the gas (methane) production stage, causing the pH to drop. Although methanogenic bacteria convert acids, they cannot function in an environment with a pH of less than 6,2. The pH of the water/sludge mixture in the digester must be maintained as close as possible to neutral (pH = 7,0). Values outside the range of $6,6 < pH < 7,6$ will not be acceptable.

Alkalinity in the form of hydrated lime, $Ca(OH)_2$ may be used in anaerobic digesters to maintain a pH equal to 7.

**EF 03.02 SLUDGE MIXING MECHANISMS**

Mixing of the contents of digesters shall be aimed at increasing the rate of sludge stabilisation, preventing cementing of sludge against the digester walls and bottom and breaking up of scum layers.

Digester sludge shall be released to flow into the raw sludge pump system under influence of gravity. Mixing shall be delivered by recycling digester sludge through the digester, through the raw sludge pump system and back into the digester for a continuous period of eight hours twice a week, preferably on Fridays and Tuesdays.

**EF 03.03 DIGESTED SLUDGE WITHDRAWAL**

Digested sludge shall be withdrawn daily according to the amount of raw sludge and humus added to the digester.

**EF 03.04 SUPERNATANT LIQUOR WITHDRAWAL**

Supernatant liquor separates from digesting sludge during periods of no mixing. Supernatant liquor shall be withdrawn immediately prior to commencement of the mixing process.

Supernatant liquor shall be withdrawn by first opening the valve of the topmost withdrawal line. On withdrawing all liquor above the outlet level to the topmost line, the valve on the centre line shall be opened. On withdrawing all liquor above the outlet level to the centre line, the valve on the bottommost line shall be opened.

Opened valves shall be closed if, instead of supernatant liquor, sludge starts flowing out.

**EF 03.05 SLUDGE DRYING BEDS**

A sludge bed shall be filled with digested sludge for a period of one month. After that the sludge shall be left for three months to dewater. Dried sludge shall be removed every month from one of the sludge drying beds.

**EF 03.06 SLUDGE REMOVAL**

Sludge shall be removed once a month by the Contractor either to:

(a) the composting grounds, to be mixed with fertiliser, etc, or
(b) a commercial dumping site suited for sludge disposal.

## EF 04 OPERATING AND MAINTENANCE MANUALS

The Contractor shall at the start of the Contract be given all available as-built information and operating and maintenance manuals.

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

## EF 05 DETAIL OF REPAIR WORK

### EF 05.01 GENERAL

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

### EF 05.02 RETURN ACTIVATED SLUDGE SYSTEM

Repair work to the return sludge system shall include but not be limited to the following:

(a) Cleaning of all return pipes and channels of the return system;

(b) Reconditioning of the sluice gate and chamber of the return system.

### EF 05.03 ANAEROBIC SLUDGE DIGESTER

The complete anaerobic sludge digester shall be emptied and cleaned to ensure removal of cemented layers of sludge inside the digester.

The Contractor shall partially empty the existing maturation ponds. The Contractor shall then pump the contents of the digester into the maturation ponds. The volume of the raw sludge sump shall be emptied to the digesters prior to emptying the digester. The digester shall be emptied and cleaned within the time taken to fill the raw sludge sump with primary sludge.

The Contractor shall determine optimum rate of sludge waste.

The Contractor shall provide for the following measures:

(a) Install temporary submersible pumping equipment and pipework to empty the digester.

(b) Install temporary pipe from the discharge point of the final effluent pump line to the maturation ponds, to bypass maturation ponds when filled with digested sludge.

### EF 05.04 PIPEWORK AND VALVES

#### EF 05.04.01 Supernatant outflow pipes and valves

Remove, repair and reinstall all valves. Clean and protect all valves against corrosion. Treat exposed pipes in accordance with Technical Specification LB: General corrosion protection.

#### EF 05.04.02 Sludge drying beds inlet pipework and valves

Remove valves, dismantle, clean, replace seals, corrosion protect and reinstall gate valves at all beds. Repair hand wheel-to-spindle connection on the gate valves at all beds over and above dismantling, cleaning, replacing seals and moving parts, etc.

**EF 05.05 SLUDGE DRYING BEDS**

(a) Remove sludge around the sludge beds.

(b) Remove sludge from all sludge beds to disposal sites within the prison grounds.

(c) Remove filter sand and dispose of where indicated by the Engineer.

**EF 05.06 SUBTERRANEAN PIPEWORK AT SLUDGE DRYING BEDS**

Flush pipework by spraying water in at the pipe chamber outlets. Remove settled sludge from pipework by flushing.

**EF 05.07 FILTRATE DRAIN SYSTEM**

(a) Clean and flush the complete filtration drain system downstream of the subterranean pipework.

**EF 05.08 OUTFLOW COLLECTION CHANNEL AND PIPELINE TO CLARIFIER**

Clean and corrosion protect pipework.

## EF 06 MAINTENANCE RESPONSIBILITIES

Maintenance responsibilities shall include:

(a) All repair work;

(b) Replacing of dysfunctional components, equipment or material;

(c) Digester sludge mixing according to prescription;

(d) Digested sludge withdrawal to sludge drying beds according to mixed sludge (raw sludge, humus, scum) production and intake;

(e) Supernatant liquor withdrawal;

(f) Maintaining a neutral pH in the digester sludge;

(g) Removing dried sludge and disposal at location approved by Engineer;

(h) Corrosion protection of all components of the sludge treatment system;

(i) Any other work and rectifying measures necessary to maintain an anaerobic sludge treatment process and the dewatering of digested sludge.

Remuneration for the monthly maintenance of sludge treatment and disposal shall be deemed included in the tendered rate for ten points of the installation of which sludge treatment and disposal form part.

The installation of which sludge treatment and disposal form part shall consist of units and services as specified in Additional Specification SA: General Maintenance, and the mechanical flow diagram.

# TECHNICAL SPECIFICATION

# EG: WATER AND WASTEWATER QUALITY TESTING

## CONTENTS



## EG 01 SCOPE

This particular specification is applicable to the water quality testing by chemical analysis for both the sewage treatment works and the potable water purification works at Beitbridge Port of Entry.

The specification covers requirements for sewage effluent standards as well as potable water standards. Testing procedures and equipment to verify these standards are also covered.

## EG 02 STANDARD SPECIFICATIONS

### EG 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

| | |
|---|---|
| SANS 5667-2 | - Water quality sampling, part 2: Guidance on sampling techniques |
| SANS 5667-2 | - Water quality sampling, part 10: Guidance on sampling of wastewater. |
| SANS 5011 | - Water - pH value |
| SANS 5217 | - Water - free and saline ammonia content |
| SANS 6048 | - Water - chemical oxygen demand |
| SANS 6049 | - Water - suspended solids content |
| SANS 6057 | - Electrical conductivity of water |
| SANS 4831 | - Microbiology: General guidance for the enumeration of coliforms: Most probable number technique |
| SANS 4833 | - Microbiology: General guidance for the enumeration of coliforms: Colony count technique at 30 °C |
| SANS 241:2006 | - Drinking water |

### EG 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

### EG 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

## EG 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

## EG 03 FLOW MEASUREMENT

Flow rate shall be measured and recorded daily to populate a database of the following parameters:

(a) Total flow
(b) Maximum flow (peak flow)
(c) Minimum flow (night flow).

## EG 04 DETAIL OF WORK

### EG 04.01 GENERAL

As part of the operational responsibilities on this project the Contractor shall regularly test wastewater and effluent quality as specified in the following clauses.

Operation shall include maintaining all testing equipment, including equipment not supplied as part of the Contract, in a clean and perfect functional condition.

### EG 04.02 TEST LABORATORY

The existing buildings shall be utilised as a site laboratory. Should the Contractor require more space, it shall be provided at his cost.

### EG 04.03 TEST EQUIPMENT

The contractor shall provide for the following analytical glassware and testing apparatus as part of this Contract:

(a) Bench top pH, accurate and precise to at least 0,1 pH unit, including reference electrode and glass sensor or combination electrode;

(b) Turbidity meter.

(c) Electrical conductivity meter, with error not exceeding 1 % or 0,1 mS/m;

(d) Magnetic stirrer with PTFE (Teflon) stirring bars;

(e) 3 x 1 000 millilitre Imhoff cones with wooden rack;

(f) 2 x 500 millilitre volumetric flasks;

(g) 3 x pipettes (glass);

(h) 5 x 500ml glass beakers

(i) 2 x 1000ml plastic beakers

(j) 3 x 1000 ml graduated measuring cylinders

## EG 04.04 WASTE WATER AND POTABLE WATER QUALITY TESTING

Wastewater and potable water quality shall be tested within the first month after completion and commissioning of the sewage treatment plant and the water purification plant respectively.

See Operation Schedules for respective waste water treatment works.

## EG 04.05 SEWAGE EFFLUENT QUALITY TESTS

The final effluent of the sewage treatment plant shall comply with the general limit of the General Authorizations in terms of Section 39 of the Water Act,1998 (Act No. 36 of 1998): DISCHARGE OF WASTE OR WATER CONTAINING WASTE INTO A WATER RESOURCE THROUGH A PIPE, CANAL, SEWER OR OTHER CONDUIT; AND DISPOSING IN ANY MANNER OF WATER WHICH CONTAINS WASTE FROM, OR WHICH HAS BEEN HEATED IN, ANY INDUSTRIAL OR POWER GENERATION PROCESS

The following analysis shall be performed by an approved authority on a monthly basis on the final effluent of the sewage works.

Faecal coliforms.(per 100ml)
Chemical Oxygen demand (mg/ℓ)
pH
Ammonia as Nitrogen (mg/ℓ)
Nitrate as nitrogen (mg/ℓ)
Chlorine as free chlorine (mg/ℓ)
Suspended solids (mg/ℓ)
Electrical conductivity (mS/m)
Ortho-phosphate as phosphorus (mg/ℓ)

Provision shall be made for the full analysis as published in table 3.1 of the GENERAL AUTHORIZATIONS once during the term of the contract.

The sample shall be taken at the outflow of the last maturation pond.

## EG 04.06 MONITORING PROGRAMME FOR SEWAGE TREATMENT WORKS

Regular measurement of the quantity and quality of wastewater final effluent shall be recorded according to the requirements of Government Notice no 1191: General Authorisations in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998), 8 October 1999. Licensed works shall be monitored in accordance with the license requirements.

The Contractor shall keep a written record and report electronically on a prescribed report form of all values for the duration of the Contract, of the following wastewater discharge and relative activities:

(a) Quantity of wastewater final effluent discharged;
(b) Quality of the wastewater final effluent discharged;
(c) Detail of the monitoring programme;
(d) Detail of failures and malfunctions in the discharge system and detail of measures taken.

## EG 04.07 POTABLE WATER QUALITY TESTS

An approved testing authority shall analyse the potable water on a monthly basis as per analysis schedule in particular specification PDH. Provision shall be made for a full Physical, organoleptic, and chemical requirements analysis once during the contract period. The sample shall be submitted to the testing authority according to prescription. The water distributed to consumers shall comply with the SANS 241:2006 Specification for the standards of drinking water. Only Class 1(recommended operational limit) water shall be distributed for human consumption.

The following analysis shall be performed by an approved authority on a monthly basis on the water delivered to the consumers.

MICROBIOLOGICAL ANALYSIS OF THE WATER IN ACCORDANCE WITH THE MICROBIOLOGICAL SAFETY REQUIREMENTS ACCORDING TO THE SANS 241:2006

The following analysis shall be performed by an approved authority on a monthly basis on the water delivered to the consumers:

Turbidity (NTU)
Calcium as Ca (mg/ℓ
Chloride as $Cl^-$ (mg/ℓ)
pH value
Electrical conductivity
Dissolved solids (mg/ℓ)
Sodium as Na (mg/ℓ)
Nitrate as N (mg/ℓ)
Magnesium as Mg (mg/ℓ)
Sulfate as $SO_4^=$ (mg/ℓ)
Aluminium as Al (µg/ℓ)
Iron as Fe (µg/ℓ)
Manganese as Mn (µg/ℓ)
Dissolved organic Carbon.

## EG 05 MEASUREMENT AND PAYMENT

Remuneration for the monthly maintenance of the wastewater quality monitoring programme, maintenance of a site laboratory if necessary, laboratory equipment, testing to be performed on site during the maintenance phase as specified and record keeping system shall be deemed included in ten points for the maintenance of the installation of which wastewater quality control, measurement and testing form part.

Remuneration for all work and expenses related to water and wastewater quality tests by approved testing authorities in terms of SANS 10259 shall be paid to the Contractor as tendered for the number of tests including all water quality parameters as specified in EG.

The Contractor shall be responsible for payment of testing authorities for any tests performed by them.

# *Monthly Water Report*

## *DWAF Water Use Registration*

| Farm Name | Title Deed | Water Use | Reg No | Expiry Date |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## *DWAF Operator Registration & Classification*

| Name & ID Number | Classification & Date of Issue |
|---|---|
| | |
| | |
| | |
| | |
| | |

**Class - Works**

Bold Face & Underline= Did not comply with the Water Act

| Date | Sample Point | Flow | Microbiological | | Nitrate as N | Sulfate as $SO_4$ | Chloride as $Cl^-$ | Sodium as Na | Magnesium as Mg | Calcium as Ca | $Cl_2$ Free | Al | Fe | Mn | pH | | Turbidity | | Cond. | DOC | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | E. coli | Thermotol.coli | | | | | | | | | | | Raw | Final | Raw | Final | | | |
| | Units | $m^3$/day | col/100 ml | | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | pH Units | | NTU | | mS/m | mg/l | Matters that require attention for the proper performance of the Water Works |
| | Spec. | | n/ | n/ | <10 | <200 | <200 | <100 | <70 | <150 | | <0.1 | <0.2 | <0.1 | | | | | <150 | <10 | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |

Compiled:

Date:

Checked:

Date:

# Sewage Analysis Report

## DWAF Water Use Registration

| Farm Name | Title Deed | Water Use | Reg No. | Expiry Date |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## DWAF Operator Registration

| Name | Reg No. & Date |
|---|---|
| | |
| | |
| | |
| | |
| | |

## Class Works

Bold Face & Underline = Did not comply with the Water Act

| Spec | Sample Point | Date | Flow | $NH_3$-N | $NO_3$-N | $PO_4$-P | COD | SupSol | pH | Cond | Res $Cl_2$ | SAR | F-Coli | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Units | | $m^3$/day | mg/l | | | | | | mS/m | mg/l | | col/100 ml | |
| | Water Act: Spec A: General Limits | | | 6 | 15 | 10 | 75 | 25 | >5.5 <9.5 | DW+70 | 0.25 | | 1000 | |
| | Water Act: Spec B: Special Limits | | | 2 | 1.5 | 2.5 | 30 | 10 | >5.5 <7.5 | DW+50 <100 | 0 | | 0 | |
| | Water Act: Spec C: Irrigation Limits(up to 500$m^3$/day | | | | | | 400 | | >6.0 <9.0 | <200 | | <5 | 100 000 | Matters that require attention for the proper performance of the Water Works |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

Compiled:

Date:

Checked:

Date:

# TECHNICAL SPECIFICATION

# EK: VALVES AND SLUICE GATES FOR WATER AND WASTEWATER TREATMENT PLANTS

## CONTENTS



## EK 01 SCOPE

This specification covers the maintenance, as well as the supply, delivery, installation, testing and commissioning of manual valves and sluice gates.

This specification shall form an integral part of the maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

## EK 02 STANDARD SPECIFICATIONS

### EK 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

SANS 1123 - Steel pipe flanges
SANS 664 - Cast-iron gate valves for water works.

### EK 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

### EK 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

## EK 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

## EK 03 ADDITIONAL REQUIREMENTS

## EK 03.01 INSTALLATION AND HAND WHEELS

Valves shall be installed in positions as shown on the relevant drawings, process flow diagrams and as specified in Clause EK 05 (Detail of work) of this specification.

Where applicable, the spindles or wheels of valves shall clearly indicate the direction of closure, which shall be clockwise when viewing the valve from and along the valve spindle axis.

## EK 03.02 GATE VALVES

Gate valves shall have non-rising spindles, or rising spindles, as specified in Clause EK 05 (Detail of work).

Each gate valve shall comply with the following specifications:

(a) Each valve shall be a resilient seal gate valve in accordance with SANS 664.

(b) Each valve shall be designed to facilitate maintenance without the body of the valve having to be removed from the line.

(c) Each valve shall be double flanged, with the flange drilling being in accordance with SANS 1123.

(d) Each valve shall be resistant to the corrosive environment in which it has to operate.

The materials to be used in the manufacture of each valve in pipelines (with diameters exceeding 100 mm) for the conveyance of water and sewage are the following:

| Component | Material |
|---|---|
| Body | Cast iron |
| Bonnet | Cast iron |
| Gate | Cast iron |
| Bridge | Carbon steel |
| Gland | Carbon steel |
| Spindle | Stainless steel 304 |
| Gate seals | Neoprene |
| Gate studs | Stainless steel 304 |
| Gate nuts | Stainless steel 304 |
| Gland packing | Graphite asbestos |
| Gaskets | Rubber |

## EK 03.03 SLUICE GATES

The frames, spindles, spindle braces and gates of all sluice gates shall be manufactured from stainless steel 304, unless otherwise specified.

All gates shall be guided by rigid guide rails. The gates shall be held uniformly against the side facings of the frames by the action of adjustable wedges and shall provide drop-tight closure under the specified conditions.

All channel sluice gates shall be of the level invert type fitted with renewable seals of a non-biodegradable material on the invert.

All sluice gates to be supplied shall be hand-operated and shall be supplied with clockwise closing hand wheels. If rising spindles are to be used, the rising spindles shall be protected by suitable sleeves which provide convenient visual inspection and greasing facilities.

Hand wheels shall be of cast iron with diameters to suit operating either directly on the head frame or on a stainless steel (grade 304) tubular pedestal to suit the installation depth. Where necessitated by the mass of the gate and/or the pressure against the gate, suitable gearing shall be provided so as to facilitate the operation.

All parts shall be designed with a minimum factor of safety against structural failure of not less than 3,0 based on the working stresses of the material. In the design due consideration shall be given to the thickness of materials with regard to corrosion and operating conditions.

The sluice gates shall be designed with suitable stiffeners to prevent the gates from deforming or buckling on account of unbalanced pressures acting on the sluice gates.

All channel sluice gates shall be designed for an unbalanced water pressure caused by a water column of twice the height of the gate.

The maximum force required at a hand wheel or crank to raise a gate or open a valve shall not exceed 100 N.

The Contractor shall supply the Engineer with all information regarding cavities to be left in the channel floors and walls and all the details concerning holding-down bolts or any other information relating to details of installation in civil structures to be constructed.

The Contractor shall be responsible for all handling, installation and grouting of the sluice gates and shall carry out all necessary adjustments to ensure proper and smooth operation.

## EK 03.04 NON-RETURN VALVES

(a) Non-return valves shall be full bore valves with swing gates.

(b) Non-return valves shall be flanged into a pipeline.

(c) Non-return valves shall be manufactured from materials suitable for use in corrosive environments. Bodies shall be manufactured from cast iron. Swing gates shall be manufactured from stainless steel.

(d) Swing gates shall rotate freely, but shall close drip-tight under return pressure.

**EK 03.05** **CORROSION PROTECTION**

Corrosion protection shall be in accordance with Technical Specification AC: Paintwork and the Contractor shall ensure that all new, serviced or reconditioned units are fit for operation in the relevant environment.

**EK 04** **OPERATING AND MAINTENANCE MANUALS**

The Contractor shall at the start of the Contract be given all available as-built information and operating and maintenance manuals.

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

**EK 05** **DETAIL OF WORK**

The Engineer will demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

The work to be done regarding valves and sluice gates is shown below.

Decommission and remove valves and sluice gates

Recondition/servicing gate valves or sluice gates. Paint valves with high gloss enamel paint. For preparation work see AC, prepare according to condition of the metal.

Installation, testing and commissioning of valves or sluice gates

**EK 06** **MAINTENANCE**

All valves and sluice gates forming part of wastewater treatment installations shall be maintained from the date of practical completion of the installation of which they form part, until the end of the Contract.

Maintenance shall include all repair work, replacing of components, fixing leaks, routine settings (of flow rates, etc), corrosion protection and all other actions necessary to maintain valves and sluice gates in a perfect functional condition.

Remuneration for maintenance of valves and sluice gates shall be deemed included in the tendered rate for ten points for the monthly maintenance of the installation of which valves and sluice gates form part.

**EK 07** **MEASUREMENT AND PAYMENT**

**EK07.01** **SUPPLY AND DELIVERY OF GATE VALVES, AIR RELEASE VALVES, NON-RETURN VALVES AND SLUICE GATES** ..... Unit: number

The unit of measurement shall be the number of manually or electrically actuated valves, air release valves or sluice gates supplied.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage or on the site, etc, as well as all royalties, patent rights, etc, for the valves or sluice gates complete with headstock, seals, guide rails, frame, etc, as specified.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

**EK07.02** **INSTALLATION, TESTING AND COMMISSIONING OF GATE VALVES, AIR RELEASE VALVES, NON-RETURN VALVES AND SLUICE GATES** .. Unit: number

The unit of measurement shall be the number of valves or sluice gates installed.

The tendered rates shall include full compensation for the installation, making good all the damaged corrosion-protected areas, testing, calibration, commissioning and maintenance of the valves or sluice gates and for all other costs and actions necessitated to obtain a complete and efficiently working system.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

**EK07.03** **SERVICE GATE VALVES, AIR RELEASE VALVES, NON-RETURN VALVES AND SLUICE GATES**..... Unit: number

The unit of measurement shall be the number of gate valves, non-return valves or sluice gates serviced.

