

	SCOPE OF WORK	Engineering
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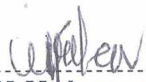
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1. INTRODUCTION

The Auxiliary Bay and Station Services chillers are used for building air-conditioning and cooling. The chillers are water cooled and have two sections which are the evaporator section and condenser sections. The evaporator section produces chilled water and is connected to the air-handling units. Heat exchange is done in the evaporator between the refrigerant and water. The condenser section is connected to the cooling tower. Heat exchange between the water from the cooling tower and refrigerant happens on the condenser. Water flows back to the cooling towers, where ultimately heat from the building is rejected. The chillers services offices, control rooms, equipment rooms and the computer room.

The Stores and Commercial Buildings and Medical Buildings are fitted with Direct Expansion (Dx) Units. The Dx units consist of outside condenser units as well as well as air-handling units which operate as evaporator units.

2. SUPPORTING CLAUSES

2.1 SCOPE

2.1.1 Purpose

The purpose of this scope of work is to outline the services required for the Kendal Power Station chiller units. The scope of work outlines the requirements for the supply of the chiller units, installation of the units, maintenance, refurbishment, servicing and the supply of critical spares.

2.1.2 Applicability

This document is applicable to the HVAC system at Kendal Power Station

2.2 Normative / Informative References

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

- [1] 240-70164623 Eskom HVAC Design Guideline
- [2] 240-53113685- Design Review Procedure
- [3] 240-102547991 General Technical Specification for HVAC Systems Standard
- [4] 240-70164623, Eskom Heating Ventilation and Air Conditioning (HVAC) Design Guideline

2.2.2 Informative

- [1] ISO 9001 Quality Management Systems
- [2] ISO 14001 of 2004: Environmental Management System
- [3] Occupational Health and Safety Act
- [4] SANS 10147: Refrigerating systems, including plants associated with air-conditioning systems

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[5] SANS 10400-Part O: Application of National Building Regulations: Lighting & Ventilation

2.3 Definitions

Term	Definition
Chiller	A machine that removes heat from a liquid, usually water, so the chilled liquid can be pumped through a building to cool the air
Compressor	The mechanical heart of an air conditioning or heat pump system that compresses low-pressure refrigerant gas into high-pressure, hot gas to circulate it through the system
Air-handling unit	A large, centralized device used to regulate, clean, and circulate air as a core part of a building's heating, ventilation, and air-conditioning (HVAC) system
Refrigerant	A special chemical fluid used in air conditioners, refrigerators, and heat pumps to absorb and move heat
Direct Expansion unit	A simple cooling setup where liquid refrigerant flows straight through an expansion device into the evaporator to absorb heat directly from the space or medium being cooled

2.3.1 Classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
AHU	Air-Handling Unit
Dx	Direct Expansion
HVAC	Heating Ventilation Cooling and Air-Conditioning
QC	Quality Control
QCP	Quality Control Plan
SOW	Scope of Work

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3. OBJECTIVES

The objective of this contract is to establish a five (5) year agreement for the supply of new chillers, their installation, repair, supply of associated spares and maintenance for key areas within Kendal Power Station. This document will clearly define all the requirements and constraints, sufficient for eligible contractors to estimate costs and compile a proposal for review.

The work is spread across multiple buildings around the station and shall be classified according to the buildings as follows:

1. Auxiliary bay - Unit 1 to 6: A total of 13 water cooled chiller systems
2. Station service building (SSB): A total of 3 water cooled chiller systems
3. Commercial building: 3 air-cooled (Dx) systems
4. Medical building: One air-cooled (Dx) system

The contract shall ensure continued HVAC availability, improved equipment reliability, reduction of obsolescence risk and compliance with environmental requirements regarding refrigerant conversion from R22 systems to environmentally acceptable alternatives. In summary, the work involves:

- Supply of HVAC chillers and associated equipment.
- Supply of critical and normal spares.
- Retrofit of obsolete refrigerant-based systems.
- Installation and commissioning of replacement HVAC systems.
- Repair and refurbishment of existing HVAC assets.
- Emergency breakdown support.
- Condition assessment services.
- Preventative and corrective maintenance.

4. DETAILED SCOPE OF WORK

4.1 Chiller Supply Scope of Work

This section is aimed at explaining the nature of work required for each area of focus in the station. It is important to note that, the currently functional units are those in the Auxiliary Bay, and these are modern units that are utilising refrigerant R134a. The rest of the buildings are currently not functional and will require a retrofit to integrate the old refrigerant R22 with a system that is compliant with the current regulations.

For the water-cooled chillers, the new units should be able to supply the same cooling capacity as the currently installed system or more. The new system must fit within the dedicated chillers environment with minimal to no modifications to the currently existing arrangements, these include the civil bases on which the units are to be installed, the condenser cooling water supply pipes and their dimensions, the evaporator chilling water inlet and outlet pipes and dimensions.

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For the DX system, more changes to the arrangement are acceptable as the systems, such as frames, evaporator and condenser setups. This is due to the systems being much older and as a result, may not easily integrate with newer more modern systems. However, all proposed modifications must be well justified and subject to approval.

4.1.1 Auxiliary Bay Chillers

The Auxiliary Bay chillers are water cooled chillers that utilise R134a refrigerant for cooling. The chillers are mounted on civil bases and have evaporator and condenser units.

The evaporator section produces chilled water and is connected to the air-handling units. Heat exchange is done in the evaporator between the refrigerant and water. The condenser section is connected to the cooling tower. Heat exchange between the water from the cooling tower and refrigerant happens on the condenser. Water flows back to the cooling towers, where ultimately heat from the building is rejected. The chillers services offices, control rooms, equipment rooms and the computer room.

The chillers use auxiliary cooling water for the condenser circuit as duty and the HVAC cooling towers as backup. If it is required for new chillers to be installed, the current civil bases should be utilised. The water pipework and nominal bores should remain the same

Quantity

- 12 Units

Technical Specifications

- Refrigerant: R134a.
- Cooling Capacity: 582 kW minimum.
- Supply Voltage: 400V $\pm$ 10%.
- Frequency: 50 Hz.
- Condenser water inlet temperature: minimum: 27°C, maximum 30°C.
- Condenser water outlet temperature: minimum 31°C, maximum: 36°C
- Chilled water outlet temperature: 6-7°C
- Chilled water inlet temperature: 8-10°C
- Dimensions: 7.265mX2.18mX2.54m (LXWXH)
- Operating weight: 3083 kg
- Compressor size: Circuits A & B: 80 tons of refrigeration
- Chiller and Evaporator water pipes nominal bore sizes: 150 NB

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Quantity

- 1 Unit

Technical Specifications

- Refrigerant: R134a.
- Cooling Capacity: 577 kW minimum
- Nominal power supply (V-pH-Hz): 400-3-50
- Voltage range: 360-440V
- Condenser water inlet temperature: minimum: 27°C, maximum 30°C.
- Condenser water outlet temperature: minimum 31°C, maximum: 36°C
- Chilled water outlet temperature: 6-7°C
- Chilled water inlet temperature: 8-10°C
- Dimensions: 3.059m X 9.36m X 1.743 m (LXWXH)
- Operating weight: 3020 kg
- Chiller and Evaporator water pipes nominal bore sizes: 150 NB

4.1.2 Station Service Building (SSB)

The Station Services Building chiller plant utilises water cooled chillers with the same working principle as the Auxiliary Bay Chillers. The condenser water circuit receives its supply from the Auxiliary Cooling system as the main supply and the dedicated HVAC cooling tower unit situated outside of the SSB as backup.

Quantity

- 3 Chillers

Technical Requirements

- Refrigerant: R22
- Minimum Cooling Capacity: 509 kW +10%
- Voltage ratings and limits (V-pH-Hz): 400-3-50Hz
- Condenser water inlet temperature: minimum: 27°C, maximum 30°C.
- Condenser water outlet temperature: minimum 31°C, maximum: 36°C
- Chilled water outlet temperature: 6-7°C
- Chilled water inlet temperature: 9-11°C
- Dimensions: 4.255m X 0.912 X 1.956 m (LXWXH)
- Mass: 4400 kg
- Chiller and Evaporator water pipes nominal bore sizes: 150 NB
- The chiller types should be changed to chillers that utilise the refrigerants stipulated in SANS 10147