The tendered rate shall include full compensation for cleaning, removing rust, removing dried sludge or other solids from surfaces and moving parts, proper greasing of all moving parts, preparation for corrosion protection coating and painting of gate valves or sluice gates.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

**EK07.04** **RECONDITION GATE VALVES, AIR RELEASE VALVES, NON-RETURN VALVES AND SLUICE GATES** ..... Unit: number

The unit of measurement shall be the number of gate valves or sluice gates reconditioned.

The tendered rate shall include full compensation for cleaning, removing rust, removing dried sludge or other solids from surfaces and moving parts, replacing components such as spindles, hand wheels or gates, replacing or repair of seals, proper greasing of all moving parts, preparation for corrosion protection, painting or any other action or cost necessitated to recondition a gate valve or sluice gate to a perfect functional condition.

Items will be listed in the Schedule of Quantities for different types and sizes of equipment.

**EK07.05** **DECOMMISSION AND REMOVE GATE VALVES, AIR RELEASE VALVES, NON-RETURN VALVES AND SLUICE GATES**..... Unit: number

The unit of measurement shall be the number of valves or sluice gates decommissioned and removed.

The tendered rate shall include full compensation for all labour and equipment required to decommission and remove values or sluice gates, such as installation of temporary spades or blank flanges, maintaining existing liquid volumes, loosening and removal of bolts and nuts, or any other action required.

Separate items will be scheduled in the Schedule of Quantities for different types and sizes of valves or sluice gates.

## TECHNICAL SPECIFICATION

# EM: OPERATION OF WASTEWATER WORKS

## CONTENTS



## EM 01 SCOPE

Wastewater works shall mean all units, components, equipment and materials, and their relation to each other, employed to enable reliable and effective wastewater treatment.

This specification covers the operation of a wastewater works and equipment related to effective wastewater treatment.

The Contractor shall manage and operate the wastewater works in accordance with the prescriptions in this specification, the relevant operation and maintenance manuals and Additional Specification SF. Operation duties shall generally refer to all tasks and actions required to operate the process units and components of the following wastewater works and shall include (among others):

**TABLE 1 : PROCESS UNITS FOR TYPICAL DPW SYSTEM TYPES**

| Septic Tanks System | Oxidation Pond system | Rotating Bio-contactor (RBC) System | Biological Filtration System | Activated Sludge System |
|---|---|---|---|---|
| Septic tank(s) | Inlet works: Screening & degritting | Inlet works: Screening & degritting | Inlet works: Screening, degritting, flow measuring | Inlet works: Screening, degritting, flow measuring |
| French drain(s) | Floating solids trap | Septic tank(s) | Peak flow cut-off & storage/ balancing tank | Peak flow cut-off & storage/balancing tank |
| | Oxidation ponds: primary & secondary | Biological reactor(s): rotating discs | Pump station(s) | Biological reactor(s): completely mixed, oxidation ditch, sequencing batch, multiple tanks. |
| | Surface aerator(s) | Humus tank(s) | Flow regulating facilities | Aerator(s): Vertical axis surface, horizontal axis surface, course/fine bubble |
| | Re-circulation facilities | Flow regulating facilities | Primary settling tank(s) | Waste activated sludge (WAS) facilities |
| | Flow measuring facilities | Flow measuring facilities | Bio filter(s) | Flow regulating facilities |
| | On site burial facility: grit & screenings | Maturation pond(s) | Humus tank(s) (Secondary settling tank SST) | Return activated sludge (RAS) facilities |

| | | | | |
|---|---|---|---|---|
| | | Reed bed(s) | Chemical phosphate removal facilities | Clarifier(s) (Secondary settling tank – SST) |
| | | Sludge drying beds | Chlorine dosing & contact facilities | Chemical phosphate removal facilities |
| | | On site burial facility: Grit & screenings | Flow measuring facilities | Biological nutrient removal facilities |
| | | Sludge disposal facilities: Burial, lagoon storage, composting, co-disposal export | Maturation pond(s) | Chlorine dosing & contact facilities |
| | | | Anaerobic digester(s) | Flow measuring facilities |
| | | | Sludge drying beds | Maturation pond(s) |
| | | | On site burial facility: Grit & screenings | Sludge drying beds |
| | | | Sludge disposal facilities: Burial, lagoon storage, composting, co-disposal, export | On site burial facility: Grit & screenings |
| | | | | Sludge disposal facilities: Burial, lagoon storage, composting, co-disposal, export |

This specification covers requirements for effluent standards, as well as testing procedures and equipment to verify these standards.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with Portion 3: Additional Specifications included in this document.

Assessment of the following design parameters is a prerequisite for proper operation of the wastewater works:

**TABLE 2 : KEY DESIGN PARAMETERS FOR PROCESSES AND UNITS**

**NOTE:** Acknowledged guidelines must be used for design & construction, e.g. WISA, 1988: Manual on the Design of Small Sewage Works

| **Septic Tanks System** | **Oxidation Pond system** | **Rotating Bio-contactor (RBC) System** | **Biological Filtration System** | **Activated Sludge System** |
|---|---|---|---|---|
| Population served | Population served & per capita organic loads | Population served & per capita organic loads | Population served & per capita organic loads | Population served & per capita organic loads |
| Hydraulic retention time (combined building drainage system) | Average & peek dry & wet weather flow rates | Average & peak dry & wet weather flow rates | Average & peak dry & wet weather flow rates | Average & peak dry & wet weather flow rates |

| | | | | |
|---|---|---|---|---|
| Sludge retention time | Hydraulic & organic loading rates | Hydraulic & organic loading rates | Hydraulic, organic & nutrient loading rates per surface area & bed volume | Hydraulic, organic & nutrient loading rates |
| Desludging frequency | Hydraulic retention time | Septic tank capacity & desludging frequency | Type, size, volume, void ratio & depth of filter media | Sludge age (20 – 30 days) & solids loading rate |
| Type & permeability of subsoil | Availability of land for ponds & for effluent disposal by irrigation | Wetted surface area: Number, size, spacing & submersion depth of discs | Aeration rate of filter media | Active sludge mass & density |
| | Suitability of climatic conditions | Hydraulic retention time | Dosing rate of flow distribution assembly | Hydraulic control of sludge mass (by wasting of sludge from reactor): WAS rate – volume of reactor/sludge age |
| | Proximity to residential areas (Odours) | Rotational speed of discs | Rotational speed of flow distribution assembly | Sludge age required for nitrification |
| | | Geometry & surface loading rates of humus tanks & appurtenances | Geometry & surface loading rates of TSTs, humus tanks & appurtenances | Return flow rate of activated sludge (1.5 – 2.5 x influent flow rate) |
| | | Sludge & effluent return flow rates | Effluent return flow rates | Oxygen requirements, type & capacity if aeration equipment, control of aeration rate |
| | | | Geometry & hydraulic retention time of anaerobic digester & appurtenances | Surface and solids flux loading rates of clarifier (sludge volume index) |
| | | | | Additional reactor volume & anaerobic/anoxic zones required for biological nutrient removal |

## EM 02 STANDARD SPECIFICATIONS AND REGULATIONS

### EM 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof.

| | | |
|---|---|---|
| SANS 1200 | - | Standardised specification for civil engineering construction |
| SANS 5667-2 | - | Water quality sampling, part 2: Guidance on sampling techniques |
| SANS 5667-2 | - | Water quality sampling, part 10: Guidance on sampling of wastewater (when available) |
| SANS 5011 | - | Water – PH value |
| SANS 5217 | - | Water – free and saline ammonia content |
| SANS 6048 | - | Water – chemical oxygen demand |
| SANS 6049 | - | Water – suspended solids content |
| SANS 6057 | - | Electrical conductivity of water |
| SANS 4831 | - | Microbiology: General guidance for the enumeration of coliforms: Most probable number technique |
| SANS 4833 | - | Microbiology: General guidance for the enumeration of coliforms: Colony count technique at 30°C |

**EM 02.02** **OTHER SPECIFICATIONS**

The following Technical Specifications for repair and maintenance of wastewater process units shall be read in conjunction with this specification and shall be deemed to form part thereof:

EA Wastewater inlet works
EB Wastewater pump systems
EC Sedimentation tanks
ED Rotating biological contactor
EE Activated sludge works
EF Sludge treatment and disposal
EG Water and wastewater quality testing
EK Valves and sluice gates for water and wastewater
EQ Reed beds

**EM 02.03** **ACTS, REGULATIONS AND STATUTORY REQUIREMENTS**

All relevant regulations and statutory requirements as laid down in the latest edition of the following acts shall be adhered to:

- Occupational Health and Safety Act, 1993: Construction Regulations, 2003 as promulgated in Government Gazette No. 25207 and Regulation Gazette No. 7721 of 18 July 2003
- National Water Act (No. 36 of 1998)
- Water Services Act (No. 108 of 1997)
- Environment Conservation Act (No. 73 of 1989)
- National Environmental Management Act (No. 107 of 1998)

## EM 02.04 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

## EM 02.05 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

# EM 03 LEGAL AND GENERAL REQUIREMENTS

## EM 03.01 DEFINITION OF WATER USE

A water use must be licensed unless it is:

Listed in Schedule 1 (See page 152 of Government Gazette No. 19182 dated 26 August 1998)

An existing lawful use.

Permissible under a general authorisation (See Government Gazette No. 20526 dated 8 October 1999)

The responsible authority can waive the need for a license.

This specification covers the legal requirements for water use as regulated by the National Water Act (No. 36 of 1998). The following categories of water use are scheduled:

Taking of water and storage of water (Section 2 (a) and (b)) of the Water Act.

Engaging in a controlled activity, identified as such in Section 37 (1) of the Water Act. Irrigation of any land with waste or water containing waste generated through any industrial activity or by a water works (Section 21 (e) of the Water Act).

Discharging of waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit, and disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generating process.

Disposing of waste in a manner which may detrimentally impact a water resource (Section 28 of the Water Act).

## EM 03.02 OPERATOR REGISTRATION AND CLASSIFICATION OF WATER CARE WORKS

In the terms of Section 26 (f) of the Water Act (No. 36 of 1988) operators shall be registered with the Department of Water Affairs. The Contractor shall be responsible for the registration of workers/operators in terms of this requirement (See Regulation R2834 dated 27 December 1985). The water care works will be classified by the Engineer for tendering purposes.

Draft regulations regarding the registration of waterworks and process controllers in terms of section 116 of the National Water Act, 1998 was published in Regulation Gazette No. 8411 dated 24 February 2006 and tenderers shall familiarize themselves with the progress regarding the promulgation of the new regulations.

The preliminary classification of the Wastewater Treatment Works is Class D

- Required operator class 2 and 0 per shift.
- Class 3 supervisor
- Class V weekly supervision

## EM 03.03 COMPILATION OF A BASIC ASSESSMENT REPORT

In terms of the National Environmental Management: Waste Act, 2008 (Act 59 of 2008) a Basic Assessment process must be conducted as part of a waste management license application for the treatment of effluent, wastewater or sewage with an annual through put capacity of more than 2 000 $m^3$ but less than 15 000 $m^3$. The expansion of such facilities, which requires an amendment of the existing license, will also require that a Basic Assessment must be conducted.

The activities involved are published in Government Notice No 718 dated 3 July 2009 under Category A of the Notice.

## EM 03.04 ENVIRONMENTAL IMPACT ASSESSESSMENT REPORT (EIAR)

In terms of the National Environmental Management: Waste Act, 2008 (Act 59 of 2008) an Environmental Impact Assessment process must be conducted as part of a waste management license application for the treatment of sewage, effluent or wastewater with an annual throughput capacity of 15 000 $m^3$ or more.

The construction and expansion of these facilities will also require that an Environmental Impact Assessment must be conducted. The activities involved are published under Category B of Government Notice No 718 dated 3 July 2009.

## EM 03.05 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

An Environmental Management Plan (EMP) is required for all repair work that may generate waste (such as sewage sludge) or that may detrimentally impact the environment during repair and operation of the water care works.

The Contractor shall prepare and submit an EMP to the Department of Public Works' project manager. His approval is not required, but the EMP should guide repair work so as to safeguard the environment from detrimental impact. The Contractor shall make provision in his tendered rates for all costs implied by the EMP.

# EM 04 OPERATION

## EM 04.01 GENERAL

Operation shall include all activities and all other actions or rectifying measures necessary for optimal operation of water care works.

Remuneration for operation of the complete water works shall be deemed included in ten points for the tendered rate of monthly payment of operation of the works.

## EM 04.02 GENERAL DESCRIPTION OF THE WASTEWATER TREATMENT WORKS

### EM 04.02.01 BEIDBRIDGE PORT OF ENTRY

Raw sewage flows under gravity from the residential area to the inlet works. Raw sewage generated in the low-lying areas is collected at a pump station from where it is pumped to the inlet works.

At the inlet works inorganic suspended solids are removed by hand raked screens, detritus channels and a rag catcher.

The sewage then flows into the activated sludge plant consisting of a biological reactor with fine bubble aeration and a secondary settling tank (SST). The sludge from the SST is returned to the biological reactor by means of the RAS pumps. The supernatant of the SST flows to the Reed beds for final treatment, where after it is disinfected by chlorination with calcium hypochlorite.

Waste activated sludge (WAS) is withdrawn from the biological reactor or from the under flow from the SST. It is preferred that the WAS is withdrawn from the biological reactor to enable the preferential withdrawal of the scum and filamentous organisms from the system. The sludge is treated in an anaerobic basin, from which the supernatant is returned to the biological reactor, while the digested sludge is pumped to the sludge drying beds.

The final effluent flows from the reed beds and a chlorine contact chamber into the environment and finally into the Limpopo river.

## EM 04.03 PREPARATORY OPERATIONAL TASKS

The preparatory tasks to be executed shall include, but shall not be limited to the items listed in the table below:

| EM 04.02 | PREPARATORY OPERATIONAL TASKS |
|---|---|
| 01 | Satisfy legal and general requirements. |
| 02 | Draft inventories of process units, components, materials, etc. |
| 03 | Draft process flow diagrams. |
| 04 | Derive from available information the design capacity and current load of the works. |
| 05 | Assess compliance with relevant design parameters to enable optimal operation of the plant according to its original functionality. |
| 06 | Draft plant-specific Operation and Maintenance manuals. |
| 07 | Institute required safety measures. |
| 08 | Draft template logbook. |
| 09 | Draft water balance of water and wastewater system. |

## EM 04.04 GENERAL OPERATION WORK

General operation of the water care works shall be done in accordance with this specification, with Additional Specification SF: General Operations and with the Particular Specification related to this work.
Remuneration for the monthly operation of an installation is determined by a ten point per month scoring system (refer to score card in Technical Specification SF: General Operation of an Installation).

The Contractor shall ensure that the plant is operational for 24 hours a day for 7 day a week and shall ensure at least one night watchman that has been trained and is knowledgeable of the plant's operational procedures as well as the setting of mechanical equipment.

The scoring system includes but is not limited to the following operational parameters:

| EM 04.03 | GENERAL OPERATION WORK | FREQUENCY |
|---|---|---|
| 01 | General housekeeping: Keep site in neat and acceptable condition. | Daily |
| 02 | Control access to the site. | Daily |
| 03 | Maintain safety conditions on site. | Daily |
| 04 | Log and report spills, pollution events, power failures, extraordinary process phenomena, etc. Check auto-reset of power to mechanical equipment. | Event |
| 05 | Calibrate and set flow measuring to ensure equalised hydraulic loading rates on downstream process units. | Yearly |
| 06 | Calibrate and set flow measuring equipment to ensure accurate flow data. | 6 Months |
| 07 | Calibrate and set peak wet weather flow cut-off weirs at inlet works. | Yearly |
| 08 | Synchronise, by means of mathematical modelling and measurement, process units in integrated systems with recycling (such as activated sludge systems) and make adjustments where necessary. | 6 Months |
| 09 | Develop a feel for effective treatment by means of visual indicators of good/bad plant performance: Colour, odour, foam, algae growth, aerator spray patterns, effluent clarity, bubbles, floating material, solids accumulation, flow patterns, turbulence, touch. | Daily |
| 10 | Record operating hours and kW-hours of all mechanical equipment. | Daily |
| 11 | Check operation of all valves and sluices. | Monthly |
| 12 | Wastewater quality control analysis by an approved authority. | Daily |
| 13 | Quality monitoring programme and record keeping and reporting system. | Daily |
| 14 | Operation of a site laboratory. | Daily |
| 15 | Tests performed on site to evaluate component performance. | Daily |
| 16 | Supply of all chemicals necessary for the operation of the plant. | Daily |
| 17 | Workers, operators and supervisors. | Daily |
| 18 | Tools and equipment and laboratory equipment for operational needs | Daily |
| 19 | Compliance with the required effluent standard subject to the Engineer's discretion. | Daily |
| 20 | Operation of the entire plant to its optimum capacity. | 24 hours per day |

## EM 04.05 OPERATION OF SPECIFIC PROCESSES AND UNITS

Operation of specific processes, units and components of the water care works shall be done in accordance with this specification, with Additional Specification SF: General Operations and with the Particular Specification related to this work.

The specific operation work to be performed and executed shall include, but shall not be limited to the items listed in the table below.

| | | OPERATION OF SPECIFIC PROCESSES AND UNITS | FREQUENCY |
|---|---|---|---|
| 01 | | **Inlet works** | |
| | 01 | Hand-raked screens: Remove screenings (rags, plastics, etc), ensuring that only degradable material is passed on to subsequent process units, last removal after evening peak flow | 2 hours during day |
| | 02 | Alternate flow through degritting channels and remove grit from isolated channel | Daily |
| | 03 | Dispose of screenings and grit by on-site burial | Daily |
| | 04 | Measure and log pH | Daily |
| 02 | | **Re-circulation facilities** | |
| | 01 | Check whether pumps are operating | Hourly |
| | 02 | Check return flow rates | Monthly |
| 03 | | **Flow measuring facilities** | |
| | 01 | Check whether measuring facilities are operating: Level sensor, integrating flow meter, data logger | Daily |
| | 02 | Keep flume/weir and stilling chamber free of floating/settling material | Daily |
| | 03 | At flumes/weirs where continuous recording equipment is not available, measure and record flow depth and time daily at visually observed peak flows, and at least once per month at minimum night flow | Daily |
| 04 | | **On-site burial of solids** | |
| | 01 | Ensure daily covering with soil of disposed material | Daily |
| | 02 | Attend to nuisance conditions at disposal site | Event |
| 05 | | **Biological Reactor** | |
| | 01 | Check whether aerators are operating | Hourly |
| | 02 | Check whether return flow pumps are operating | Hourly |
| | 03 | Measure and record return flow rate | Monthly |
| | 04 | Measure MLSS | Weekly |
| | 05 | Remove scum and clean overflow weir | Daily |
| | 06 | Control and record WAS withdrawal | Daily |
| 06 | | **Secondary settling tanks.** | |
| | 01 | Scour settling tank and check for clumps of floating sludge | Daily |
| | 02 | Remove scum and clean overflow weirs and launders | Daily |
| | 03 | Clean submerged portion of settling tank walls by pushing settled sludge on inclined surfaces down to the apex of the cone | Monthly |
| 07 | | **Flow regulating facilities** | |
| | 01 | Keep flow-routing chambers free of accumulating solids. | Daily |
| 08 | | **Pump stations** | |
| | 01 | Check operation and correct switching of pumps. | Daily |

| | | | |
|---|---|---|---|
| | 02 | Clean pump sumps. | Weekly |
| 09 | | **Disinfection** | |
| | 01 | Check operation of chlorination facilities. | Daily |
| | 02 | Clean chlorine contact tank. | Monthly |
| | 03 | Measure and Log Total Chlorine | Daily |
| 10 | | **Effluent disposal facilities** | |
| | 01 | Ensure erosion free discharge to receiving water body. | Monthly |
| | 02 | Measure and log quality of treated effluent | weekly |
| 11 | | **Power supply** | |
| | 01 | Check operation of stand-by generator where applicable. | Weekly |

**EM 04.06** **CHEMICALS**

The Contractor shall be required to supply all chemicals used in treatment of wastewater as instructed by the Engineer. The Contractor shall include the cost for chemicals in the ten points per month for the operation of an installation.

A chemicals logbook shall be supplied by the Contractor to record the use of chemicals. The logbook shall be completed with every test and shall include the following information:

(a) Date
(b) Name of testing official
(c) Test performed
(d) Chemical used
(e) Amount used (weight).

The Contractor shall be liable to replace any unaccounted for chemicals at his own cost.

**EM 04.07** **MONITORING AND REPORTING**

The contractor shall keep a written record of all measurements taken and analyses done for process control and for reporting to relevant authorities in terms of legal or project management requirements.

A logbook shall be kept for daily recording of failures, malfunctions, spills, pollution events, power failures and detail of measures taken.

The monitoring programme for the above measurements and analyses shall include, but shall not be limited to the items listed in the table below.

**EM 05** **PAYMENT ITEMS**

**EM.05.01** **Pump out of sludge into a suitable waste containment vehicle for transportation**.....Unit: cubic metre ($m^3$)

The unit of measurement shall be the cubic metre of sludge pumped, multiplied by the distance (one-way) in kilometre.

The tendered rates shall include full compensation for all components, materials, tools, transport, site handling and labour necessary for the complete pumping, removal and disposal of the sludge.

The Contractor shall be required to provide a certificate of the disposed sludge as proof from the registered treatment plant indicated by the Engineer.

The waste containment vehicle shall be a commercially registered waste containment vehicle capable of handling no less than $10m^3$ at a time.