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4.1.3 Commercial and Medical Buildings

The Commercial and Medical buildings consists of air-cooled chillers (Dx units). In the Dx units, the refrigerant directly comes into contact with the cooling coil in the AHU, cooling the air in the AHU. The refrigerant will exchange heat with air in the AHUs and evaporate into low temperature, low pressure vapour. The air in the AHUs gets cooled and is transported to the offices through ducts. The low pressure, low temperature vapour will then go into the compressor, where it is compressed into high pressure, high temperature gas. Heat from the high temperature, high pressure gas is rejected into heat drawn from the atmosphere by the outside condenser unit and the vapour condenses into high pressure, medium temperature liquid. The refrigerant passes through the expansion valve, where it becomes a low pressure, low temperature liquid.

The Dx units use air as their primary source of refrigerant cooling. The units are mounted on civil bases on the roof tops of the commercial and medical buildings. If it is required for the units to be changed, no modifications should be done to the currently existing civil bases. The current civil bases should accommodate the mass and dimensions of the Dx units to be installed.

The currently existing Dx units utilise R22 refrigerant as the cooling media. The Contractor should supply and install a Dx unit that utilises the refrigerants with a global warming potential (GWP) of less than 1000 and change the cooling coils of the air-handling units to suit the required refrigerant

4.1.3.1 Commercial Building

Mezzanine Office Technical Specifications

- Capacity: 123 kW+10%
- Refrigerant: R22
- The condenser unit, compressor and fans are mounted on a frame with dimensions 3.352mX2.024mX1.477m (LXWXH)
- Supply Voltage: 380V

Main Office Technical Specifications (Two identical units)

- Capacity: 64 Kw+10%
- Refrigerant: R22
- The condenser unit, compressor and fans are mounted on a frame with dimensions 3.352mX1.054mX1.477m (LXWXH)
- Supply Voltage: 380V

4.2 Maintenance and Servicing Scope of Work: Water-cooled chiller

The following shall apply for any maintenance services required on the water-cooled chillers:

4.2.1 Detailed Scope of Work

- Inspect the complete chiller system.
- Record the **existing condition and operating parameters before maintenance.**

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- Clean and service the condenser and evaporator water circuits.
- Inspect and clean strainers, filters and water-side components.
- Check refrigerant circuit condition.
- Inspect compressor condition and operating performance efficiency.
- Inspect electrical/control panels.
- Check all safety and protection devices.
- Check refrigerant leaks.
- Check insulation and pipework.
- Test the chiller under operating conditions after servicing.
- Provide a detailed service report with **before-and-after readings**.
- Identify defects requiring future repair, but **do not replace major components without approval**.

4.2.2 Compressor

The following should be recorded with regards to the compressor before servicing commences:

- Record compressor suction pressure.
- Record compressor discharge pressure.
- Record suction temperature.
- Record discharge temperature.
- Record compressor running current on all phases.
- Record voltage.
- Record compressor operating hours, if available.
- Record oil pressure/differential pressure, where applicable.
- Record oil level and oil condition.
- If the oil levels are found to be low, the supplier should top-up the oil and do oil sampling
- Record refrigerant superheat/subcooling where applicable.
- Record compressor vibration.
- Record evaporator and condenser entering/leaving water temperatures.
- Record chilled-water and condenser-water flow rates, where measurable.

4.2.2.1 Chiller electrical condition:

The following activities are specifically for the compressor/chiller electricals:

- Compressor motor winding resistance.
- Winding insulation resistance
- Phase-to-phase resistance balance.

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- Phase current balance while running.
- Terminal connections for overheating/looseness.
- Contactor condition.
- Overload protection.
- Motor protection devices.
- Earth continuity.
- Signs of overheating or electrical deterioration.

4.2.3 Compressor oil

- Inspect oil level.
- Check oil colour and appearance.
- Check for abnormal odour or contamination.
- Check for metal particles.
- Inspect the oil filter/strainer.
- Do oil sampling
- Replace oil pumps

4.2.4 Condenser

- Isolate and drain as required.
- Inspect condenser tubes.
- Mechanical/chemical cleaning as appropriate.
- Remove scale and fouling.
- Inspect tube condition.
- Check for corrosion.
- Check tube leakage.
- Inspect tube sheets.
- Inspect water boxes.
- Inspect gaskets
- **This should be done before and after servicing**

4.2.5 Evaporator

- Inspect evaporator tubes.
- Clean tubes as required.
- Check for scaling/fouling.
- Inspect water boxes.