**EM.05.02** **Disposing of sludge at a registered commercial source on the instruction of the Engineer/Department's representatives** ..... Unit: cubic metre – kilometre ($m^3$-km)

The unit of measurement shall be the cubic meter load of sludge multiplied with the number of kilometres travelled (one way trip) to the commercial source approved by the Engineer.

The tendered rate shall include full compensation for the labour, materials and equipment needed to transport sludge to a registered wastewater treatment works indicated by the Engineer.

The tendered rate shall include, value related as well as all time related preliminary and general charges, the operation and maintenance cost of the suitable commercial waste containment vehicle and the remuneration costs of the driver and workers.

The tendered rate shall include full compensation to the sludge receiving facility for the disposal of the sludge.

The Contractor shall be required to provide a certificate of the disposed sludge as proof from the registered treatment plant indicated by the Engineer.

**EM.05.03** **Water use licence Audit (Wastewater)**

The unit of measurement shall be the sum rate for conducting all works describe hereunder by a qualified aquatic scientist (Pr. Sci. Nat) on a once off basis to be carried out within 3 months post site handover.

The tendered rate shall include full compensation for the labour, materials, equipment and reporting needed. The audit shall include the following:

a) Site specific long-term Bio-monitoring program establishment

b) Monitoring program for aquatic macro-invertebrates and habitat integrity

c) Plant process audit

d) Risk abatement plan

**EM.05.03** **Water User Association membership**

**TABLE 3: MONITORING PROGRAMME: FREQUENCY OF MEASUREMENTS AND ANALYSES**

| System | Sampling point | On-site measurements | | | | | | Chemical analyses (grab sampling) | | | | | | | | | | | Chemical analyses (composite sampling) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Temp | pH | Flow rate | SVI | DO | Sludge depth | COD | SS | VSS | $NH_3$ | $NO_3$ | TKN | $PO_4$ | DO | Alkal-inity | EC | F.coli | COD | SS | $NH_3$ | $PO_4$ |
| Rotating bio contactor (RBC) | ST Inlet | - | day | daily peaks | - | - | month | month | month | month | - | - | month | month | month | month | - | - | - | - | - | - |
| | Septic tank | - | - | - | - | - | month | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Reactor outlet | - | day | - | day | - | - | month | month | - | - | - | - | - | month | - | - | - | - | - | - | - |
| | Humus tank overflow | - | - | - | - | - | - | month | month | - | month | month | - | - | - | - | - | - | - | - | - | - |
| | Humus tank underflow | - | - | monthly at daily peak | - | - | - | - | month | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Maturation pond outlet | - | day | - | - | - | - | month | month | - | month | month | - | month | - | month | month | month | - | - | - | - |
| Activated sludge system | Reactor inlet | - | day | daily continuous | - | day | - | month | month | month | month | - | 6 months | month | - | month | month | - | year | year | year | year |
| | Reactor | - | day | - | day | day | - | month | month | month | month | - | - | - | - | month | - | - | - | - | - | - |
| | Clarifier overflow | - | - | - | - | day | - | month | month | - | month | month | - | - | - | month | - | - | - | - | - | - |
| | Clarifier underflow | - | - | monthly at daily peak | - | - | - | - | month | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Maturation pond outlet | - | day | - | - | - | - | month | month | - | month | month | - | month | - | - | month | month | year | year | year | year |

## TECHNICAL SPECIFICATION

# EQ: REED BEDS

## CONTENTS



## EQ 01 SCOPE

This specification covers the requirements for the maintenance responsibilities for reed beds which are used as tertiary treatment components for clarifier effluent at wastewater treatment works.

Reed beds as part of a wastewater works is used for polishing of final effluent as part of the whole process of chemical oxygen demand reduction and nutrient removal to a lesser extend but mainly for suspended solids removal and the improvement of the bacteriological quality of the effluent.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

## EQ 02 STANDARD SPECIFICATIONS AND ADDITIONAL SPECIFICATIONS AND REQUIREMENTS

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

### EQ 02.01 GENERAL STANDARD SPECIFICATION

Reed beds are usually earth structures with HDPE linings and concrete in and out flow structures, to which the following specification shall apply:

SANS 1200 Standardized Specification for civil engineering construction.

### EQ 02.02 ADDITIONAL REQUIREMENTS

The out flow structure shall be a single pipe out flow mounted on a swivel so the the height of the water in the reed bed can be adjusted according to operational instructions.

The earth walls of the reed beds shall be cared for not to be overgrown by natural vegetation and all shrubs, bushes and trees shall be removed before they can cause any damage to the walls. Natural grass on the outer surface of the walls need not to be removed but shall be cut regularly and shall not be allowed to grow to a length that exceeds 100 mm. Natural grass and weeds shall not be allowed to grow onto the surface of the reed beds and it shall be removed regularly.

**EQ 02.03** **OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993: Construction Regulation, 2003 as promulgated in Government Gazette No. 25207 and Regulation Gazette No. 7721 of 18 July 2003.

**EQ 02.04** **MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**EQ 02.05** **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**EQ 03** **OPERATING AND MAINTENANCE MANUALS**

The Contractor shall at the start of the Contract be given all available as-built information and operating and maintenance manuals.

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

**EQ 04** **DETAIL OF WORK**

**EQ 04.01** No scheduled repair work **is indicated in the schedule of quantities.**

**EQ 05** **MAINTENANCE**

Maintenance of reed beds shall include all work necessary to maintain in a good condition with regard to the establishment of trees, weeds and natural grass amongst the reed growth. Invasive growths shall be removed manually and disposed of.

Reed bed outlet structures, inlet weirs and all pipe work and channels interconnecting the reed beds with other units (such as sedimentation tank outlet pipes or effluent recycle outlet channels) shall be maintained clean, neat and in a perfect functional condition.

The regular maintenance of reed bed walls with regard to erosion and the removal of bushes and trees from the walls shall form part of the maintenance work.

Remuneration for the maintenance of reed beds shall be included in the tendered rate for ten points for maintenance of the installation of which reed beds form part.

Installations shall be as defined in Additional Specification SA: General Maintenance, and on the mechanical flow diagram.

## EQ 06 MEASUREMENT AND PAYMENT

### EQ 06.01 SUPPLY ,DELIVERY AND PLANTING OF REED BEDS .....Unit: $m^2$

The unit of measurement shall be the Square meter of reeds bed planted.

The tendered rate shall include full compensation for the labour, materials and equipment needed for planting in a specified area.

Department:
Public Works and Infrastructure
REPUBLIC OF SOUTH AFRICA

# MECHANICAL WORKS

# TECHNICAL SPECIFICATIONS

# SECTION FA - FD

# FA: HEATING, VENTILATION AND AIR CONDITIONING

**CONTENTS:**



## FA.1 SCOPE: HEATING, VENTILATION AND AIR-CONDITIONING SYSTEMS

This specification covers the general repair and maintenance of heating, ventilation and air-conditioning systems, which include the following:

(a) Room air-conditioning units with air cooled condensers
(b) Refrigeration pipework
(c) Electric motors
(d) Air filters
(e) Air terminals
(f) Noise and vibration
(g) Painting and cleaning
(h) Labelling and identification.

This specification also addresses the training of
- User Client and associates, and
- Maintenance staff.

This specification shall form an integral part of the repair and maintenance contract document, and shall be read in conjunction with the additional and specifications compiled as part of this document.

## FA.2 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall deemed to form part thereof:

### FA.2.1 SANS and other specifications and codes

SANS 10400 - The applications of building regulations
SANS 10103 - The measurement and rating of environmental noise with respect to annoyance and speech communication
SANS 10139 - The prevention, automatic detection and extinguishing of fire in buildings
SANS 10140 - Identification colour marketing
SANS 10142 - Code of practice for the wiring of premises
SANS 10147 - Refrigerating systems, including plants associated with air conditioning systems

SANS 630 - Decorative high-gloss enamel paint for interior and exterior
Act 103 - National Building Regulations and Building Standard Act, 1977 (Act No 103 of 1977) as amended

**FA.2.2** **Department of Public Works Specifications**

PW 371 - Specification of materials and methods to be used

STD.PWD.VIII - Standard specification for refrigeration services

**FA.2.3** **Occupational Health and Safety Act of 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) shall be adhered to.

**FA.2.4** **Manufacturers' specifications, codes of practice and installation instructions**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**FA.2.5** **Municipal regulations, laws and by-laws**

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**FA.2.6** **Variations and additions to standard specifications**

The following additional general specifications and requirements shall be read in conjunction with this specification and shall be adhered to: Additional Specifications (SA, SB, SC, SD and SF)

## TECHNICAL DETAILS OF EXISTING INSTALLATION

At the time of compilation of this document the existing installation consisted of the equipment listed below:

### Table 1: Status of mechanical installations in the facilities at the border post

| Facility | | HVAC systems |
|---|---|---|
| 1. | Entrance from RSA-Canopy and offices | There is are 2 x 2.8 kW split air conditioning units which are using R22 gas as the refrigerant, one of the unit is not working |
| 2. | Light vehicle inspection department | There is are 2 split air conditioning units which are supplying the offices, they are both using R22 gas as the refrigerant, and are both not working properly |
| 3. | Public toilets | There is no extraction in the public toilets |
| 4. | Immigration and customs (main building) | There are two types of air conditioning systems in the main building. One being ducted packaged units with diffusers and the other is split type air conditioning units. Most of the split units are using R22 gas as a refrigerant and some are using the recommended R410A refrigerant. All the packaged_units are using R22. The packaged units are not working efficiently. The two packaged units sizes are 190 000 Btus and 230 000 Btus |
| 5. | HRM police office | The air conditioners in the HRM are 2 x split type using R22 refrigerant as the cooling and heating medium |
| 6. | Police logistics | There are split type air-conditioning systems which are using R22, 2 of the air conditioners are not working |
| 7. | Temporally tent offices | There are temporally tent and mobile offices which are also air conditioned |

| | | |
|---|---|---|
| 8. | Agriculture and police station | There are split type air-conditioning systems which are using R22 |
| 9. | Police barracks | There are 9 x split type air-conditioning systems which are using R22, with the outdoor units installed along the walls of the building, each supplying an office |
| 10. | Vehicle inspection section | There are 6 x split type air-conditioning systems which are using R22 |
| 11. | Customs export offices | There are split type air-conditioning systems which are using R22 |
| 12. | Customs export ramp | There are split type air-conditioning systems which are using R22, |
| 13. | Customs import ramp | There are split type air-conditioning systems which are using R22, |
| 14. | Sewerage pump station | There is a waste water treatment plant at the border post |
| 15. | Clearing agents Truck release outbound | There are split type air-conditioning systems which are using R22, with the outdoor units installed along the walls of the building, each supplying an office |
| 16. | Control point (Zimbabwe) | There is are 2 x 2.8 kW split air conditioning units which are using R22 gas as the refrigerant, one of the unit is not working |

**Table 2: Status of mechanical installations in the houses at the border post**

| House No. | HVAC systems |
|---|---|
| House No. 1 | There are 8 x split type air conditioning units at this house; the make of most of the units is LG. The units are all using R22 as the refrigerant |
| House No. 2 | There are 3 x split type air conditioning units at this house; 2 x units are all using R22 as the refrigerant and the other one is using the recommended R410 A |
| House No.3 | There are 1 x split type air conditioning unit at this house which is using the R22 gas as the refrigerant |
| House No. 4 | There are 3 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| House No.5 | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| House No. 6 | There are 5 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| House No.7 | There are 6 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| House No. 8 | There are 4 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| House No. 9 | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| House No. 10 | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| House No. 11 | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| House No. 12 | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| House No. 13 | There are 3 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| House No. 14 | There are 5 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| House No. 15 | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |

| | |
|---|---|
| House No. 16 | There are 4 x split type air conditioning units at this house;<br>The units are all using R22 as the refrigerant |
| House No. 17 | There are 3 x split type air conditioning units at this house;<br>The units are all using R22 as the refrigerant |
| House No. 18 | There are 4 x split type air conditioning units using R22 as the refrigerant and 1 split unit using the recommended<br>R410 A |
| House No.19 | There are 2 x split type air conditioning units at this house;<br>The units are all using R22 as the refrigerant |
| House No. 20 | There are 6 x split type air conditioning units at this house;<br>The units are all using R22 as the refrigerant |
| House No.21 | There are 6 x split type air conditioning units at this house;<br>The units are all using R22 as the refrigerant |
| House No. 22 | There are 6 x split type air conditioning units at this house; the make of most of the units is LG. The units are all using<br>R22 as the refrigerant |
| House No. 23 | There are 2 x split type air conditioning units at this house;<br>The units are all using R22 as the refrigerant |
| House No. 24 | There are 2 x split type air conditioning units at this house;<br>The units are all using R22 as the refrigerant |
| House No. 25 | There are 2 x split type air conditioning units at this house;<br>The units are all using R22 as the refrigerant |
| House No. 26 | There are 2 x split type air conditioning units at this house;<br>The units are all using R22 as the refrigerant |
| House No. 27 | There are 2 x split type air conditioning units at this house;<br>The units are all using R22 as the refrigerant |
| House No. 28 | There are 2 x split type air conditioning units at this house;<br>The units are all using R22 as the refrigerant |
| House No. 29 | There are 2 x split type air conditioning units at this house;<br>The units are all using R22 as the refrigerant |

**Table 3: Status of mechanical installations at the customs and immigration official houses in Musina**

| House No. | HVAC systems |
|---|---|
| 1. House No. 1 Kremetart Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 2. House No. 7 Kremetart Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 3. House No. 11 Kremetart Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 4. House No. 33 Kremetart Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 5. House No. 39 Kremetart Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 6. House No. 41 Kremetart Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 7. House No. 48 Kremetart Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 8. House No. 54 Kremetart Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 9. House No. 3 Sering Singel Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 10. House No. 4 Sering Singel Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 11. House No. 5 Sering Singel Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 12. House No. 8 Sering Singel Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 13. House No. 11 Sering Singel Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 14. House No. 13 Sering Singel Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 15. House No. 18 Sering Singel Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 16. House No. 27 Sering Singel Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 17. House No. 29 Sering Singel Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 18. House No. 31 Sering Singel Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 19. House No. 37 Sering Singel Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 20. House No. 39 Sering Singel Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 21. House No. 41 Sering Singel Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 22. House No. 12 Kerk Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 23. House No. 16 Kerk Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |

| | |
|---|---|
| 24. House No. 1 Willem Smit Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 25. House No. 3 Willem Smit Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 26. House No. 40 Paul Mills Street, | There are 4 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 27. House No. 44 Paul Mills Street, | There are 5 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 28. House No. 17 Van Zyl Street, | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |
| 29. House No. 9 Dominee Henrico | There are 2 x split type air conditioning units at this house; The units are all using R22 as the refrigerant |

**Table 4: Recommendations for mechanical installations in the facilities at the border post.**

| Facility | HVAC systems |
|---|---|
| Entrance from RSA- Canopy and offices | Replace the non-working split type air conditioner and service the other air conditioning unit |
| Light vehicle inspection department | Repair and service the air conditioning units |
| Immigration and Customs (main building) | Repair and service the air conditioning units. Replace 2 x old split type air conditioning units. Service the central ducted air-conditioning system in the main building |
| HRM police office | Repair and service the air conditioning units. Replace 3 x old split type air conditioning units |
| Police logistics | Repair and service the air conditioning units. |
| Temporally tent offices | Repair and service the air conditioning units. Replace 4 x old split type air conditioning units |
| Agriculture and police station | Repair and service the air conditioning units. |
| Police barracks | Repair and service the air conditioning units. Replace 3 x non-working split type air conditioning units |
| Vehicle inspection section | Repair and service the air conditioning units. Replace 2 x old split type air conditioning units |
| Customs export offices | Repair and service the air conditioning units. |
| Customs export ramp | Repair and service the air conditioning units. Replace 3 x old split type air conditioning units and 1 non-working split type unit |
| Customs import ramp | Repair and service the air conditioning units. Replace 4 x old split type air conditioning units |
| Control point (Zimbabwe) | Decommission the existing system which is using R22 gas as the refrigerant and replace with a system using an environmental friendly and energy efficient system |

**Table 5: Recommendations for mechanical installations in the houses at the border post**

| House No. | HVAC systems |
|---|---|
| 1. House No. 1 | Repair and service the air conditioning units. Replace 3 x non-working split type air conditioning units |
| 2. House No. 2 | Repair and service the air conditioning units. |
| 3. House No.3 | Repair and service the air conditioning units. |
| 4. House No. 4 | Repair and service the air conditioning units. Replace 1 x split type air conditioner |
| 5. House No.5 | Service the air conditioning units |
| 6. House No. 6 | Service the air conditioning units |
| 7. House No.7 | Service the air conditioning units |
| 8. House No. 8 | Service the air conditioning units |
| 9. House No. 9 | Service the air conditioning units |
| 10. House No. 10 | Service the air conditioning units |
| 11. House No. 11 | Service the air conditioning units |
| 12. House No. 12 | Service the air conditioning units |
| 13. House No. 13 | Service the air conditioning units |
| 14. House No. 14 | Service the air conditioning units |
| 15. House No. 15 | Service the air conditioning units |
| 16. House No. 16 | Service the air conditioning units |
| 17. House No. 17 | Service the air conditioning units |
| 18. House No. 18 | Service the air conditioning units |
| 19. House No.19 | Service the air conditioning units |
| 20. House No. 20 | Service the air conditioning units |
| 21. House No.21 | Service the air conditioning units |
| 22. House No. 22 | Service the air conditioning units |
| 23. House No. 23 | Service the air conditioning units |
| 24. House No. 24 | Service the air conditioning units |
| 25. House No. 25 | Service the air conditioning units |
| 26. House No. 26 | Service the air conditioning units, |
| 27. House No. 27 | Service the air conditioning units |
| 28. House No. 28 | Service the air conditioning units |
| 29. House No. 29 | Service the air conditioning units |

**Table 6: Recommendations for mechanical installations at the customs and immigration official houses in Musina**

| House No. | HVAC systems |
|---|---|
| 30. House No. 1 Kremetart Street, | Service and repair the air conditioning units |
| 31. House No. 7 Kremetart Street, | Service and repair the air conditioning units |
| 32. House No. 11 Kremetart Street, | Service and repair the air conditioning units |
| 33. House No. 33 Kremetart Street, | Service and repair the air conditioning units |
| 34. House No. 39 Kremetart Street, | Service and repair the air conditioning units |
| 35. House No. 41 Kremetart Street, | Service and repair the air conditioning units |
| 36. House No. 48 Kremetart Street, | Service and repair the air conditioning units |
| 37. House No. 54 Kremetart Street, | Service and repair the air conditioning units |
| 38. House No. 3 Sering Singel Street, | Service and repair the air conditioning units |
| 39. House No. 4 Sering Singel Street, | Service and repair the air conditioning units |
| 40. House No. 5 Sering Singel Street, | Service and repair the air conditioning units |
| 41. House No. 8 Sering Singel Street, | Service and repair the air conditioning units |
| 42. House No. 11 Sering Singel Street, | Service and repair the air conditioning units |
| 43. House No. 13 Sering Singel Street, | Service and repair the air conditioning units |
| 44. House No. 15 Sering Singel Street, | Service and repair the air conditioning units |
| 45. House No. 18 Sering Singel Street, | Service and repair the air conditioning units |
| 46. House No. 27 Sering Singel Street, | Service and repair the air conditioning units |
| 47. House No. 29 Sering Singel Street, | Service and repair the air conditioning units |
| 48. House No. 31 Sering Singel Street, | Service and repair the air conditioning units |
| 49. House No. 37 Sering Singel Street, | Service and repair the air conditioning units |
| 50. House No. 39 Sering Singel Street, | Service and repair the air conditioning units |
| 51. House No. 41 Sering Singel Street, | Service and repair the air conditioning units |
| 52. House No. 12 Kerk Street, | Service and repair the air conditioning units |
| 53. House No. 16 Kerk Street, | Service and repair the air conditioning units |
| 54. House No. 1 Willem Smit Street, | Service and repair the air conditioning units |
| 55. House No. 3 Willem Smit Street, | Service and repair the air conditioning units |
| 56. House No. 40 Paul Mills Street, | Service and repair the air conditioning units |
| 57. House No. 44 Paul Mills Street, | Service and repair the air conditioning units |
| 58. House No. 17 Van Zyl Street, | Service and repair the air conditioning units |
| 59. House No. 9 Dominee Henrico | Service and repair the air conditioning units |

## FA.3 REPAIR AND INSTALLATIONS REQUIREMENTS

### FA3.1 GENERAL REPAIR AND INSTALLATION REQUIREMENTS

(a) All materials and equipment supplied and installed shall be new and of high quality and manufactured to the relevant specifications, suitable for providing efficient, reliable and trouble-free service.

(b) All work shall be executed in a first-class workman-like manner by qualified tradesmen.

(c) All equipment, component parts, fittings and materials supplied and/or installed, shall conform in respect of quality, manufacture, test and performance to the requirements of the applicable current SABS specifications and codes, except where otherwise specified or approved by the Engineer in writing.

(d) All materials and workmanship which, in the opinion of the Engineer, is inferior to that specified for the work will be condemned. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Engineer.

(e) The Contractor shall submit a detailed list of the equipment and material to be used to the Engineer for approval before placing orders or commencing installation.

(f) All new equipment, materials and systems shall be installed and positioned such as to not impede on access routes, entrances and other services. The Contractor shall coordinate these items taking other services and equipment into account.

(g) All control equipment and serviceable items shall be installed and positioned such that they will be accessible and maintainable.

(h) The Contractor shall make sure that all safety regulations and measures are applied and enforced during the repair and construction periods to ensure the safety of the public and User Client.

(i) Repair work shall be programmed in accordance with Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures, to ensure the shortest possible down-time of any service and the least inconvenience to the User Client and public. The Contractor shall make sure that the necessary notifications and notices are timeously put into place for these activities.

## FA.3.2 TESTING OF REFRIGERATION PIPING AND EQUIPMENT

(a) All new refrigerant pipe installations shall be thoroughly tested to be sure that they are absolutely tight. Nitrogen must be used to pressure test the system at 1, 5 times the working pressure. A pressure-reducing valve must be used to set the test pressure. A leak test must be carried out on the entire system.

(b) All new refrigerant pipe installations shall be vacuum pumped by means of a suitable vacuum pump. An absolute pressure of 2500 micron must be reached. Allow the system to stand under vacuum for a minimum of 12 hours. If no noticeable rise in pressure has taken place after 12 hours, the system may be charged.

(c) The dryness of the refrigeration system shall be indicated by an approved moisture indicator.

(d) Should moisture be present, the system shall be leak tested and the leak repaired. Should no leak be present, the system shall be flushed with dry nitrogen and vacuum pumped again as described above.

(e) If the completed system complies with all the Specifications and passes the test and inspection, it can be approved and the Contractor may be instructed to recharge the system with the correct refrigerant and refrigerant charge.

(f) Under no circumstances shall the refrigerant piping/installation be purged.

## FA.3.3 REFRIGERANTS

(a) No CFC refrigerant shall be used in new installations.

(b) Equipment still running on CFC shall be maintained until such time that a leak occurs or the system has to be decanted. The system shall then be converted to a compatible HCFC or HFC as described in the Montreal Protocol and recommended by the compressor manufacturer.

(c) Any CFC refrigerant that has to be discharged, shall be decanted by means of an approved reclaiming system, and not discharged to the atmosphere. Should the Contractor not comply with this requirement, full action shall be taken contractually and statutory against him.

(d) Any refrigeration system not supplied with three-way service valves, shall be provided with Schreuder type service valves. These valves shall be installed on both suction and discharge lines of the compressors. Tap-o-line valves shall not be fitted or used on the systems.

(e) In the event of an electrical motor burn-out in a hermetic or semi-hermetic compressor, a burn-out drier shall be used. Purging only is prohibited. The burn-out drier shall be installed and removed as per the manufacturer's instructions.

(f) No synthetic components or solutions shall be used to repair leaks in refrigeration piping, on coils or evaporators. Only approved gas welding shall be used. Should the leak be of such nature that repair is not possible, the item should be replaced.

## FA.3.4 SELF-CONTAINED AIR-CONDITIONING UNITS

(a) The self-contained packaged unit shall be a fully catalogued product and documentation shall include performance curves and selection tables.

(b) Self-contained room air-conditioning units consist of unit casing, compressor, evaporator and fan, condenser and fan, refrigerant pipework with expansion device and the relevant controls. The condenser unit shall form an integral part of the unit or be separate for split applications.

(c) Unit casings shall be of sheet metal construction with a baked enamel finish to give a corrosion resistance. Units shall be suitably insulated to ensure quiet operation.

(d) Evaporator fans shall be of the double inlet centrifugal type with integral motor or belt-driven. The fan assembly shall be isolated from the unit by means of rubber mounts and the unit shall operate without vibration.

(e) Condensate trays shall be manufactured of non-corrosive materials and shall be insulated and condensate shall be piped to the nearest drain point.

(f) Washable WP 77 filters shall be provided and installed behind the inlet grille and shall be easily removable.

(g) Compressors shall be of the hermetically sealed dome type with crankcase heaters and suitable vibration isolators.

(h) Condenser coils shall be copper tubes with aluminium fins for inland use. Condenser fans shall be propeller fans or of the centrifugal type.

(i) Refrigerant piping shall be installed and repaired as specified in FA.3.

## FA.4 AS-BUILT INFORMATION AND OPERATING AND MAINTENANCE MANUALS

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals and system data sheets.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

The Contractor shall allow for the required equipment and facilities to establish the correct as-built information.

All information shall be recorded and reproduced in electronic format, as well as three sets of hard copies to be supplied to the Department.

Over and above what is specified in Additional Specification SB: Operating and Maintenance Manuals, the operating and maintenance manual to be compiled shall be structured to include at least the following:

**(a) System description**

Complete system description and the working of the plant.

**(b) Commissioning data**

Complete commissioning, test and inspection data of plant.

**(c) Operating data**

(i) Plant running check list and frequency of servicing required;
(ii) Safety precautions to be implemented;
(iii) Manual and automatic operation;
(iv) Maintenance duties and logging required;
(v) Lubricating oils and service instructions;
(vi) Pre-start checklist for each system;
(vii) Starting and stopping procedures.

**(d) Mechanical equipment**

(i) Description of all major items with the make, model number, names, addresses and telephone numbers of the suppliers, manufacturers or their agents;
(ii) Design capacities of all equipment, including selection parameters, selection curves, capacity tables, etc.;
(iii) Manufacturers' brochures and pamphlets;
(iv) Schedule of spares with part numbers recommended to be held as stock.

**(e) Maintenance instructions**

(i) Schedule of maintenance particulars, frequency of services and replacements;
(ii) Trouble-shooting guide;
(iii) Part number of all replacement items and spares;
(iv) Capacity curves of pumps, fans and compressors;
(v) Serial numbers of all items of equipment.

**(f) Electrical equipment**

(i) Schedule of equipment, indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
(ii) Maintenance instructions;
(iii) Manufacturers' brochures and pamphlets;
(iv) Complete as-built circuit diagrams and diagrammatic representation of interconnections of all electrical equipment.

**(g) Instrumentation and control**

(i) Description of each control system;
(ii) Schedule of control equipment indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
(iii) Maintenance instructions;
(iv) Manufacturers' brochures and pamphlets.

**(h) Drawings**

Paper prints of all as-built mechanical and electrical drawings and wiring diagrams framed behind glass shall be mounted adjacent to each relevant control panel.

## FA.5 TRAINING OF OPERATORS FOR OPERATION AND INSTALLATION

In addition to the requirements of Additional Specification SD: General Training, the Contractor shall allow and provide for additional training of the HVAC maintenance staff as specified and set out in this specification. The objective of this training will be to ensure that the following is achieved:

(a) Understanding of equipment;
(b) High plant operating efficiencies to reduce operating costs;
(c) Reduce the maintenance cost of the plant to an acceptable level, and maintain the cost at this level in so far as they are affected by the operating conditions;
(d) Prevent the mal-operation of the plant and its associated equipment.

In the event of the designated staff not achieving the set goals the Contractor shall be responsible to ensure that such personnel attend an approved maintenance course as available from the Department or manufacturer.

The Contractor shall, in collaboration with the Engineer, ensure that the maintenance personnel be re-evaluated on an annual basis by means of a set examination, to ensure the upkeep of skill level and knowledge.

The evaluation and training course to be utilised for the evaluation of the HVAC maintenance staff shall include at least the following:

(a) Equipment and component recognition;

(b) Emergency procedures to be followed in the event of power failure, water shortage, and accidents related to refrigerator systems;

(c) Safety precautions to be followed and implemented;

(d) The identification, reporting and recording of faults and operation of equipment;

(e) The logging of boiler plant operation, readings and setting;

(f) In the event of plant running on ammonia, the full SAIRAC course on handling ammonia as refrigerant shall be attended by the maintenance staff.

## FA.6 LOGGING AND RECORDING PROCEDURES

The Contractor shall under this repair and maintenance contract institute a logging and recording system as part of his maintenance control plan as defined in Additional Specification SA: General Maintenance. This shall consist of a log and record book which shall be utilised to log and record all operations, faults, system checks, breakdowns, maintenance visits, inspections, etc.

The logbook shall be kept in a safe place at the maintenance section and shall only be utilised by the boiler house supervisor, the Contractor and the Engineer. A copy of the monthly entries and recordings into this logbook shall be submitted by the Contractor together with this monthly report to the Engineer.

The logbook shall be structured to include at least the following:

(i) Daily inspection and maintenance actions;
(ii) Monthly inspection and maintenance actions;
(iii) Six-monthly inspection and maintenance actions;
(iv) Breakdown reports;
(v) Statutory inspection and test comments and reports.

The Contractor shall also institute an attendance register, which shall be kept in a safe place at the maintenance section. This register shall be completed by all persons visiting the relevant plants, including:

(a) Contractor and maintenance personnel;
(b) Inspectors;
(c) User Client and associates;
(d) Engineer.

This register shall state the date, time-in, time-out, name, company and reason for visit. A copy of the register shall be submitted by the Contractor together with his monthly report.

On completion of repair work and/or the installation of new equipment the plant and equipment shall be put into operation after all tests and adjustments have been carried out to the satisfaction of the Engineer. Where new plant is installed the Contractor shall run and operate the system for a period of time specified by the Engineer and train the staff of the User Client to operate and maintain the system. This operation shall be done strictly in accordance with Clause SC 11 of the Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

Logging of the operation of the installations shall commence immediately upon startup.

The Contractor shall submit a full commissioning report as per attached commissioning data sheet.

## FA.7 TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK

On completion of repair work the Contractor shall prior to recommissioning test the plant and its equipment. This operation shall be done strictly in accordance with Clause SC 08 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

Except where otherwise provided in the Contract, the Contractor shall provide labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. Arrangements for these tests shall be made by the Contractor and he shall give at least 72 hours written notice to the Engineer before commencing the test.

In the event of the plant or installation not passing the test, the Employer shall be at liberty to deduct from the Contract amount all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is to be operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the certificate of practical completion of repair work is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Department may assign staff as observers, but such observation time shall not be counted as instruction time.

After complete installation of the system all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the performance of all equipment, as well as certificates obtained from all the relevant authorities and statutory bodies, etc.

The Contractor shall only utilise departmentally approved inspection authorities for all inspections and tests to be conducted. This will be done and approved in writing among the relevant parties.

## FA.8 QUALITY ASSURANCE SYSTEM

The Contractor shall institute an approved quality assurance (QA) system, which shall be submitted to the Engineer for his approval. The records of this QA system shall be kept throughout the duration of the Contract and be submitted to the Engineer at regular intervals as required.

## FA.9 COMMISSIONING AND RECOMMISSIONING OF PLANT AND INSTALLATION

### FA.9.1 GENERAL

On completion of repair work and/or the installation of new equipment the plant and equipment shall be put into operation after all tests and adjustments have been carried out to the satisfaction of the Engineer. Where new plant is installed the Contractor shall run and operate the system for a period of time as specified by the Engineer and train the staff of the User Client to operate and maintain the system. This operation shall be done strictly in accordance with Clause SC 11 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

Logging of the operation of the installations shall commence immediately upon start-up.

The Contractor shall submit a full commissioning report as per attached commissioning data sheet.

## FA.9.2 RECOMMISSIONING OF PLANT AND ANCILLARY EQUIPMENT

On completion of repair work the Contractor shall re-commission the plant and its equipment. This operation shall be done strictly in accordance with Clause SC 11 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures. This operation shall also be carried out strictly in accordance with the manufacturer's specification and shall be witnessed by the Engineer.

Recommissioning checks to be carried out shall be categorised under the following headings:

(a) Mechanical checks
(b) Electrical and control checks.

On completion of repair work the Contractor shall re-commission the plant and its ancillary equipment. This operation shall be done strictly in accordance with the manufacturer's specification and shall be witnessed by the Engineer. This shall include but not be limited to the following:

(a) All required recommissioning mechanical checks

(i) Check system for leaks;
(ii) Check rotation of all fans;
(iii) Check mountings of all equipment.

(b) All required recommissioning electrical and control checks

(i) Check all wiring connections for tightness and repair any hot connections.

(ii) Check that all electrical equipment have been properly reconnected in accordance with the manufacturer's specification.

(iii) Perform and record all required electrical insulation tests on equipment.

(iv) Check and test all controls with main circuits isolated.

(v) Check all motor-driven equipment for correct rotational directions.

(vi) Check and test the operation of all indication and warning lights.

(vii) Check, set, record and readjust all equipment control and set points in accordance with manufacturer's specification.

(viii) Run all motor-driven equipment for a period to ensure free movement and correct operation. Feed pumps only to be operated for a short interval to check rotation.

## FA.9.3 COMMISSIONING AND COMPLETION OF REPAIRS

On completion of the recommissioning checks the Contractor shall proceed with the commissioning. This operation shall be done strictly in accordance with Clause SC 11.02 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures. This operation shall also be carried out in accordance with the manufacturer's specification and shall include but not be limited to the following for the different types of equipment:

### FA.9.3.1 Self-contained air-conditioning unit

(a) Check evaporator and condenser pressures and superheat.

(b) If the unit needs charging, find leak, decant, repair leak and recharge unit.

(c) Check fans, fan speed control and fan motors.

(d) Check entering and leaving air temperatures over evaporator coil.

(e) Check operation of all safeties:

(i) LP cut-out pressure
(ii) HP cut-out pressure
(iii) Low on-coil thermostat
(iv) Set point of oil pressure safety
(v) Oil pressure trip.

(f) Check anti-recycle timer.

(g) Check all running amps of fans and compressors.

(h) Check compressor unloading mechanism if applicable.

(i) Complete commissioning data sheet.

The Contractor shall visit, inspect, test and readjust the plant during the 30-day period following the recommissioning to ensure the correct functioning of the plant and its associated equipment.

## FA.10 GUARANTEE OF INSTALLATION AND EQUIPMENT

The Contractor shall provide and obtain guarantees from the manufacturer(s) and/or supplier(s) to the effect that each piece of new equipment supplied and installed under the repair contract, will comply with the required performance and will function as part of the complete system.

All new equipment, including the complete new installations and the systems as a whole, shall be guaranteed for a period of 12 (twelve) months commencing on the day of issue of a certificate of completion for repair work of the installation.

## FA.11 MAINTENANCE TOOLS AND SPARES

Each maintenance workshop shall be equipped with the necessary maintenance tools and spares as required by the specific type of plants and installation for the daily operation and maintenance of the plant. At the start of the repair and maintenance contract the Contractor shall make an inventory of the existing tools and spares in the presence of the User Client, and any shortfall or damaged tools and spares shall be replaced with new. All replacement tools and spares shall be as specified by the boiler and equipment manufacturers. These tools and spares shall be kept in a lockable room or cabinet of which the maintenance supervisor and the Contractor shall carry keys. The Contractor shall on a monthly basis take stock of these items in the presence of the maintenance supervisor and shall record and report to the Engineer. Any shortfall shall be replaced by the Contractor as part of his responsibility under this Contract.

The tools and spares to be carried shall include, but not be limited to at least the following:

(a) Tools

(i) Electric welding (arc welder)
(ii) Oxy-acetylene welding set
(iii) Soldering iron
(iv) Pipe cutter
(v) Swaging tool set
(vi) Flaring tool set
(vii) Leak detector (electronic or leak torch or Spectro light)
(viii) Vacuum pump
(ix) Service valve ratchet
(x) Refrigerant reclaim unit
(xi) Flow measuring hood
(xii) Pitot tube
(xiii) Vacuum gauge
(xiv) Digital thermo anenometer
(xv) Hygrometer
(xvi) Tung tester
(xvii) Coil comb
(xviii) Multimeter
(xix) Amp meter
(xx) Combination spanner set
(xxi) Combination socket set
(xxii) Allen keys
(xxiii) Screwdriver set
(xxiv) Drill set
(xxv) Drilling (arc welder)
(xxvi) Pop rivet gun
(xxvii) Tab and die set
(xxviii) Three-jaw gear pulley
(xxix) Hacksaw
(xxx) Level
(xxxi) Bench vice
(xxxii) Assorted files
(xxxiii) Tape 5 m
(xxxiv) Torch

(b) Spares

It is recommended that essential parts be maintained in inventory. Essential parts are those parts used frequently in responding to routine and urgent work requests. Consider the accessibility to spares and the time it takes to obtain them. The goal is to avoid stockpiling parts, as well as to avoid being without a needed part. The following parts are regarded as essential spares:

(i) Schreuder valves
(ii) Relevant refrigerants
(iii) Relevant refrigeration compressor oil
(iv) Filter/dryers
(v) Expansion valves
(vi) Filter sets
(vii) Relevant V-belts
(viii) Lubricants and greases.

## FA.12 REPAIR WORK TO INSTALLATION SYSTEMS AND EQUIPMENT

### FA.12.1 GENERAL

At the start of the repair and maintenance contract all the systems, installations and equipment shall be repaired as specified in this specification. This repair work shall include but not be limited to the specified specification details.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve. The said repair work shall be executed in accordance with the relevant codes of practice, standard, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional specifications included in this document.

The repair work items shall be listed in tabular form with all relevant details, such as capacity, size, manufacturer, model number, etc.

All repair work shall be executed within the approved period for repairs to be agreed at the start of the Contract period. All new equipment, materials and systems shall be furnished with a written guarantee of a defects liability period of 12 months from date of issue of a certificate for completion of the repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

Repair work items shall be categorised for the following installations:

(a) Self-contained air-conditioning units.

### FA.12.2 SELF-CONTAINED AIR-CONDITIONING UNITS

(a) Clean air intake screen.
(b) Replace filters.
(c) De-rust, neutralise and touch up paintwork.
(d) Replace canvas collars.
(e) Clean housing, ensure all panels are properly secured and door panels close properly.
(f) Check setting and operation of all pressure switches, reset if required.
(g) Check setting and operation of all safety switches, i.e. LP and HP switches, oil pressure switch.
(h) Check setting and operation of thermostats.
(i) Check timers and reset if required.
(j) Check operation of seven-day timer.
(k) Check running current of fans and compressor and settings and operation of overloads.
(l) Check tightness of all electrical terminals.
(m) Ensure operation of local and remote isolators.
(n) Check condition of all cables and whether cables are neatly strapped and reposition and strap if required.
(o) Ensure correct operation of emergency stop.
(p) Carry out a leak test on all refrigeration piping and components inclusive of evaporator and condenser.
(q) All leaks shall be repaired. Should a leak on a component be of such a nature that it cannot be repaired, the component shall be replaced. The procedure to follow is as set out in FD 03.
(r) The superheat setting of the thermostatic expansion valve shall be checked and adjusted if required (setting approximately 8 °C).
(s) The filter dryer shall be replaced.
(t) Check compressor vibration mounts.

(u) Test oil acidity.
(v) Check refrigerant charge sight glass being clear or flashing.
(w) Check moisture indication being dry.
(x) Clean condensate tray and test drainage operation.
(y) Clean evaporator and condenser blades and check unbalance.
(z) Replace suction line insulation.
(aa) Check all service valves for full operation, replace caps if missing.

## FA.13 MAINTENANCE TO INSTALATION AND EQUIPMENT

### FA.13.1 GENERAL

Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with commencement of the Contract. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 24-month contract period.

This part of the Contract shall include:

(a) Routine preventative maintenance;
(b) Corrective maintenance; and
(c) Breakdown maintenance,

as defined in Additional Specification SA: General Maintenance, for the specified installations described under FD 01 of this specification.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, statutory regulations, standards, regulations, municipal laws and by-laws and the manufacturers' specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be instituted by the Contractor, as specified in Additional Specification SA: General Maintenance.

All new equipment, components and materials supplied and installed under the maintenance contract shall be furnished with prescribed manufacturer's guarantees.

The maintenance work and items are to be categorised by the Contractor for each maintenance activity under the following headings:

(b) Self-contained air-conditioning units.

The Contractor shall be remunerated monthly, based on his performance, for maintaining the complete installation in a perfect functional condition.

## FA.13.2 DEFINITION AND QUALIFICATION OF ACTIONS

### FA.13.2.1 Daily maintenance actions

Daily actions are the responsibility of the User Client. These checks are to be performed by staff responsible of the facility. The self-contained air-conditioning units should run during working hours and/or continuously. The status of these systems can thus be monitored by observation on a daily routine.

(a) Self-contained air-conditioning units:

- Does the unit perform and maintain temperature?
- Is the temperature in the areas concerned satisfactory?
- Is the condensate drain working properly?

These daily checks shall be logged at the facility, ie by the kitchen manager and the maintenance personnel.

### FA.13.2.2 Monthly maintenance actions

TABLE FA.13.2.2/2: SELF-CONTAINED AIR-CONDITIONING UNIT

| REFERENCE NUMBER | ACTION |
|---|---|
| S-1 | Clean filters, replace if required |
| S-2 | Inspect air intake and discharge for blockages |
| S-3 | Check all refrigerant, drainage pipes for damaged and leaks |
| S-4 | Check sight glass: clear or flash gas |
| S-5 | Carry out visual inspection of condenser coil for blockages and correct operation of fans |
| S-6 | Carry out visual inspection of evaporator coil for blockages and correct operation of supply fan |
| S-7 | Check enclosure for damages |
| S-8 | Check electric motor running temperatures |
| S-9 | Check electric connections for tightness |
| S-10 | Test thermostat and control operation |
| S-11 | Clean condensate tray and test drainage for proper operation |
| S-12 | Check cooling and heating cycle |

Note: The monthly actions shall include the activities of the daily maintenance actions.

### FA.13.2.3 Biannual maintenance actions

TABLE FA 13.02.03/2: SELF-CONTAINED AIR-CONDITIONING UNITS

| REFERENCE NUMBER | ACTION |
|---|---|
| S-1 | Clean filters, replace if required |
| S-2 | Inspect air intake and discharge for blockages |
| S-3 | Check all refrigerant, drainage pipes for damages and leaks |

| | |
|---|---|
| S-4 | Check sight-glass: clear or flash gas |
| S-5 | Carry out visual inspection of condenser coil for blockages and correct operation of fans |
| S-6 | Carry out visual inspection of evaporator coil for blockages and correct operation of supply fan |
| S-7 | Check enclosure for damages |
| S-8 | Check electric motor running temperatures |
| S-9 | Check electric connections for tightness |
| S-10 | Test thermostat and control operation |
| S-11 | Clean condensate tray and test drainage for proper operation |
| S-12 | Check filter/dryer |
| S-13 | Check superheat and functioning of expansion valve |
| S-14 | Check operation of HP and LP switch |
| S-15 | Check operation of controllers |
| S-16 | De-rust, neutralise and touch up paint work |
| S-17 | Check cooling and heating cycle |
| S-18 | Clean evaporator and condenser coil chemically |
| S-19 | Clean all filter frames and seals |
| S-20 | Check fan motor and compressor current |
| S-21 | Check and test overload settings |
| S-22 | Lubricate all bearings |

Note: The above biannual actions include the activities of the monthly maintenance actions.