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- Inspect tube sheets.
- Check for leakage.
- Inspect gaskets.
- Clean strainers.
- Verify chilled-water flow.
- Record entering/leaving chilled-water temperatures.
- **This should be done before and after servicing**

4.2.6 Refrigerant circuit

- Refrigerant pressure checks.
- Refrigerant leak detection.
- Inspect refrigerant piping.
- Inspect joints and fittings.
- Check service valves
- Check refrigerant sight glass where fitted.
- Check filter-drier condition where applicable.
- Check expansion valve operation.
- Check solenoid valves.
- Check refrigerant charge condition.
- Check superheat.
- Check subcooling.
- Check refrigerant temperature sensors.
- Check insulation on suction piping.
- If refrigerant is low, the contractor should identify the cause and top up the refrigerant after the cause has been identified.
- Top up refrigerant

4.2.7 Chiller efficiency

The chiller efficiency test should include a performance test.

4.2.8 Chilled Water

- Entering temperature and pressure
- Leaving temperature and pressure
- Flow rate

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4.2.9 Condenser Water

- Entering temperature and pressure
- Leaving temperature and pressure
- Flow rate

4.2.10 Refrigerant

- Suction pressure
- Discharge pressure
- Suction temperature
- Discharge temperature

4.2.11 Mandatory routine service

- Cleaning
- Inspection
- Lubrication where applicable
- Electrical checks
- Instrument checks
- Condenser/evaporator cleaning
- Vibration measurements

4.2.12 Electrical Scope of Work

The electrical scope of work for the boards and motors for the chilled water and condenser pumps will be done by Eskom Kendal Power Station

4.3 Maintenance and Servicing Scope of Work: Dx units

4.3.1 Detailed Scope of Work

- Inspect the complete Dx system.
- Record the **existing condition and operating parameters before maintenance.**
- Clean and service the condenser and AHU components.
- Inspect and clean strainers and filters.
- Check refrigerant circuit condition.

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- Inspect compressor condition and operating performance efficiency.
- Inspect electrical/control panels.
- Check all safety and protection devices.
- Check refrigerant leaks.
- Check insulation and pipework.
- Test the Dx unit under operating conditions after servicing.
- Provide a detailed service report with **before-and-after readings**.
- Identify defects requiring future repair, but **do not replace major components without approval**.

4.3.2 Compressor

The following should be recorded with regards to the compressor before servicing commences:

- Record compressor suction pressure.
- Record compressor discharge pressure.
- Record suction temperature.
- Record discharge temperature.
- Record compressor running current on all phases.
- Record voltage.
- Record compressor operating hours, if available.
- Record oil pressure/differential pressure, where applicable.
- Record oil level and oil condition.
- If the oil levels are found to be low, the supplier should top-up the oil and do oil sampling
- Record refrigerant superheat/subcooling where applicable.
- Record compressor vibration.
- Record evaporator and condenser entering/leaving water temperatures.
- Record chilled-water and condenser-water flow rates, where measurable.

4.3.3 Dx unit electrical condition:

The following activities are specifically for the compressor/Dx units electricals:

- Compressor motor winding resistance.
- Winding insulation resistance
- Phase-to-phase resistance balance.
- Phase current balance while running.
- Terminal connections for overheating/looseness.

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- Contactor condition.
- Overload protection.
- Motor protection devices.
- Earth continuity.
- Signs of overheating or electrical deterioration.

4.3.4 Compressor oil

- Inspect oil level.
- Check oil colour and appearance.
- Check for abnormal odour or contamination.
- Check for metal particles.
- Inspect the oil filter/strainer.
- Do oil sampling
- Replace oil pumps

4.3.5 Condenser

- Isolate and drain as required.
- Inspect condenser tubes.
- Mechanical/chemical cleaning as appropriate.
- Remove scale and fouling.
- Inspect tube condition.
- Check for corrosion.
- Check tube leakage.
- Inspect tube sheets.
- Inspect water boxes.
- Inspect gaskets
- **This should be done before and after servicing**

4.3.6 AHU

- Inspect AHU tubes.
- Clean tubes as required.
- Check for scaling/fouling.
- Check for leakage.
- Inspect gaskets.
- Clean strainers.