## FA.14 MEASUREMENT AND PAYMENT

**FA.14.01(a) Item**

**As-built information and O&M Manuals**..... Unit: sum

The tendered sum shall include full compensation for the compilation and submission of inventory lists and operating and maintenance manuals in accordance with Additional Specification SB: Operating and Maintenance Manuals. The tendered sum shall also include full compensation for all equipment necessary to establish the exact position and levels of services, as well as the recording of all information on electronic drawing format.

**FA.14.01(b) Item**

**Development of training syllabus**..... Unit: number

The tendered sum shall include full compensation for the compilation and submission of training syllabus. The tendered sum shall also include full compensation for all equipment necessary to establish the syllabus, as well as the recording of all information and providing to the engineer.

**FA.14.01(c) Item**

**Presenting a training course for operators and maintenance staff.** ..... Unit: days

The tendered sum shall include full compensation for the compilation and submission of training course presentation agenda, list of attendees and duration and location for the training to take place. The tendered sum shall also include full compensation for all equipment necessary to establish and present the course, as well as the recording of all information and providing to the engineer.

**FA.14.01(d) Item**

**Logging and recording**..... Unit: sum

The tendered sum shall include full compensation for the compilation and submission of operation conditions, services, maintenance visits, reports, breakdowns, samples, inspections, tests, as well as the recording of all information and providing to the engineer.

**FA.14.01(e) Item**

**Inspection and reporting**..... Unit: number

The tendered sum shall include full compensation for the compilation and submission of operation conditions, defects, failures, tests necessary, as well as the recording of all information and providing to the engineer.

**FA.14.01(f) Item**

**Repair Leaking Drain Pipe**..... Unit: number

The unit of measurement shall be the number of defective components repaired. The tendered rate shall include full compensation for the removal of the defective component, the repairs on the leaking pipe as well as testing.

**FA.14.01(g) Item**

**Replace AC contactors**..... Unit: number

The unit of measurement shall be the number of defective contactors replaced. The tendered rate shall include full compensation for the removal of the defective contactor, the supply and installation of the new component as well as testing.

**FA.14.01(h) Item**

**Derust, neutralise and touch-up paint work**..... Unit: number

The unit of measurement shall be the number of units from which derusting, neutralising and paint work is done. The tendered rate shall include full compensation for the removal of the defective component, derust, neutralise and install back in position of the new component as well as testing.

**FA.14.01(i) Item**

**Replace Control (PC) Board**..... Unit: number

The unit of measurement shall be the number of defective PC Boards diagnosed and replaced. The tender rate shall include full compensation for the removal of the defective boards as well as the supply, installation and testing of the new PC board.

**FA.14.01(j) Item**

**Replace Compressor**..... Unit: number

The unit of measurement shall be the number of defective compressors replaced. The tender rate shall include full compensation for the removal of the defective compressor as well as the supply, installation, of the new compressor, re-gas system and testing and commissioning of the unit.

**FA.14.01(k) Item**

**Repair or replace fan and motor**..... Unit: number

The unit of measurement shall be the number of defective components repaired or replaced. The tendered rate shall include full compensation for the removal of the defective component, the supply and installation of the new component or repairs on the defective component as well as testing.

**FA.14.01(l) Item**

**Replace sensor**..... Unit: number

The unit of measurement shall be the number of defective components replaced. The tendered rate shall include full compensation for the removal of the defective component, the supply and installation of the new component as well as testing.

**FA.14.01(m) Item**

**Repair/Replace controller**..... Unit: number

The unit of measurement shall be the number of defective components replaced. The tendered rate shall include full compensation for the removal of the defective component, the supply and installation of the new component or repairs of the defective component as well as testing.

**FA.14.01(n) Item**

**Replace capacitor**..... Unit: number

The unit of measurement shall be the number of defective components replaced. The tendered rate shall include full compensation for the removal of the defective component, the supply and installation of the new component as well as testing.

**FA.14.01(o) Item**

**Repair insulation**..... Unit: number

The unit of measurement shall be the number of units with poor insulation. The works per unit to cover the complete linear length of Class O Armaflex SS self-seal tubes supplied and installed. The tendered rate shall include full compensation for the removal of the existing isolation: supply, handling and installation of the specified type of isolation. This rate shall further include for the supply of all cable ties, clamps and other material necessary to ensure that the installation conforms to the specification.

**FA.14.01(p) Item**

**Regas R410 and R22 Charged AC Units**..... Unit: kg

The unit of measurement shall be the number of AC units vacuumed, re-gassed and lubricated. The tendered rate shall include full compensation for the evacuation of the unit, the re-filling of the gas and the lubrication of all fan bearings.

**FA.14.01(q) Item**

**Repair mounting brackets & supports**..... Unit: number

The unit of measurement shall be the number of defective units repaired. The tendered rate shall include full compensation for the removal of the loose mounting and the unit, the supply and installation of the new mounting screw and all accessories to bring the unit to a completely rigid and safe mounting state.

**FA.14.01(r) Item**

**Ensure operation of local and remote isolators**..... Unit: number

The unit of measurement shall be the number of defective units for which testing of isolators must be conducted as suspected to be faulty. The tendered rate shall include full compensation for the testing of isolators, the supply and installation of the new components where necessary and repairs as well as testing.

**FA.14.01(s) Item**

**Replace fuse**..... Unit: number

The unit of measurement shall be the number of defective fuse replaced. The tendered rate shall include full compensation for the removal of the defective fuse, the supply and installation of the new component as well as testing.

**FA.14.01(t) Item**

**Ensure correct operation of emergency stop**..... Unit: number

The unit of measurement shall be the number of defective units for which testing of emergency stop must be conducted as suspected to be faulty. The tendered rate shall include full compensation for the testing, the supply and installation of the new components where necessary and repairs as well as testing.

**FA.14.01(u) Item**

**Carry out leak test**..... Unit: number

The unit of measurement shall be the number of defective units on which tests are conducted. The tendered rate shall include full compensation for the complete leak test of refrigeration gas on R410 or R22 charged units to include all material or equipment and tools used.

**FA.14.01(v) Item**

**Repairs of refrigeration gas leaks**..... Unit: number

The unit of measurement shall be the number of defective units on which leaks are detected. The tendered rate shall include full compensation for the complete repairs of refrigeration gas pipe on R410 or R22 charged units, include all material or equipment and tools used.

**FA.14.01(w) Item**

**Check expansion valves**..... Unit: number

The unit of measurement shall be the number of defective components checked. The tendered rate shall include full compensation for the checking and adjustment of the defective component as well as testing.

**FA.14.01(x) Item**

**Check expansion valves and replace caps**..... Unit: number

The unit of measurement shall be the number of defective components checked. The tendered rate shall include full compensation for the checking and adjustment of the defective component, replacement of caps, as well as testing.

**FA.14.01(y) Item**

**Check compressor vibration mountings**..... Unit: number

The unit of measurement shall be the number of compressor mounting units repaired. The tendered rate shall include full compensation for the removal of the loose mountings, the supply and installation of the new mounting screw and all accessories to bring the compressor to a completely rigid and safe mounting state.

**FA.14.01(z) Item**

**Carry out oil acidity test**..... Unit: number

The unit of measurement shall be the number of defective units on which tests are conducted. The tendered rate shall include full compensation for the complete oil acidity test on ac units to include all material or equipment and tools used.

**FA.14.01(aa) Item**

**Check refrigeration charge sight glass**..... Unit: number

The unit of measurement shall be the number of defective components checked. The tendered rate shall include full compensation for the checking and adjustment of the defective component as well as testing.

**FA.14.01(ab) Item**

**Check moisture**..... Unit: number

The unit of measurement shall be the number of defective components checked. The tendered rate shall include full compensation for the checking and adjustment of the defective component as well as testing.

**FA.14.01(ac) Item**

**Clean evaporator and condenser blades**..... Unit: number

The unit of measurement shall be the number of defective components checked. The tendered rate shall include full compensation for the checking and adjustment of the defective component as well as testing.

**FA.14.01(ad) Item**

**Commisioning**..... Unit: number, sum

The unit of measurement shall be the number of units commissioned. The tendered rate shall include full compensation for testing and producing test reports and commissioning results to the engineer.

**FA.14.01(ae) Item**

**Repair insulation**..... Unit: m

The unit of measurement shall be the linear length of insulation supplied and installed or repaired. The tendered rate shall include full compensation for the removal of the existing isolation: supply, handling and installation of the specified type of isolation. This rate shall further include for the supply of all cable ties, clamps and other material necessary to ensure that the installation conforms to the specification.

**FA.14.01(af) Item**

**Repair sheet metal ducting**..... Unit: m

The unit of measurement shall be the linear length of ducting supplied and installed or repaired. The tendered rate shall include full compensation for the removal of the existing ducting: supply, handling and installation of the specified type of ducting. This rate shall further include for the supply of all brackets, clamps and other material necessary to ensure that the installation conforms to the specification.

**FA.14.01(ag) Item**

**Repair diffusers**..... Unit: number

The unit of measurement shall be the number of diffusers supplied and installed or repaired. The tendered rate shall include full compensation for the removal of the existing diffusers: supply, handling and installation of the specified type of diffusers. This rate shall further include for the supply of all clamps and other material necessary to ensure that the installation conforms to the specification.

**FA.14.01(ah) Item**

**Repair grills**..... Unit: number

The unit of measurement shall be the number of grills supplied and installed or repaired. The tendered rate shall include full compensation for the removal of the existing grills: supply, handling and installation of the specified type of grills. This rate shall further include for the supply of all clamps and other material necessary to ensure that the installation conforms to the specification.

**FA.14.01(ai) Item**

**Clean filters or replace if may not be reused**..... Unit: number

The unit of measurement shall be the number of filters supplied and installed or cleaned. The tendered rate shall include full compensation for the removal of the filters: supply, handling and installation of the specified type of filters, or cleaning of the existing filters and re installing into position. This rate shall further include for the supply of all clamps and other material necessary to ensure that the installation conforms to the specification.

**FA.14.01(aj) Item**

**Replace air conditioning unit**..... Unit: number

The unit of measurement shall be the number of specified AC units replaced (Heating & Cooling). The tendered rate shall include full compensation for the removal of the defective unit, the supply, installation, testing and commissioning of the new unit including all piping, drainage, electrical connection complete with unistrut galvanized brackets, anti-vibration rubbers and galvanized trunking.

**FA.14.02(a) Item**

**Maintenance**..... Unit: points

The unit of measurement shall be the points (total 10 per month) as reflected by the works carried on site regarding monthly maintenance task describe in this specification. The tendered rate shall include full compensation for the monthly servicing of the units. Cleaning of filters, evaporator coils and condenser coils, cleaning of the housing, check gas pressure, gas leaks, checking of all switches, thermostat, compressors etc.

**FA.14.02(b) Item**

**Service air conditioning units**..... Unit: pc sum

The unit of measurement shall be the number of AC units serviced. The tendered rate shall include full compensation for the Bi-Annual servicing of the units as per Manufacturer's instructions and also prescribed by this specification. Cleaning of filters, evaporator coils and condenser coils, cleaning of the housing, check gas pressure, gas leaks, checking of all switches, thermostat, compressors etc.

## HVAC COMMISSIONING DATA SHEET - AIR CONDITIONING UNITS

| | | | |
|---|---|---|---|
| INSTALLATION: | | | |
| A/C MAKE | | | |
| Model number: | Inside unit | | |
| | Outside unit | | |
| Serial number: | Inside unit | | |
| | Outside unit | | |
| Voltage: | | | |
| Starting amps: | | | |
| Running amps: | | | |
| | | **COOLING** | **HEATING** |
| System discharge gauge pressure: (kPa and running) | | | |
| System suction gauge pressure: (kPa and running) | | | |
| Condenser : cooling medium inlet temperature: | | | |
| Condenser : cooling medium outlet temperature: | | | |
| Evaporator : air inlet temperature: | | | |
| Evaporator : air outlet temperature: | | | |
| Room dry bulb temperature after 1 hour A/C operation: | | | |
| Ambient dry bulb temperature: | | | |

**COMMISSIONED BY:** **ENGINEER:**

PRINT: ..... PRINT: .....

SIGNATURE: ..... DATE..... SIGNATURE: ..... DATE.....

# FB: INCINERATOR INSTALLATION

**CONTENTS:**



## FB.1 SCOPE: INCINERATOR INSTALLATION, REPAIR AND MAINTENANCE

(a) This specification covers the general repair and maintenance of incinerator installations which include the following methods of firing:

(i) Electrical
(ii) Coal
(iii) Oil
(iv) Gas.

(b) This specification also covers the repair and maintenance to the following ancillary incinerator equipment:

(i) Coal handling equipment
(ii) Ash handling equipment
(iii) Grit collectors and chimneys
(iv) Oil, electrical or gas firing equipment
(v) Oil, electrical or gas storage facilities
(vi) Firing tools
(vii) Refractories
(viii) Instrumentation and controls
(ix) Electrical control panel.

(c) This specification also addresses the following:

(i) Training
(ii) Operating of incinerators.

(d) This specification shall form an integral part of the repair and maintenance contract document, and shall be read in conjunction with the additional and relevant specifications compiled as part of this document.

## FB.2 APPLICABLE STANDARD SPECIFICATIONS FOR INCINERATORS

### FB.2.1 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall deemed to form part thereof:

#### FB.2.1.1 SABS and other specifications and codes

SANS 10400 - The applications of the building regulations
SANS 10142 - Code of practice for the wiring of premises
SANS 10140 - Identification colour marking
SANS 10044 - Parts I to IV: Welding
SANS 460 - Copper tubes for domestic plumbing
SANS 10103 - The measurement and rating of environmental noise with respect to annoyance and speech communications

#### FB.2.1.2 Department of Public Works specifications

PW 371 - Specification of materials and methods to be used
Standard Specification for electrical installations and equipment pertaining to mechanical installations

#### FB.2.1.3 Occupational Health and Safety Act of 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) shall be adhered to.

#### FB.2.1.4 Manufacturers' specifications, codes of and practice and installation instructions

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

#### FB.2.1.5 Municipal regulations, laws and by-laws

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

## FB.3 VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS

The following additional general specifications and requirements shall be read in conjunction with this specification and shall be adhered to.

## FB.3.1 GENERAL REPAIR AND INSTALLATIONS REQUIREMENTS

(a) All materials and equipment supplied and installed shall be new and of high quality and manufactured to the relevant specifications, suitable for providing efficient, reliable and trouble-free service.

(b) All work shall be executed in a first-class workman-like manner by qualified tradesmen.

(c) All equipment, component parts, fittings and materials supplied and/or installed, shall conform in respect of quality, manufacture, test and performance to the requirements of the applicable current SABS specifications and codes, except where otherwise specified or approved by the Engineer in writing.

(d) All materials and workmanship which, in the opinion of the Engineer, is inferior to that specified for the work will be condemned. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Engineer.

(e) The Contractor shall submit a detailed list of the equipment and material to be used to the Engineer for approval before placing orders or commencing installation.

(f) All new equipment, materials and systems shall be installed and positioned such as to not impede on access routes, entrances and other services. The Contractor shall coordinate these items taking other services and equipment into account.

(g) All control equipment and serviceable items shall be installed and positioned such that they will be accessible and maintainable.

(h) The Contractor shall make sure that all safety regulations and measures are applied and enforced during the repair and construction periods to ensure the safety of the public and User Client.

(i) Repair work shall be programmed in accordance with Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures, to ensure the shortest possible down-time of any service and the least inconvenience to the User Client and the public. The Contractor shall make sure that the necessary notifications and notices are timeously put into place for these activities.

## FB.4 OPERATING AND MAINTENANCE MANUALS

The Operating and Maintenance Manuals compiled as part of the previous RAMP contracts contain the maintenance data for the incinerator installation and are available from the Department. The Contractor shall verify and check the correctness of the data and shall, at his expense, regularly update the inventory list and the operating and maintenance manuals and add information as may be necessary for the effective operation and maintenance of the system.

This shall be done in accordance with Additional Specification **SB: Operating and Maintenance Manuals**.

All information shall be recorded and reproduced in electronic format, as well as three sets of hard copies to be supplied to the Department.

Over and above what is specified in Additional Specification SB: Operating and Maintenance Manuals, the operating and maintenance manual to be compiled shall be structured to include at least the following:

(a) System description

Complete system description and the working of the plant.

(b) Commissioning data

Complete commissioning, test and inspection data of plant.

(c) Operating data

a. Plant running check list and frequency of servicing required;
b. Safety precautions to be implemented;
c. Manual and automatic operation;
d. Operator's duties (logging requirements);
e. Pre-start checklist for each system;
f. Starting and stopping procedures.

(d) Mechanical equipment

a. Description of all major items with the make, model number, names, addresses and telephone numbers of the suppliers, manufacturers or their agents;
b. Design capacities of all equipment, including selection parameters, selection curves, capacity tables, etc;
c. Manufacturers' brochures and pamphlets;
   Schedule of spares with part numbers recommended to be held as stock.

(e) Maintenance instructions

a. Schedule of maintenance particulars, frequency of services and replacements;
b. Trouble-shooting guide;
c. Part number of all replacement items and spares;
d. Capacity curves;
e. Serial numbers of all items of equipment.

(f) Electrical equipment

   Schedule of equipment, indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
(ii) Maintenance instructions;
(iii) Manufacturers' brochures and pamphlets;
(iv) Complete as-built circuit diagrams and diagrammatic representation of interconnections of all electrical equipment.

(g) Instrumentation and control

(i) Description of each control system;
(ii) Schedule of control equipment indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
(iii) Maintenance instructions;
   Manufacturer's brochures and pamphlets.

(h) Drawings

(i) Paper prints of all as-built mechanical and electrical drawings;
(ii) Wiring diagrams framed behind glass shall be mounted adjacent to each relevant control panel.

## FB.5 TRAINING OF OPERATORS INCINERATOR OPERATION AND INSTALLATION

In addition to the requirements of Additional Specification **SD: General Training**, the Contractor shall allow and provide for additional training of the incinerator operating staff as specified and set out in this specification. The objective of this training will be to ensure that the following be achieved:

(a) High standard of operator skills;
(b) Proper incineration of waste material,
(c) Reduce the maintenance cost of the plant to an acceptable level, and to maintain the cost at this level in so far as these costs are affected by the operating conditions;
(d) Prevent maloperation of the plant and its associated equipment;
(e) Correct method of waste and ash handling,
(f) Ensure and assist in achieving and maintaining the conditions as laid down by the Atmospheric Pollution Prevention Act, 1965.

The Contractor shall, in collaboration with the Engineer, ensure that the incinerator plant personnel be re-evaluated on an annual basis by means of a set examination, to ensure the upkeep of skill level and knowledge. Compilation of a set examination shall form part of the training responsibilities.

The evaluation and training course to be utilised for the evaluation of the incinerator operators shall include at least the following:

(a) Equipment and component recognition;

(b) How to operate the incinerator, including:

(i) Waste handling
(ii) Loading and starting the incinerator
(iii) Operating and incineration temperature
(iv) Draught controlling
(v) Manual and automatic controlling of firing equipment
(vi) Cleaning of incinerator equipment
(vii) Ash removal and handling;

(c) Ash and grit removal procedures and methods;

(d) Control and operating of fuel firing equipment;

(e) Emergency procedures to be followed in the event of power failure, fuel leaks, burner failure, etc.

(f) Safety precautions to be followed and implemented;

(g) The identification, reporting and recording of faults and operation of equipment;

(h) The logging of incinerator plant operation, readings and settings.

## FB.6 LOGGING AND RECORDING PROCEDURES

The Contractor shall under this repair and maintenance contract institute a logging and recording system as part of his maintenance control plan as defined in Additional specification **SA: General and Maintenance**. This shall consist of a log and record book which shall be utilised to log and record all operations, faults, system checks, breakdowns, maintenance visits, inspections, fuel delivery, ash removal, readings, etc.

The logbook shall be kept in a safe place and shall only be utilised by the operating staff, the Contractor and the Engineer. Copies of the monthly entries and recordings into the logbook shall be submitted by the Contractor together with his monthly report to the Engineer.

The logbook shall be structured to include at least the following:

(a) Daily inspection and maintenance actions;
(b) Monthly inspection and maintenance actions;
(c) Six-monthly inspection and maintenance actions;
(d) Annual inspection and maintenance actions;
(e) Breakdown reports;
(f) Type and quantity of waste incinerated;
(g) Daily plant operating conditions, observations, recordings and measurements;
(h) Statutory inspection and test comments and reports;
(i) Fuel delivery report, stating the date, type of fuel, quantity and delivery vehicle registration number;
(j) Ash waste removal report, stating the date and vehicle registration number.

The Contractor shall also institute an attendance register which shall be kept in a safe place. This register shall be completed by all persons visiting the incineration installation, including:

(a) Incinerator operators, cleaning staff and supervisor
(b) Contractor and maintenance personnel
(c) Inspectors
(d) Department personnel
(e) Engineer

The register shall state the date, time-in, time-out, name, company and reason for visit.

A copy of the register shall be submitted by the Contractor together with his monthly report.

## FB.7 TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. The Contractor shall make arrangements for such tests and shall give at least 72 hours written notice to the Engineer, before commencing the test.

In the event of the plant or installation not passing the test, the Department shall be at liberty to deduct from the Contract amount all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the system is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Department may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

After completing the installation or systems, all equipment shall be tested, adjusted and readjusted until they operate to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the efficiency of all equipment, as well as certificates to be obtained from all relevant authorities and statutory bodies, etc.

## FB.8 QUALITY ASSURANCE SYSTEM

The Contractor shall institute an approved quality assurance (QA) system which shall be submitted to the Engineer for approval. The records of this QA system shall be kept throughout the duration of the Contract and submitted to the Engineer at regular intervals as required.

## FB.9 COMMISSIONING AND RECOMMISIONING OF PLANT AND INSTALLATION

### FB.9.1 GENERAL

On completion of the repair work and/or the installation of new systems the plant and equipment shall be put into operation after all tests and adjustments have been carried out to the satisfaction of the Engineer. Where new plant is installed, the Contractor shall run and operate the system for a period of time as specified by the Engineer and train the staff of the User Client to operate and maintain the system.

Logging of the operation of the installations shall commence immediately upon startup.

The Contractor shall submit a full commissioning report.

## FE 09.02 RECOMMISSIONING OF INCINERATOR INSTALLATION

On completion of the statutory inspections and tests or major incinerator repairs the Contractor shall recommission the incinerator and its ancillary equipment. This operation shall be done strictly in accordance with the manufacturer's specification and shall be witnessed by the Engineer. This shall include but not be limited to the following:

(a) All required precommissioning mechanical checks

(i) Check that incinerator interiors are clean and free of any foreign matter.
(ii) Ensure that new refractories are properly baked out in accordance with the manufacturer's specifications.
(iii) Check that all chambers are unobstructed and clean.
(iv) Check the operation of all dampers for proper movement.
(v) Ensure that the grit collectors are clean.
(vi) Ensure that all oil or gas burners are properly mounted.
(vii) Check that all loading and ashing doors are properly installed and operate freely.
(viii) Check that the chimney is clean and securely supported and fixed.
(ix) Ensure that the oil or gas supplies are working and that no leaks are present

(b) All required precommissioning electrical checks

(i) Check all wiring connections for tightness and repair any hot connections.
(ii) Check that all electrical equipment have been properly reconnected in accordance with the manufacturer's specification.
(iii) Perform and record all required electrical insulation tests on equipment.
(iv) Check and test all controls with main circuits isolated.
(v) Check all motor-driven equipment for correct rotational directions.
(vi) Check and test the operation of all indication and warning lights.
(vii) Check, set, record and readjust all equipment control and set points in accordance with manufacturer's specification.
(viii) Run all motor-driven equipment for a period to ensure free movement and correct operation, feed pumps only to be operated for a short interval to check rotation.
(ix) Check and test all solenoid, ignition and blower-fan operations.
(x) Test all temperature switching points and recalibrate to correct set points.

(c) Commissioning of the incinerator

On completion of the precommissioning checks the Contractor shall proceed with the commissioning of the incinerator. This shall be done strictly in accordance with the manufacturer's specification and shall include but not be limited to the following:

(i) Load incinerator with waste and close all ash and loading doors.
(ii) Ensure that the oil or gas supply to the burners are open.
(iii) Ensure that the electrical control panel is activated and all settings are in the ON-position.
(iv) Set damper controls to correct position.
(v) Activate burners and set temperature.
(vi) Allow burners to heat up chamber.

(vii) Set timers and record all cut-out points.

(viii) For coal-fired incinerators, load incinerator according to manufacturer's specification, light fire and load as directed.

The Contractor shall visit, inspect, test and readjust the incinerator over the 30-day period following the recommissioning to ensure the correct functioning of the incinerator and its associated equipment.

## FB.10 GUARANTEE OF INSTALLATION AND EQUIPMENT

The Contractor shall provide guarantees obtained from the manufacturer(s) and/or supplier(s) to the effect that each piece of new equipment, supplied and installed under the repair contract, complies with the required performance and will function as part of the complete system.

All new equipment, including, the complete new installations and the systems as a whole shall be guaranteed for a period of 12 (twelve) months commencing upon day of issue of certificate of completion for repair work of the installation.

## FB.11 MAINTENANCE TOOLS AND SPARES

Each incinerator installation shall be equipped with the necessary maintenance tools and spares required by the specific type of incineration installation for the daily operation and maintenance of the plant. At the start of the repair and maintenance contract the Contractor shall in the presence of the User Client make an inventory of the existing tools and spares, and any shortfall or damaged tools and spares shall be replaced with new. All replacement tools and spares shall be as specified by the incinerator and ancillary equipment manufacturers. These tools and spares shall be kept in a lockable room or cabinet of which the incinerator supervisor and the Contractor shall carry keys. The Contractor shall on a monthly basis take stock of these items in the presence of the incinerator supervisor and record and report to the Engineer. Any shortfall shall be replaced by the Contractor as part of his responsibility under this Contract.

The tools and spares to be carried shall include but not be limited to at least the following:

(a) Tools

(i) Combination hoe/rake
(ii) Poker
(iii) Shovel
(iv) All other necessary tools for the type of installation.

## FB.12 FUEL DELIVERY RECORDING AND CONTROL

As part of this repair and maintenance contract, the Contractor shall, in collaboration with the User Client and fuel provider, institute a quality and delivery control plan for each incinerator installation. This control plan shall consist of a set of records to be completed with each fuel delivery, stating the following:

(a) Delivery note number
(b) Date of fuel delivery
(c) Quantity of fuel delivered

(d) Type of fuel delivered
(e) Fuel sample identification number
(f) Contractor's signature on acceptance of information and fuel sample
(g) Fuel deliverer's signature
(h) Incinerator supervisor's signature
(i) Comments by any party.

The type of fuel to be accepted shall comply with the specification to be agreed between the User Client and the Engineer.

Where coal-fired incinerators are installed the Contractor shall be responsible for taking a sample of each batch of delivered coal and sending it to an approved laboratory for confirmation that the coal samples conform to the agreed type of coal for the specific installation. The result of the tested sample shall contain the following:

(a) Various coal sampled mesh sizes
(b) Calorific value
(c) Moisture content
(d) Ash content
(e) Ash fusion temperature
(f) Volatile content.

The results of these tests shall be submitted to the Engineer.

The Contractor shall, in collaboration with the Engineer, institute the necessary measures to ensure the safe keeping and security of the fuel storage. All the relevant recorded information shall be submitted monthly together with Contractor's maintenance schedules to the Engineer.

## FB.13 INCINERATED WASTE ASH REMOVAL RECORDING AND CONTROL

As part of this repair and maintenance contract, the Contractor shall, in collaboration with the User Client, ash Removal Company and the Engineer institute an ash removal control plan for each incinerator installation. This control plan shall consist of a set of records to be completed with each removal taking place and shall include the following:

Date of contact of Removal Company for removal of ash;
(a) Date of actual ash removal;
(b) Approximate quantity of ash removed;
(c) Ash destination address, to be completed by Removal Company;
(d) Random samples of ash taken and recorded by Contractor;
(e) Contractor's signature on acceptance of information;
(f) Removal company signature;
(g) Incinerator supervisor's acceptance signature;
(h) Comments by any party.

The Contractor shall at random take samples of the ash and send it to an approved laboratory for analysis in order to determine if correct incineration is taking place.

The Contractor shall, in collaboration with the User Client and the Engineer, also institute a control plan to ensure safe handling and storing of the ash.

All the relevant recorded information shall be submitted, together with Contractor's maintenance schedules, monthly to the Engineer.

## FB.14 REPAIR WORK TO INSTALLATIONS, SYSTEMS AND EQUIPMENT

## FB.14.1 GENERAL

During the repair and maintenance contract all the systems, installations and equipment shall be repaired as specified in this specification. This repair work shall include but not be limited to the specified specification details.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve. The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and relevant specifications included in this document.

The repair work items are listed in tabular form with all relevant details, such as capacity, size, manufacturer, model number, etc.

All repair work shall be executed within the period specified in the Appendix to Tender. All new equipment, materials and systems shall be furnished with a written guarantee of a defects liability period of 12 months commencing on the date of issue of a certificate of completion of the repair work. These guarantees shall be furnished in favour of the Department of Public Works.

Repair work items for the incinerator installations are categorised under the following headings:

(a) All requirements as laid down in the Occupational Health and Safety Act No 85 of 1993.
(b) Incinerator casing
(c) Bracings
(d) Refractories
(e) Grit collector
(f) Loading and ashing doors
(g) Chimney
(h) Draught control equipment
(i) Emission control
(j) Oil burners
(k) Electrical and temperature controls
(l) Intensifier
(m) Paintwork
(n) Oil storage and piping system
(o) Incinerating plant room.

## FB.14.2 INSPECTION OF INCINERATOR EQUIPMENT AND INSTALLATION

At the start of the repair and maintenance contract the Contractor shall decommission the incinerator installation, followed by an inspection and report to the Engineer on any defects, faults and repairs required, which shall include but not be limited to the following:

(a) Incinerator casing

Clean and inspect incinerator casing for any defects, corrosion, weld failures, etc, and if necessary perform a material thickness test.

(b) Bracings

Clean and inspect bracings for any defects, corrosion, weld failures and damages.

(c) Refractories

Clean and inspect all refractory work to the loading door, hearth, walls, roof, etc, for defects, cracks, damage and failures.

(d) Grit collector

Clean and inspect grit collector (if installed) for any defects and correct operation.

(e) Loading and ashing doors

Clean and inspect loading and ashing doors for any defects, damages and correct operation, including hinges, slides, slide guides, latches and handles.

(f) Chimney

Clean and inspect chimney stack, including mountings, welds, material, etc, for any defects, damage and repairs required.

(g) Draught control equipment

Clean and inspect all draught controls such as barometric damper, dooroperated draught limiter, stack damper, etc, for any defects, damages repairs required and correct operation.

(h) Emission control equipment

Clean and inspect all emission control equipment such as refractory screen, grit settling chamber, arrestor screen, etc, for any defects, damages, repairs required and correct operation.

(i) Fuel burners (if fitted)

Clean and inspect all fuel burner equipment, including primary and after burners for any defects, damages, repairs required and correct operation.

(j) Electrical and temperature controls

Clean and inspect all electrical control equipment, including control panel, temperature sensors, pyrometer, timers, circuit breakers, switches, pilot lights, solenoids, etc, for any defects, damage, repairs required and correct operation.

(k) Intensifier (if fitted)

Clean and inspect intensifier blower for any defects, damages, repairs required and correct operation.

(l) Paintwork

Clean and inspect paintwork to casing doors and chimney stack for any defects and damages.

(m) Fuel storage piping and pumping system

Clean and inspect all fuel storage tanks, day tanks, piping and pumping systems and installations for any leaks, defects, damages and repairs required.

(n) Incinerator housing

Clean and inspect incinerator house, floor, roofing, ash bunker, coal bunker (if installed), etc, for suitability, defects, damages and repairs required.

## FB.14.3 INCINERATOR EQUIPMENT AND INSTALLATION

Any repair work which may be required on the incinerator plant installation shall be executed using approved materials, equipment, methods and tooling suitable for the specific application. The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, statutory regulations, manufacturers' specifications and codes of practice and as specified in all additional and specifications included in this document. During the repair contract the following items are to be repaired and serviced as required by the Inspection Authority, incinerator manufacturer and this specification.

**Repair work to incinerator and ancillary equipment**

(a) Incinerator casing

Any corroded sections, damages to mild metal steel casings and welds shall be repaired in accordance with the manufacturer's specifications and the relevant SABS code for welding which shall include cutting, material, preparation, welding, welding material and equipment required to perform these repairs.

(b) Bracings

Any corroded sections and/or damages to the bracings and welds shall be repaired in accordance with the manufacturer's specification and the relevant SABS code for welding which shall include cutting, bracing material, preparation, welding, welding material and equipment required to perform these repairs.

(c) Refractories

Where refractories are found to be cracked, damaged and loose, these refractories shall be broken out, and the surfaces cleaned and prepared for new casting. The casting of new refractories shall be done in accordance with the manufacturer's specifications with the correct high temperature durable, high strength, high abrasion resistant monolithic castable material, mixed in the correct ratios, formed and applied to the correct thickness as specified by the manufacturer. Before the incinerator is recommissioned these refractories shall be baked out to ensure that there is no more trapped moisture.

(d) Grit collector (if installed)

Replace mountings if necessary to grit collector and clean of all foreign matter and dust. Where grit collector is concealed to such an extent that repairs are not possible, this unit shall be replaced with new in accordance with manufacturer's specification.

(e) Loading and ashing doors

Ensure the free movement of the loading door slides and guides. If damaged, provide required repairs to these slabs and guides, as well as repair of damages to the handles and door frame. If necessary, remove door refractories and recast with new as described in item (c) above. The hinges and latches to the ashing doors are to be cleaned and the Contractor shall make sure that they operate properly. If ashing doors are cracked or broken these are to be replaced with high grade cast-iron doors supplied by the manufacturer.

(f) Chimney

Any corroded sections of chimney stack shall be replaced with new chimney sections which shall be designed, manufactured, supplied and installed in accordance with the manufacturer's specification for the incinerator and the applicable site conditions.

New chimneys shall be manufactured of 3CR12 material. The Contractor shall ensure that all chimney mountings are replaced with new and are properly secured and fixed.

The Contractor shall reflash all roof penetration.

(g) Draught control equipment

All draught equipment shall be overhauled, and all damaged sections and equipment replaced with new original replacement parts as supplied by the manufacturer of the incinerator. This shall include the barometric damper, door-operated draught limiter and stack damper.

(h) Emission control equipment

All emission control equipment shall be repaired in accordance with the manufacturer's specification.

No equipment shall be changed from the original design. Where equipment is found to be damaged these shall be replaced with new as supplied by the manufacturer of the incinerator.

This equipment shall include the stainless steel arrestor screen, refractory section and low-velocity grit settling chamber.

(i) Fuel burner equipment

All fuel burner equipment such as the primary and after burners shall be dismantled, stripped, cleaned, serviced, overhauled and repaired in accordance with the manufacturer's specification. This shall include replacement of fuel jets if required. The fuel solenoids shall be properly cleaned and tested.
All blower fans shall be tested and if required, bearings shall be replaced, and fan blocks and passages cleaned.

All gaskets and joint seals are to be replaced. The unit shall be reassembled, refitted, tested and adjusted in accordance with the manufacturer's specification.

(j) Instrumentation and controls

All instrumentation and control equipment shall be inspected, tested, repaired, adjusted and where necessary replaced. All repair and service work shall be done strictly in accordance with the manufacturer's specification.

The repair work to the instrumentation and control equipment shall include at least the following:

(1) Test all equipment for correct operation.
(2) Inspect, test, service, adjust setting and if necessary repair and/or replace pyrometer.
(3) Inspect, recalibrate and if beyond repair, replace temperature sensors.
(4) Inspect, test, service, adjust and if necessary, replace timers.

(k) General electrical power installation

The Contractor shall be responsible for the repair and maintenance work of the general power installation in the incinerator house. All repair work to this installation shall be done in accordance with the Standard Specification for Electrical Installations and Equipment pertaining to Mechanical Services of the Department of Public Works. This work shall include all repair work to the existing power sockets, cabling, wiring, lighting, and distribution boards.

(l) Electrical control panels

All electrical control panels shall be inspected, tested, and repaired, including all equipment in the control panel. All repair and service work shall be done strictly in accordance with the manufacturer's specification.

The repair work to the electrical control panels shall at least include the following:

(1) Test all control equipment for correct operation.
(2) Check and test all MCBs, isolators, contactors, overloads, other type of motor drives, pilot lights, control switches, etc, and readjust all set points. Where equipment is found to be faulty these shall be replaced with new approved equipment.
(3) Check all wiring and connections for proper conducting and replace where hot connections are found.
(4) Clean out panel interior and exterior, inspect panel body, fascias, doors, paintwork, etc, and repair where necessary.

(m) Intensifiers (if fitted)

Dismantle, strip, service, overhaul intensifier blower in accordance with the manufacturer's specification. Reassemble, test and fit to incinerator.

(n) Paintwork

The Contractor shall clean, prepare and repaint the incinerator casing and chimney stack with 400 °C heat resistant paint in accordance with the manufacturer's specification.

The Contractor shall also be responsible for maintaining painted surfaces of the incinerator house and equipment.

(o) Fuel storage, piping and pumping systems

The Contractor shall inspect, clean, test, repair and where necessary, replace damaged equipment on the fuel storage, piping and pumping equipment. All equipment shall be serviced and repaired in accordance with the manufacturer's specification.

(p) Incinerator housing

The Contractor shall ensure that the incinerator house is kept clean and in a safe working condition.

## FB.15 MAINTENANCE TO INSTALLATIONS, SYSTEMS AND EQUIPMENT

### FB.15.1 GENERAL

Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with access to the site. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 24-month contract period. This part of the Contract shall include:

(a) Routine preventative maintenance;
(b) Corrective maintenance, and
(c) Breakdown maintenance,

as defined in Additional Specification SA: General Maintenance, for the specified installations described under FE 01 of this specification.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification **SA: General Maintenance** and this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, statutory regulations, standards, regulations, municipal laws and by-laws and the manufacturers' specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be instituted by the Contractor, as specified in Additional Specification SA: General Maintenance.
All new equipment, components and materials supplied and installed under the maintenance contract shall be furnished with a prescribed manufacturer's guarantee.

The maintenance work and items are to be categorised for each maintenance activity under the following headings:

(a) Incinerator
(b) Fuel firing equipment
(c) Fuel storage and handling equipment
(d) Waste handling and storage
(e) Incinerated waste and handling and removal
(f) Electrical installation and controls.

The Contractor shall be remunerated monthly, based on his performance, for maintaining the complete installation in a perfect functional condition.

### FB.15.2 ROUTINE PREVENTATIVE MAINTENANCE

This routine maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification **SA: General Maintenance** and this specification related to this work.

The routine maintenance work to be performed and executed shall include, but not be limited to the items listed in tables FB 15.02/1, FB 15.02/2, FB 15.02/3 and FB 15.02/4 below under the respective headings.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

**TABLE FB 15.02/1: DAILY ACTIONS AND MAINTENANCE**

| ITEM | MAINTENANCE DESCRIPTION | ACTION RESPONSIBILITY | ACTION |
|---|---|---|---|
| 1 | Type and quantity of waste | Incinerator supervisor | Check/Record |
| 2 | Fuel quantity consumed | Incinerator supervisor | Check/Record |
| 3 | Operation hours | Incinerator supervisor | Check/Record |
| 4 | Operation comments | Incinerator supervisor | Check/Record |
| 5 | Inspect fuel system for leakages and correct functioning. | Incinerator supervisor | Check/Record |
| 6 | Clean interior and exterior of incinerator and keep incinerator plant room clean. | Incinerator supervisor | Clean/Record |
| 9 | Complete log book actions as specified in FB 06. | Incinerator supervisor | Check/Record |

**TABLE FB 15.02/2: MONTHLY ACTIONS AND MAINTENANCE**

| ITEM | MAINTENANCE DESCRIPTION | ACTION RESPONSIBILITY | ACTION |
|---|---|---|---|
| 1 | All as listed under table FB 15.02/1 | Incinerator supervisor and Contractor | Check/Record Adjust/Repair |
| 2 | Test firing equipment as described by the manufacturer. | Contractor | Test/Record |
| 3 | Check the draught controls for correct operation in accordance with the manufacturer's specification. | Contractor | Check/Record |
| 4 | Inspect refractories and if found to be damaged it must be repaired. | Contractor | Check/Record |
| 5 | Lubricate all required lubrication points. | Incinerator supervisor and Contractor | Check/Service/ Record |
| 6 | Visual inspection of all incinerator house equipment and installations for any pending defects, faults, etc. | Incinerator supervisor and Contractor | Check/Record |
| 7 | Inspect and test all control functions and readjust if necessary. | Contractor | Test/Record/ Adjust |
| 8 | Inspect all seals and joints for leakages and replace if necessary. | Contractor | Check/Record/ Replace |

| | | | |
|---|---|---|---|
| 9 | Sample and analyse fuel quality. | Incinerator supervisor, fuel supplier and Contractor | Check/Record/ Test |
| 10 | Check waste ash removal implementation and report. | Incinerator supervisor, ash removal company and Contractor | Check/Record |
| 11 | Inspect, service, repair and replace where required all electrical equipment and installations. | Contractor | Test/Record Adjust/Repair |
| 12 | Inspect, service all fuel piping and equipment. | Contractor | Test/Record Adjust/Repair |

**TABLE FB 15.02/3: SIX-MONTHLY ACTIONS AND MAINTENANCE**

| ITEM | MAINTENANCE DESCRIPTION | ACTION RESPONSIBILITY | ACTION |
|---|---|---|---|
| 1 | All as listed under tables FB 15.02/1 and FB 15.02/2 | Incinerator supervisor and Contractor | Check/Record Adjust/Repair |
| 2 | Inspect loading and ashing doors, repair and replace as required. | Contractor | Check/Record Service/Repair |
| 3 | Fully test, inspect, service, adjust, repair and replace as required draught control equipment. | Contractor | Check/Record Service/Repair |
| 4 | Inspect, clean out, repair and replace as required all fuel storage and firing equipment. | Contractor | Check/Record Service/Repair |
| 5 | Inspect, clean and repair chimney stacks. | Contractor | Check/Record Service/Repair |

**TABLE FB 15.02/4: ANNUAL ACTIONS AND MAINTENANCE**

| ITEM | MAINTENANCE DESCRIPTION | ACTION RESPONSIBILITY | ACTION |
|---|---|---|---|
| 1 | All as listed under tables FB 15.02/1, FB 15.02/2 and FB 15.02/3 | Incinerator supervisor and Contractor | Check/Record Adjust/Repair |
| 2 | Annual survey by Occupational, Health and Safety Inspector. | Contractor, Department and Inspector | Inspect/Test Service/Repair |
| 3 | Inspect and repaint all equipment and building elements where required. | Contractor | Inspect/Test Service/Repair |
| 4 | Inspect, clean, repair refractories. | Contractor | Inspect/Test Service/Repair |
| 5 | Remove, strip, service, repair, adjust and repair fuel burners and associated equipment. | Contractor | Inspect/Test Service/Repair |

## FB.15.3 CORRECTIVE MAINTENANCE

The corrective maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification **SA: General Maintenance** and this specification related to this work.