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- Verify refrigerant flow.
- Record entering/leaving refrigerant temperatures.
- **This should be done before and after servicing**

4.3.7 Refrigerant circuit

- Refrigerant pressure checks.
- Refrigerant leak detection.
- Inspect refrigerant piping.
- Inspect joints and fittings.
- Check service valves
- Check refrigerant sight glass where fitted.
- Check filter-drier condition where applicable.
- Check expansion valve operation.
- Check solenoid valves.
- Check refrigerant charge condition.
- Check superheat.
- Check subcooling.
- Check refrigerant temperature sensors.
- Check insulation on suction piping.
- If refrigerant is low, the contractor should identify the cause and top up the refrigerant after the cause has been identified.
- Top up refrigerant

4.3.8 Chiller efficiency

The chiller efficiency test should include a performance test.

4.3.9 Refrigerant

- Suction pressure
- Discharge pressure
- Suction temperature
- Discharge temperature

4.3.10 Mandatory routine service

- Cleaning
- Inspection
- Lubrication where applicable

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- Electrical checks
- Instrument checks
- Condenser/evaporator cleaning
- Vibration measurements

5. COMPULSORY SITE CLARIFICATION MEETING AND SITE WALK-DOWN

Tenderers shall attend a compulsory site clarification meeting and site walk-down at Kendal Power Station before submitting a tender. Each Tenderer must therefore submit the signed attendance confirmation with the tender submission. Failure to attend the compulsory site clarification meeting and site walk-down shall render the tender non-responsive.

The objective is to:

- Familiarise tenderers with the existing HVAC installations.
- Confirm existing equipment locations.
- Verify equipment accessibility.
- Assess available installation space.
- Assess interface requirements with existing infrastructure.
- Assess maintenance access requirements.
- Assess potential installation constraints.

6. INSTALLATION REQUIREMENTS

For all systems, the contractor shall provide:

- Equipment submittal for units that will be replaced for approval
- Detailed installation methodology.
- Rigging plans.
- Safety file.
- Risk assessments.
- Isolation schedules.

The Contractor shall minimise modifications where possible to:

- Existing civil bases.
- Existing chilled water pipework.
- Existing condenser water pipework.
- Existing building structures.

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- Existing electrical interfaces.

7. COMMISSIONING REQUIREMENTS

For the systems where commissioning is applicable, the contractor shall provide:

- Factory Acceptance Test (FAT) procedures.
- Site Acceptance Test (SAT) procedures.
- Commissioning procedures.
- Commissioning reports.
- Performance test reports.

Performance tests shall demonstrate:

- Cooling capacity.
- Water flow rates.
- Refrigerant operating conditions.
- Electrical consumption.
- System reliability.

8. CONTRACTOR DELIVERABLES

The contractor shall submit:

- Quality Control Plan (QCP).
- Method Statement.
- FAT documentation.
- Commissioning reports.
- Performance reports.
- Training material.
- Operation and Maintenance Manuals.
- Spare Parts List.
- As-built drawings.
- Maintenance Schedule.
- Equipment Datasheets.
- Warranty documentation.

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9. BREAKDOWN SUPPORT

The contractor shall have personnel to assist if required in case of any breakdowns or failures on site.

10. SPARES SUPPLY

The contractor should be able to readily supply ANY spares items for the water-cooled and Dx units when required.

11. TRAINING

The contractor shall provide training, which includes:

- System operation.
- Preventative maintenance.
- Fault finding.
- Refrigerant management.
- Safety requirements.
- Emergency procedures.

12. DEVELOPMENT TEAM

- Madini Mulaudzi
- Mphalela Mokonyane

13. ACCEPTANCE

This document has been seen and accepted by:

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14. REVISIONS

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**Supply of new chillers and associated spares,
installation, repair and maintenance.**

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