The Contractor shall inspect and check all equipment, materials, systems and installation for any pending breakdowns, maladjustments or anomalies of equipment.

The Contractor shall report and take actions to correct such defects.

## FB.15.4 BREAKDOWN MAINTENANCE

Breakdown maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification **SA: General Maintenance**.

All breakdown problems experienced shall be acted upon within the time limitations allowed in the General Maintenance specifications.

All breakdown maintenance shall be done in accordance with the relevant specifications, standards, regulations and codes.

The Contractor shall have access to the necessary spares, equipment and tools for any possible breakdowns.

## FB.16 MEASUREMENT AND PAYMENT

**FB.16.01(a) Item**

**As-built information and O&M Manuals**..... Unit: sum

The tendered sum shall include full compensation for the compilation and submission of inventory lists and operating and maintenance manuals in accordance with Additional Specification SB: Operating and Maintenance Manuals. The tendered sum shall also include full compensation for all equipment necessary to establish the exact position and levels of services, as well as the recording of all information on electronic drawing format.

**FB.16.01(b) Item**

**Development of training syllabus**..... Unit: number

The tendered sum shall include full compensation for the compilation and submission of training syllabus. The tendered sum shall also include full compensation for all equipment necessary to establish the syllabus, as well as the recording of all information and providing to the engineer.

**FB.16.01(c) Item**

**Presenting a training course for operators and maintenance staff.** ..... Unit: days

The tendered sum shall include full compensation for the compilation and submission of training course presentation agenda, list of attendees and duration and location for the training to take place. The tendered sum shall also include full compensation for all equipment necessary to establish and present the course, as well as the recording of all information and providing to the engineer.

**FB.16.01(d) Item**

**Logging and recording**..... Unit: sum

The tendered sum shall include full compensation for the compilation and submission of operation conditions, services, maintenance visits, reports, breakdowns, samples, inspections, tests, as well as the recording of all information and providing to the engineer.

**FB.16.01(e) Item**

**Reconditioning of the incinerator**..... Unit: number

Reconditioning of the incinerator to bring back to good working conditions. The tendered rate shall include full compensation for work to include but not limited to repairs (including removal and re-installing) of damaged fans, controls, electrical connections as well as doors and latches as well as the supply and installation of dilapidated components, testing and commission of the complete reconditioning of the incinerator installation..

**FB.16.02(a) Item**

**Maintenance**..... Unit: points

The unit of measurement shall be the points (total 10 per month) as reflected by the works carried on site regarding monthly maintenance task describe in this specification. The tendered rate shall include full compensation for the monthly servicing of the installation, including the cleaning and material or tools used to carry out the monthly maintenance tasks.

# FC: KITCHEN EQUIPMENT

**CONTENTS:**



## FC.1 SCOPE: KITCHEN EQUIPMENT INSTALLATION, REPAIR AND MAINTENANCE

This specification covers the general repair and maintenance of kitchen equipment, which include the following:

(a) Industrial stoves
(b) Extract canopies

This specification also addresses training of
- User Client's operators, and
- Maintenance staff.

This specification shall form an integral part of the repair and maintenance contract document, and shall be read in conjunction with the additional and specifications compiled as part of this document.

### FC.1.1 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall deemed to form part thereof

#### FC.1.1.1 SABS and other specifications and codes

SANS 10400 - The applications of the building regulations
SANS 10142 - Code of practice for the wiring of remises
SANS 10140 - Identification colour marking
SANS 10044 - Parts I to IV: Welding
SANS 10103 - The measurement and rating of environmental noise with respect to annoyance and speech communications
Atmospheric Pollution Prevention Act No 45 of 1965

**FC.1.1.2 Department of Public Works Specifications**

PW 371 - Specification of materials and methods to be used

Standard Specification for electrical installations and equipment pertaining to mechanical installations

**FC.1.1.3 Occupational Health and Safety Act of 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) shall be adhered to.

**FC1.1.4 Manufacturers' specifications, codes of practice and installation instructions**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**FC1.1.5 Municipal regulations, laws and by-laws**

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

## FC.2 VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS

The following additional general specifications and requirements shall be read in conjunction with this specification and shall be adhered to.

### FC.2.1 GENERAL REPAIR AND INSTALLATION REQUIREMENTS

(a) All materials and equipment supplied and installed, shall be new and of high quality and manufactured to the relevant specifications, suitable for providing efficient, reliable and trouble-free service.

(b) All work shall be executed in a first-class workman-like manner by qualified tradesmen.

(c) All equipment, component parts, fittings and materials supplied and/or installed, shall conform in respect of quality, manufacture, test and performance to the requirements of the applicable current SABS specifications and codes, except where otherwise specified or approved by the Engineer in writing.

(d) All materials and workmanship which, in the opinion of the Engineer, is inferior to that specified for the work will be condemned. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Engineer.

(e) The Contractor shall submit a detailed list of the equipment and material to be used to the Engineer for approval before placing orders or commencing installation.

(f) All new equipment, materials and systems shall be installed and positioned such as not to impede on access routes, entrances and other services. The Contractor shall coordinate these items taking other services and equipment into account.

(g) All control equipment and serviceable items shall be installed and positioned such that they will be accessible and maintainable.

(h) The Contractor shall make sure that all safety regulations and measures are applied and enforced during the repair and construction periods to ensure the safety of the public and the User Client.

(i) Repair work shall be programmed in accordance with Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures, to ensure the shortest possible down-time of any service, and the least inconvenience to the User Client and the public. The Contractor shall make sure that the necessary notifications and notices are timeously put into place for these activities.

## FC.3 OPERATING AND MAINTENANCE MANUALS

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals and system data sheets.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

All information shall be recorded and reproduced in electronic format as well as supplying the Department with three sets of hard copies.

Over and above what is specified in Additional Specification SB: Operating and Maintenance Manuals, the operating and maintenance manual to be compiled shall be structured to include at least the following:

(a) System description

Complete description and the working of the equipment.

(b) Commissioning data

Complete commissioning, test and inspection data of equipment.

(c) Operating data

(i) Equipment running checklist and frequency of servicing required;
(ii) Safety precautions to be implemented;
(iii) Manual and automatic operation;
(iv) Operator's duties (logging requirements);
(v) Lubricating oils and service instructions;
(vi) Pre-start checklist for individual equipment;
(vii) Starting and stopping procedures.

(d) Mechanical equipment

(i) Description of all major items with the make, model number, names, addresses and telephone numbers of the suppliers, manufacturers or their agents;

(ii) Design capacities of all equipment, including selection parameters, selection curves, capacity tables, etc;
(iii) Manufacturer's brochures and pamphlets;
(iv) Schedule of spares with part numbers recommended to be held as stock.

(e) Maintenance instructions

(i) Schedule of maintenance particulars, frequency of services and replacements;
(ii) Trouble-shooting guide;
(iii) Part numbers of all replacement items and spares;
(iv) Capacity curves of pumps, fans and compressors, etc;
(v) Serial numbers of all items of equipment.

(f) Electrical equipment

(i) Schedule of equipment, indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
(ii) Maintenance instructions;
(iii) Manufacturer's brochures and pamphlets;
(iv) Complete as-built circuit diagrams and diagrammatic representation of interconnections of all electrical equipment.

(g) Instrumentation and control

(i) Description of each control system;
(ii) Schedule of control equipment, indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
(iii) Maintenance instructions;
(iv) Manufacturer's brochures and pamphlets.

(h) Drawings

(i) Paper prints of all as-built mechanical and electrical drawings;
(ii) Wiring diagrams of each individual control panel shall be put inside the panel, and a set provided to the maintenance supervisor.

## FC.4 OPERATORS TRAINING AND EQUIPMENT INSTALLATION

In addition to the requirements of Additional Specification SD: General Training, the Contractor shall allow and provide for training of the kitchen equipment operators as specified and set out in this specification. The objective of this training will be to ensure that the following be achieved:

(a) High standard of operator skills;
(b) High equipment operating efficiencies to reduce operating costs;

(c) Reduce the maintenance cost of the equipment to an acceptable level, and maintain the cost at this level in so far as it is affected by the operating conditions;
(d) Prevent maloperation of the equipment.

The training course to be utilised for the evaluation of the kitchen operating staff shall include at least the following:

(a) Equipment and component recognition.

(b) How to operate the equipment, including the following:

(i) Starting the equipment;
(ii) Manual and automatic controlling;
(iii) Shut-down of equipment for short periods;

(iv) Cleaning of equipment;

(v) Normal shut-down.

(c) Emergency procedures to be followed in the case of power failure, water shortage, etc.

(d) Safety precautions to be followed and implemented.

(e) The identification, reporting and recording of faults and operation of equipment.

(f) The logging of equipment operation, readings and settings.

## FC.5 LOGGING AND RECORDING PROCEDURES

The Contractor shall under this repair and maintenance contract institute a logging and recording system as part of his maintenance control plan as defined in Additional Specification SA: General Maintenance. This shall consist of a log and record book which shall be utilised to log and record all operations, faults, system checks, breakdowns, maintenance visits, inspections, readings, etc.

The logbook shall be kept in a safe place inside the kitchen supervisor's office and shall only be utilised by the supervisor, the Contractor and the Engineer. Copies of the monthly entries and recordings into this logbook shall be submitted by the Contractor together with his monthly report to the Engineer.

The logbook shall be structured to include at least the following:

(a) Daily inspection and maintenance actions;
(b) Monthly inspection and maintenance actions;
(c) Six-monthly inspection and maintenance actions;
(d) Breakdown reports;
(e) Daily equipment operating conditions, observations, recordings and measurements (including steam pressure, water meter readings and number of meals prepared);
(f) Statutory inspection and test comments and reports.

The Contractor shall also institute an attendance register, which shall be kept in a safe place inside the kitchen supervisor's office. This register shall be completed by all persons handling the kitchen equipment, including:

(a) Contractor and maintenance personnel
(b) Engineer
(c) User Client
(d) User Client associates.

The register shall state the date, time-in, time-out, name, company and reason for visit. A copy of the register shall be submitted by the Contractor together with his monthly report.

## FC.6 TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. The Contractor shall make arrangements for such tests and he shall give at least 72 hours written notice to the Engineer before commencing the test.

In the event of the equipment not passing the test, the Employer shall be at liberty to deduct from the Contract amount all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any equipment is operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the system is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Department may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

After completing the installation or system, all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the efficiency of all equipment, as well as certificates to be obtained from all relevant authorities and statutory bodies, etc.

The Contractor shall only utilise departmentally approved inspection authorities for all inspections and tests to be conducted. This will be done and approved in writing between the relevant parties.

## FC.7 QUALITY ASSURANCE SYSTEM

The Contractor shall institute an approved quality assurance (QA) system which shall be submitted to the Engineer for approval. The records of this QA system shall be kept throughout the duration of the Contract and submitted to the Engineer at regular intervals as required.

## FC.8 COMMISSIONING AND RECOMMISIONING OF EQUIPMENT

### FC.8.1 GENERAL

On completion of the repair work and/or the installation of new equipment the equipment shall be put into operation after all tests and adjustments have been carried out to the satisfaction of the Engineer. Where new equipment is installed the Contractor shall run and operate the equipment for a period of time as specified by the Engineer and train the staff of the User Client to operate and maintain the system.

Logging of the operation of the installations shall commence immediately upon start-up.

The Contractor shall submit a full commissioning report.

## FC.8.2 RECOMMISSIONING OF EQUIPMENT

On completion of the inspections and tests of major repairs the Contractor shall recommission the equipment. This operation shall be done strictly in accordance with the manufacturer's specification and shall be witnessed by the Engineer. The operation shall include but not be limited to the following:

(a) All required precommissioning mechanical checks

(i) Check all steam, water and drain connections.
(ii) Check all moving points.
(iii) Check all seals.
(iv) Check and record that all lubrication to equipment and components has been done in accordance with manufacturer's specification.
(v) Check and ensure that all valves and safety valves are correctly installed and in the correct operating position. Safety valves are to be set in accordance with the required blow-off pressure for the installation.

(b) All required precommissioning electrical checks

(i) Check all wiring connections for tightness and repair any hot connections.
(ii) Check that all electrical equipment has been properly reconnected in accordance with the manufacturer's specification.
(iii) Perform and record all required electrical insulation tests on equipment.
(iv) Check and test all controls without livening up electrical equipment.
(v) Check all motor-driven equipment for correct rotational directions.
(vi) Check and test the operation of all indication and warning lights.
(vii) Check, set, record and readjust all equipment control and set points in accordance with manufacturer's specifications.
(viii) Run all motor-driven equipment for a period to ensure free movement and correct operation, feed pumps only to be operated for a short interval to check rotation.

(c) Commissioning of equipment

On completion of the precommissioning checks the Contractor shall proceed with the commissioning of the equipment. This shall be done strictly in accordance with the manufacturer's specification and shall include but not be limited to the following:

(i) During the commissioning process all level and warning system checks are to be performed on the water-level control system where applicable.
(ii) During load conditions the equipment shall be readjusted and finally switched to automatic operation on completion of all automatic control functions for correct operation where applicable.

The Contractor shall visit, inspect, test and readjust the installation during the 30-day period following the recommissioning to ensure the correct functioning of the equipment and its associated equipment.

## FC.9 GUARANTEE OF INSTALLATION AND EQUIPMENT

The Contractor shall provide guarantees obtained from the manufacturer(s) and/or supplier(s) to the effect that each piece of new equipment, supplied and installed under the repair contract, complies with the required performance and will function as part of the complete system.

All new equipment including the complete new installations and the systems as a whole shall be guaranteed for a period of 12 (twelve) months commencing on the day of issue of a certificate of completion for repair work of the installation.

## FC.10 REPAIR WORK TO INSTALLATIONS, SYSTEMS AND EQUIPMENT

### FC.10.1 GENERAL

All repair work shall be executed with approved materials and equipment suitable to the systems and/or installations they serve. The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and specifications included in this document.

The repair work items are listed in tabular form with all relevant details such as capacity, size, manufacturer, model number, etc.

All repair work shall be executed within the specified durations as listed in the Appendix to Tender. All new equipment, materials and systems shall be furnished with a written guarantee of a defects liability period of 12 months from date of issue of a certificate of completion for the repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

Repair work items for the kitchen equipment are categorised under the following headings:

(a) Stoves
(b) Extract canopies.

### FC.10.2 STOVES

(a) Repair plate temperature controllers (electric and gas stoves).
(b) Repair oven doors.
(c) Repair Sprague tubing (electric stoves).
(d) Replace circuit breakers (electric stoves).

### FC.10.3 EXTRACT CANOPIES

(a) Check and reset fire dampers.
(b) Clean filters/replace damaged filters.

## FC.11 MAINTENANCE TO INSTALLATIONS AND EQUIPMENT

### FC.11.1 GENERAL

Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with access to the site. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 24-month contract period.

This part of the Contract shall include:

(a) Routine preventative maintenance;
(b) Corrective maintenance, and
(c) Breakdown maintenance,

as defined in Additional Specification SA: General Maintenance, for the specified installations described under FC 01 of this specification.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance and this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, statutory regulations, standards, regulations, municipal laws and by-laws and the manufacturers' specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be instituted by the Contractor, as specified in Additional Specification SA: General Maintenance.

All new equipment, components and materials supplied and installed under the maintenance contract shall be furnished with a prescribed manufacturer's guarantee.

The maintenance work and items are to be categorised by the Contractor for each maintenance activity under the following headings:

(a) Stoves
(b) Extract canopies.

The Contractor shall be remunerated monthly, based on his performance, for maintaining the complete installation in a perfect functional condition.

## FC.12 DEFINITION AND QUALIFICATION OF ACTIONS

### FC.12.1 Daily maintenance actions

Daily actions are the responsibility of the User Client. These are to be performed by the responsible staff in the kitchens.

(a) Operating checks

(i) Check water connections and supply.
(ii) Check steam connections, supply and pressure.
(iii) Check drain connections.
(iv) Check operation of temperature controllers.
(v) Check operations of mechanical movement.
(vi) Do a visual check for steam leaks.

These daily checks shall be logged at the facility, i.e. by the kitchen supervisor.

## FC.12.2 Monthly maintenance actions

Monthly maintenance actions are the responsibility of the Contractor.

(a) General maintenance on all kitchen equipment

(i) Check all safety valve settings and operation.
(ii) Check all steam traps, sight glasses and steam/condense piping including lagging and pipe supports.
(iii) Clean out all strainers.
(iv) Check all overload settings and safety devices on electric control panels.
(v) Lubricate all bearings, gear boxes and check oil levels and top up where required.
(vi) All daily maintenance schedules shall be included in the monthly schedules.

(b) Stoves

(i) Check operation of oven doors and latches.
(ii) Check the operation and calibration of temperature controllers (electric and gas).
(iii) Check the operation of plates.
(iv) Check the electrical connections including cables.
(v) Check the operation of the circuit breakers.

(c) Extract canopies

(i) Clean filters.
(ii) Check operation of fire dampers.
(iii) Check operation of extract fan.
(iv) Check control panel.
(v) Check all electrical connections.
(vi) Clean all grease cups.

## FC.12.3 Biannual maintenance actions

Biannual maintenance actions are the responsibility of the Contractor.

(a) General

(i) Check all electric motor bearings.

(ii) Check all electric motor for phase balance (three-phase).

(iii) Check staking and running amps on all electrical equipment.
(iv) Check and reset overload, over and under voltage settings on control equipment.

(v) Check and reset all timers.

(vi) Rotating equipment inside ovens:
(1) Clean equipment;
(2) Lubricate bearings/lushes;
(3) Realign.

(vii) Clean all strainers.

(viii) Check all connections (water, steam and drainage).

(ix) All electrical connections must be re-tightened.

(x) Reset and check all pressure-reducing valves and safety valves.

Note: The above annual actions shall include the daily and monthly actions.

## FC.13 MEASUREMENT AND PAYMENT

**FC.13.01(a) Item**

**As-built information and O&M Manuals**..... Unit: sum

The tendered sum shall include full compensation for the compilation and submission of inventory lists and operating and maintenance manuals in accordance with Additional Specification SB: Operating and Maintenance Manuals. The tendered sum shall also include full compensation for all equipment necessary to establish the exact position and levels of services, as well as the recording of all information on electronic drawing format.

**FC.13.01(b) Item**

**Development of training syllabus**..... Unit: number

The tendered sum shall include full compensation for the compilation and submission of training syllabus. The tendered sum shall also include full compensation for all equipment necessary to establish the syllabus, as well as the recording of all information and providing to the engineer.

**FC.13.01(c) Item**

**Presenting a training course for operators and maintenance staff.** ..... Unit: days

The tendered sum shall include full compensation for the compilation and submission of training course presentation agenda, list of attendees and duration and location for the training to take place. The tendered sum shall also include full compensation for all equipment necessary to establish and present the course, as well as the recording of all information and providing to the engineer.

**FC.13.01(d) Item**

**Logging and recording**..... Unit: sum

The tendered sum shall include full compensation for the compilation and submission of operation conditions, services, maintenance visits, reports, breakdowns, samples, inspections, tests, as well as the recording of all information and providing to the engineer.

**FC.13.01(e) Item**

**Stove heating plates**..... Unit: number

The unit of measurement shall be the number of repaired or replaced heating plates. The tender rate shall include full compensation for the repair or replacement work, making good the installation as well as the testing of the works completed.

**FC.13.01(f) Item**

**Knobs and handles**..... Unit: sum

The unit of measurement shall be the sum of repairs or replacements for all knobs and handles of the stove. The tender rate shall include full compensation for the repair or replacement work, making good the installation as well as the testing of the works completed.

**FC.13.01(g) Item**

**Degreasing of convection oven**..... Unit: number

The unit of measurement shall be the number of stoves on which the degreasing was conducted. The tender rate shall include full compensation for the work, making good the installation as well as the testing of the works completed.

**FC.13.01(h) Item**

**Extraction canopy**..... Unit: number

The unit of measurement shall be the number of extraction canopies repaired. The tender rate shall include full compensation for the repair or replacement of components including the fan and motor, attenuators, mounting, ducting, making good the installation as well as the testing of the works completed.

**FC.13.02(a) Item**

**Maintenance**..... Unit: points

The unit of measurement shall be the points (total 10 per month) as reflected by the works carried on site regarding monthly maintenance task describe in this specification. The tendered rate shall include full compensation for the monthly servicing of the installation, including the cleaning and material or tools used to carry out the monthly maintenance tasks.

**FC.13.02(b) Item**

**Testing of installation**..... Unit: sum

The unit of measurement shall be the sum to cover all testing parameters as prescribed by the engineer under circumstance where the faulty components on the stove cannot be determined. The tendered rate to include the removal of components, testing and repairs/replacements of such faulty components, installations and testing.

# FD: FIRE PROTECTION INSTALLATIONS

**CONTENTS:**



## FD.1 SCOPE: FIRE PROTECTION SYSTEMS

This section of the specification covers the general maintenance of the conventional firefighting equipment installations, which include the following:

a) Fire hydrants

b) Fire hose reels

c) Fire extinguishers.

This specification shall form an integral part of the maintenance and servicing contract document and shall be read in conjunction with the additional compiled as part of this document.

## FD.2 STANDARD SPECIFICATIONS

### FD.2.1 General Standard Specifications, Regulations and Codes

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall deemed to form part thereof.

a) SANS and other specifications and codes

b) SANS 6172; - Fire extinguishers, classification system, fire ratings

c) CKS 532; - Fire extinguishers, foams

d) SANS 10105-1; - Fire extinguishers, portable, classification system, control systems

e) SANS 1322; - Fire extinguishers, portable, non-refillable

f) SANS 1567; - Fire extinguishers, portable, rechargeable, carbon dioxide

g) SANS 1573; - Fire extinguishers, portable, rechargeable, foams

h) SANS 1475-1; - Fire extinguishers, portable, reconditioning

i) SANS 810; - Fire extinguishers, powder, portable, rechargeable

j) SANS 1522; - Fire extinguishers, powders

k) SANS 1571; - Fire extinguishers, transportable, rechargeable

l) SANS 889; - Fire extinguishers, water fire extinguishers, portable,

m) SANS 10105-1; - Firefighting equipment, fire extinguishers, portable

n) SANS 1322; - Firefighting equipment, fire extinguishers, portable,

o) SANS 543; - Firefighting equipment, fire hose reels

p) SANS 10105-2; - Firefighting equipment, fire hose reels

q) SANS 1128-2; - Firefighting equipment, fire hose, pipe couplings, pipe

r) SANS 1128-1; - Firefighting equipment, fire hydrants

s) SANS 810; - Firefighting equipment, powder fire extinguishers,

t) SANS 1475-1; - Firefighting equipment, reconditioning, fire

u) SANS 889; - Firefighting equipment, water fire extinguishers,

v) SANS 543; - Fire hose reels

w) SANS 10105-2; - Fire hose reels, classification systems, control systems

x) SANS 1475-2; - Fire hose reels, reconditioning

y) SANS 1456-5; - Fire hoses, collapsible, delivery pipes (firefighting), oil

z) SANS 1456-2; - Fire hoses, collapsible, delivery pipes (firefighting),

aa) SANS 1456-1; - Fire hose, collapsible, delivery pipes (firefighting),

bb) SANS 1456-4; - Fire hoses, collapsible, delivery pipes, coated materials,

cc) SANS 1456-3; - Fire hoses, collapsible, delivery pipes, uncoated

dd) SANS 1128-2; - Fire hoses, pipe couplings, pipe connections

ee) SANS 1128-1; - Fire hydrants, fire-fighting equipment

ff) SANS 1056-1; - Fire safety, ball valves

gg) SANS 10400 - Application of the NBR

hh) SANS 10287 - Automatic sprinkler installations for fire fighting

ii) FPO/82/6E(STS 10) - Standard technical specification for a pump installation

**FD.2.2** **Department of Public Works Specifications:**

a) PW 371 - Specification of Materials and Methods to be used

**FD.2.3** **Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003.**

**FD.2.4** **Manufacturers' specifications, codes of practice and installation instructions**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

In the event of a discrepancy between the statutory codes and the manufacturer's codes, the discrepancy shall be brought to the attention of the Engineer, who, in collaboration with the Employer and Local Authority, will prescribe the steps to be taken.

**FD.2.5** **Municipal regulations, laws and by-laws**

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

## FD.3 OPERATING AND MAINTENANCE MANUALS

No operating and maintenance manuals will be developed for this section.

The contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

Over and above the afore-mentioned, the Contractor shall also be responsible for the compilation of the following:

(a) Cataloguing of the fire-fighting equipment

All the fire-fighting equipment must be catalogued under the following headings:

(i) Location and details of equipment
(ii) Service date
(iii) Service frequency
(iv) Condition of equipment
(v) History: Usage incidents, breaking, etc.

(b) Provision of a "Fire Plan"

The Contractor shall provide a Fire Plan indicating positions, and keeping up to date any changes of the equipment position, status and operation.

## FD.4 OPERATORS TRAINING AND EQUIPMENT INSTALLATIONS

The end user shall be trained by the supplier of the firefighting equipment to operate the individual firefighting equipment.

Firefighting training shall be done by a nationally accredited training institute (Fire Protection Association of South Africa).

## FD.5 LOGGING AND RECORDING PROCEDURES

The Contractor shall under this repair and maintenance contract institute a logging and recording system as part of his maintenance control plan as defined in Additional Specification SA: General Maintenance. This shall consist of a log and record book, which shall be utilised to log and record all service records, system checks, breakdowns, maintenance visits, inspections, etc.

The logbook shall be stored in a safe place as agreed with the User Client and the Engineer and shall only be utilised by the Fire Protection Officer, the Contractor and the Engineer. The Contractor shall submit copies of the monthly entries and recordings into the logbook, together with his monthly report, to the Engineer.

The logbook shall be structured to include at least the following:

(a) Service records
(b) Inspection and maintenance actions
(c) Breakdown reports
(d) Fire safety officer's comments
(e) Inspection and test comments and reports.

The Contractor shall also institute an attendance register, which shall be kept in a safe place as agreed with the User Client and Engineer. This register shall be completed by all persons visiting the installation, including:

(a) Fire safety officer
(b) Contractor
(c) Inspectors
(d) Department personnel
(e) Engineer.

The register shall state the date, time-in, time-out, name, company and reason for visit.

A copy of the register shall be submitted by the Contractor together with his monthly report.

## FD.6 REPAIR WORK TO INSTALLATIONS, SYSTEMS AND EQUIPMENT

### FD.6.1 GENERAL

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve. The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all applicable additional and specifications included in this document.

The repair work items are listed with all relevant details, such as capacity, size, manufacturer, model number, etc.

All repair work shall be executed within the specified durations listed in the Appendix to Tender. All new equipment, materials and systems shall be furnished with a written guarantee of a defects liability period of 12 months commencing on the date of issue of a certificate for completion of the repair work. These guarantees shall be furnished in favour of the Department of Public Works.

Repair work items for the firefighting equipment shall be categorised under the following headings:

(a) Fire hydrants

(b) Fire hose reels

(c) Fire extinguishers.

## FD.6.2 REPAIR WORK TO EXISTING EQUIPMENT

The Contractor shall at the start of the repair and maintenance contract inspect, record and report on all the existing firefighting equipment listed in this specification.

This inspection and report shall comprise the following:

(a) Establishing the condition of all equipment;
(b) Reporting all defects to equipment;
(c) Compliance of equipment in respect of the governing regulations at the start of the Contract;
(d) Recording all equipment with an identifying system;
(e) Details of all equipment;
(f) Suitability of equipment regarding the purpose it serves;
(g) Water supply pressure;
(h) Listing of latest service.

The Contractor shall report on the above in writing to the Engineer. No repair, service and/or replacement work shall commence prior to approval by or directives from the Engineer.

## FD.6.3 FIRE HYDRANTS

Repair work to the fire hydrants system shall include, but not be limited to the following:

(a) Replacement of damaged, broken, leaking, corroded pipe work and fittings;
(b) Replacement of main hydrant seal;
(c) Repair/replacement of quick coupling catches;
(d) Replacement of damaged shaft ends (right angle wheel type);
(e) Replacement of damaged and expired or missing 65 mm diameter hose streamers;
(f) Replacement of damaged or missing 65 mm diameter hose nozzle;
(g) Replacement of damaged valve stem seal;
(h) Replacement, repair and repainting of concrete pedestals;

(i) Replacement of fire damaged, missing or shortfall fire signage to equipment;
(j) Hydrants shall be labelled with identifying tags and details recorded.

## FD.6.4 FIRE HOSE REELS

Repair work to the fire hose reel systems shall include but no be limited to the following:

(a) Replacement of the hose drum seal where leaks occur;
(b) Replacement of the 30 m hose where perished, damaged or missing;
(c) Repair damaged hose drums and, where directed by the Engineer, replace with new;
(d) Replace gland packing and gaskets to hose reel shut-off valve;
(e) Replace missing hose reel shut-off valve wheel handles;
(f) Number and catalogue hose reel;
(g) Where hose reels shut-off valves are damaged beyond repair, these shall be replaced with new;
(h) All hose reel mountings shall be checked and where loose or damaged, replaced with new;
(i) Where paintwork of equipment has deteriorated, such equipment items shall be replaced and repainted in accordance with the manufacturer's specification;
(j) Hose reels shall be labelled with identifying tags and details recorded, including service record.

## FD.6.5 FIRE EXTINGUISHERS

Repair work to the fire extinguishers shall include, but not be limited to the following:

(a) Replace wall mounting boards and brackets where damaged or missing.
(b) Dry chemical powder extinguishers shall be repaired and serviced and shall include at least the following:

(i) Replace discharge hose and nozzle where damaged or missing;
(ii) Replace gauge on bottle where reading is incorrect, damaged or missing;
(iii) Check, service and repair activation mechanism;
(iv) Replace DCP powder;
(v) Recharge discharge cylinder to the required capacity;
(vi) Reseal discharge mechanism;
(vii) Replace instructions on extinguishers where necessary;
(viii) Extinguishers shall be labelled with identifying tags and details recorded, including service record.

(c) CO 2 extinguishers shall be repaired and serviced and shall include at least the following:

(i) Replace discharge nozzle and pipe where damaged or missing;
(ii) Replace gauge on bottle where reading is incorrect, damaged or missing;
(iii) Repair activation mechanism;
(iv) Recharge with CO2 to required capacity;

(v) Reseal discharge mechanism;
(vi) Replace instructions on extinguishers where necessary;
(vii) Extinguishers shall be labelled with identifying tags and details recorded, including service record.

(d) Water extinguishers shall be repaired and serviced and shall include at least the following:

(i) Check cylinder for corrosion and report to Engineer. Where directed, the complete unit shall be replaced;
(ii) Replace discharge hose and nozzle where damaged and missing;
(iii) Replace gauge on bottle where damaged, missing or where reading is incorrect;
(iv) Check service and repair activation mechanism;
(v) Replace water content;
(vi) Recharge discharge cylinder to the required capacity;
(vii) Reseal discharge mechanism;
(viii) Replace instructions on extinguisher where damaged or missing;
(ix) Extinguishers shall be labelled with identifying tags and details recorded, including service record.

(e) Foam type extinguisher shall be serviced and repaired and shall include at least the following:

(i) Check cylinder for corrosion and report to Engineer. Where directed, the complete unit shall be replaced;
(ii) Replace discharge hose and nozzle where damaged or missing;
(iii) Replace gauge on bottle where damaged, missing or incorrect;
(iv) Check, service and repair activation mechanism;
(v) Replace foam concentrate content;
(vi) Recharge discharge cylinder to required capacity;
(vii) Reseal discharge mechanism;
(viii) Replace instructions on extinguisher where damaged or missing;
(ix) Extinguishers shall be labelled with identifying tags and details recorded, including service record.

## FD.7 MAINTENANCE TO INSTALLATIONS, SYSTEMS AND EQUIPMENT

### FD.7.1 GENERAL

Annual maintenance responsibilities for each installation including all units and components as specified shall commence with access to the site. A difference shall be made in payment prior to and after practical completion of the work.

Maintenance of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 36-month contract period.

This part of the Contract shall include:

(a) Routine preventative maintenance;
(b) Corrective maintenance, and
(c) Breakdown maintenance,

as defined in Additional Specification SA: General Maintenance, for the specified installations described under this specification.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance and this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, statutory regulations, standards, regulations, municipal laws and by-laws and the manufacturers' specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be instituted by the Contractor, as specified in Additional Specification SA: General Maintenance.

All new equipment, components and materials supplied and installed under the maintenance contract shall be furnished with a prescribed manufacturer's guarantee. The maintenance work and items are to be categorised for each maintenance activity under the following headings:

(a) Fire hydrants
(b) Fire hose reels
(c) Fire extinguishers.

The Contractor shall be remunerated monthly, based on his performance, for maintaining the complete installation in a perfect functional condition.

### FD.7.2 ROUTINE PREVENTATIVE MAINTENANCE

The routine maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance, and this specification related to this work.

The routine maintenance work to be performed and executed shall include, but not be limited to the items listed below under the respective headings.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

### FD.7.2.1 Fire hydrants

Maintenance work shall include at least the following actions and shall be scheduled in accordance with the relevant regulations and requirements and include monthly and six-monthly inspections and services.

(a) Check hydrant valve seal.
(b) Check right angle wheel for tightness.
(c) Check valve stem and or top for damage.
(d) Check valve stem seal and readjust.
(e) Check operation of quick couplers.
(f) Check operation (opening and closing movement of valve).
(g) Check water pressure and flow.
(h) Check stand pipe for rigidness and leaks.
(i) Log maintenance schedule.
(j) Report defects for processing and repair.
(k) For fire water pipe systems see Technical Specifications relevant.
(l) For fire pump see Technical Specifications relevant.

### FD.7.2.2 Fire hose reels

Maintenance work shall include at least the following actions and shall be scheduled in accordance with the relevant regulations and requirements and include monthly and six-monthly inspections and services.

(a) Check drain seal.
(b) Roll down hose and check for cracks or perishing.
(c) Check operation of PWD type nozzle.
(d) Check operation of drain.
(e) Check operation of fire hose reel valve.
(f) Lubricate moving parts of drum.
(g) Check pressure and flow of fire hose reel.
(h) Check piping for leaks and damages.
(i) Log maintenance schedules.
(j) Report defects for processing and repair.
(k) For fire water pipe systems see Technical Specifications relevant.
(l) For fire pumps see Technical Specifications relevant.

### FD.7.2.3 Fire extinguishers

Maintenance work shall include at least the following actions and shall be scheduled in accordance with the relevant regulations and requirements and include monthly and six-monthly inspections and services.

(a) General
    (i) Check mounting of backboard and bracket.
    (ii) Check charge of the extinguisher.
    (iii) Check the condition of the discharge.

(iv) Check the mechanism condition of the discharge hose.

(v) Update the log entry on the extinguisher.

(vi) Log maintenance schedule.

(vii) Report defects for processing and repair.

(b) Individual types of extinguishers

Over and above the preceding requirements, the following shall apply to individual types of extinguishers.

(i) DCP extinguishers: Check charge and replace powder at prescribed intervals.

(ii) CO2 extinguisher: Check charge.

(iii) Water extinguisher: Replace water at pre-described intervals.

(iv) Foam extinguisher:

Check foam mix and replace at predetermined intervals.

## FD.7.3 CORRECTIVE MAINTENANCE

This corrective maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance, and the Specification related to this work.

The Contractor shall inspect and check all equipment, materials, systems and installations for any pending breakdowns, maladjustments or anomalies of equipment.

The Contractor shall report and take actions to correct such shortfall.

## FD.7.4 BREAKDOWN MAINTENANCE

Breakdown maintenance of the installations, systems and equipment shall be done in accordance with Additional Specifications SA: General Maintenance.

All breakdown problems experienced shall be acted upon within the time limitations allowed in the General Maintenance specifications.

All breakdown maintenance shall be done in accordance with the relevant specifications, standards, regulations and codes.

The Contractor shall have access to the necessary spares, equipment and tools for any possible breakdowns.

## FD.8 MEASUREMENT AND PAYMENT

**FD.08.01(a) Item**

**Inspection and reporting**..... Unit: number

The tendered sum shall include full compensation for the inspection and written report on all items, systems, components, equipment and installations, including the establishment of any defects, leaks conditions, damages, shortfalls, structural soundness, and repairs required, details of existing equipment and suitability of the equipment for the purpose it serves.

**FD.08.01(b) Item**

**Testing of installation**..... Unit: number

The unit of measurement shall be the number of testing conducted to cover all testing parameters as prescribed by the engineer, such as water pressure upstream and downstream under circumstance where the water pressure for hydrants and hose reels is low. The tendered rate to include the removal of components, testing and producing a report on the findings.

**FD.08.01(c) Item**

**Servicing, cleaning and repair of fire extinguishers**..... Unit: number

The tendered rate shall include full compensation for the repair or replacement of all damaged, faulty or missing discharge hoses and nozzles, pressure gauges, operating instructions, the recharging of discharge cylinder to required capacity for DCP, water and foam extinguishers, and the recharging of CO2 extinguisher to capacity, repair, resealing of CO2 discharge mechanism, checking, servicing and repairing of activation mechanisms, replacement of water and foam extinguishers that have corroded cylinders, replacement of DCP, water or foam content of extinguishers, the replacement of fire cupboard and cabinet doors and locks, damaged, missing or shortfall fire signage, brackets and backboards, etc. The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

**FD.08.01(d) Item**

**Servicing, cleaning and repair of fire hydrants and hose reels**..... Unit: number

The tendered rate shall include full compensation for the repair or replacement of damaged, broken, leaking or corroded pipework and fittings, main hydrant seals, quick coupling catches, shaft ends for right-angle hand wheel type hydrants, streamers, hose nozzles, valve steam seals, fire cupboard doors and locks, damaged, missing or shortfall fire signage, etc. The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

The tendered rate shall include full compensation for the repair or replacement of damaged hose drums, mountings and shut-off valves, replacement of damaged or missing 30 m hoses, hose nozzles, shut-off valve wheel handles, hose drum seals where leaks occur, gland packing and gaskets of shut-off values, repainting of deteriorated paintwork, replacement of fire cupboard doors and locks, damaged, missing or shortfall fire signage, etc. The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

**FD.08.01(e) Item**

**Replace Piping**..... Unit: m

The unit of measurement shall be the length of defective pipes replaced. The tendered rate shall include full compensation for the removal of the defective pipe, the supply and installations of the new pipe as well as testing.

**FD.08.01(f) Item**

**Replace 90 Degree Bends**..... Unit: number

The unit of measurement shall be the number of defective bends replaced. The tendered rate shall include full compensation for the removal of the defective bend, the supply and installations of the new bend as well as testing.

**FD.08.01(g) Item**

**Replace reducers**..... Unit: number

The unit of measurement shall be the number of defective reducers replaced. The tendered rate shall include full compensation for the removal of the defective reducer, the supply and installations of the new reducer as well as testing.

**FD.08.01(h) Item**

**Replace Tees**..... Unit: number

The unit of measurement shall be the number of defective tees replaced. The tendered rate shall include full compensation for the removal of the defective tee, the supply and installations of the new tee as well as testing.

**FD.08.01(i) Item**

**Supply and Installation of fire extinguishers**..... Unit: number

The tendered rate shall include full compensation for the supply, delivery, positioning, installation and hand-over of the fire extinguishers, including all necessary brackets, backboards, etc. The tendered rates shall also include full compensation for the supply, delivery, positioning and fixing of all fire signage as required by regulation. The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

**FD.08.01(j) Item**

**Supply and Installation of fire extinguishers**..... Unit: number
The tendered rate shall include full compensation for the supply, delivery, positioning, installation and hand-over of the fire extinguishers, including all necessary brackets, backboards, etc. The tendered rates shall also include full compensation for the supply, delivery, positioning and fixing of all fire signage as required by regulation. The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

**FD.08.01(k) Item**

**Supply and Installation of fire extinguishers**..... Unit: number
The tendered rate shall include full compensation for the supply, delivery, positioning, installation and hand-over of the fire extinguishers, including all necessary brackets, backboards, etc. The tendered rates shall also include full compensation for the supply, delivery, positioning and fixing of all fire signage as required by regulation. The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

**FD.08.01(l) Item**

**Supply and Installation of fire hydrant**..... Unit: number
The tendered rate shall include full compensation for the supply, delivery, positioning, installation, testing, commissioning and hand-over of fire hydrants, including all necessary pipework, cabinets, cupboards, valves, brackets, fittings, bends and the reinstating of existing surfaces such as walls, floors, ceilings, etc. The tendered rate shall also include full compensation for the supply, delivery and positioning and fixing of all fire signage as required by regulation. The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

**FD.08.01(m) Item**

**Supply and Installation of fire hose reels**..... Unit: number
The tendered rate shall include full compensation for the supply, delivery, positioning, installation, testing, commissioning and hand-over of fire hose reels, including all necessary pipework, cabinets, cupboards, valves, brackets, fittings, bends and the reinstating of existing surfaces such as walls, floors, ceilings, etc. The tendered rate shall also include full compensation for the supply, delivery and positioning and fixing of all fire signage as required by regulation. The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

**FD.08.01(n) Item**

**Supply and Installation of pressure gauge**..... Unit: number

The tendered rate shall include full compensation for the supply, delivery, positioning, installation, testing, commissioning and hand-over of pressure gauge, including all necessary pipework, valves, brackets, fittings, bends and the reinstating of existing surfaces such as walls, floors, ceilings, etc.

**FD.08.02(a) Item**

**Maintenance**..... Unit: points

The unit of measurement shall be the points (total 10 per month) as reflected by the works carried on site regarding monthly maintenance task describe in this specification. The tendered rate shall include full compensation for the monthly servicing of the fire protection installations.

**FD.08.02(b) Item**

**Testing of installation**..... Unit: sum

The unit of measurement shall be the sum to cover all testing parameters as prescribed by the engineer under circumstance where the faulty components on the installations cannot be determined. The tendered rate to include the removal of components, testing and repairs/replacements of such faulty components, installations and testing.

**FD.08.02(c) Item**

**Mandatory service of fire protection installations**..... Unit: number

The unit of measurement shall be the number of equipment or installations serviced. The tendered rate shall include full compensation for the servicing of the units as per standards and regulations. The service provider must be registered with the relevant regulating bodies and provide valid certificates before commencement of the works.