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NNR: NO No.:	KOEBERG METEOROLOGICAL PROGRAMME			PAGE 1

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EMERGENCY MANAGEMENT SENIOR PHYSICIST	METEOROLOGIST	EMERGENCY MANAGEMENT MANAGER
DATE 2022-10-31	**DATE** 2022-10-31	**DATE** 2022-10-31

THIS PROCEDURE HAS BEEN SEEN AND ACCEPTED BY:

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FCA	ALARA REVIEW	SUPERSEDES
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1.0 PURPOSE

1.1 To establish the responsibilities for the Koeberg Meteorological Programme.

1.2 To describe the operating, maintenance and calibration/Verification process of the Koeberg Meteorological equipment.

2.0 SCOPE

2.1 Applicable to meteorological services rendered to Koeberg Nuclear Power Station.

3.0 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

3.1.1 **Backup Parameters** – All non-critical meteorological parameters on the primary or backup tower.

3.1.2 **Critical Data** – Data used to calculate the dispersion quality of the air at most likely height of release.

3.1.3 **Delta Temperature** – The temperature difference between two specified levels on a mast.

3.2 Abbreviations

3.2.1 **AWS** – Automatic Weather Station

3.2.2 **CCW** – Counter Clockwise

3.2.3 **CR** – Condition Report

3.2.4 **CW** – Clockwise

3.2.5 **DMM** – Digital Multimeter

3.2.6 **ECC** – Emergency Control Centre

3.2.7 **FFD** – Fitness for Duty

3.2.8 **KEP** – Koeberg Emergency Plan

3.2.9 **NNR** – National Nuclear Regulator

3.2.10 **QRL** – Quality Records List

3.2.11 **SCU** – Signal Conditioning Units

3.2.12 **SHE** – Safety, Health and Environment

4.0 REFERENCES

4.1 Referenced Documents

4.1.1 238-52, Rev 1: Emergency Planning: Meteorological Requirements for Nuclear Installations

4.1.2 238-54, Rev 1: Radiological Protection Licensing Requirements for Koeberg Nuclear Power Station

4.1.3 335-2, Rev 5: Koeberg Nuclear Power Station Management Manual

4.1.4 Design No. 00110-6: Upgrade of the Meteorological Data Acquisition and Display System

4.1.5 KAA-500, Rev 14: The Process for Controlled Procedures

4.1.6 KSA-011, Rev 14: The Requirements for Controlled Documents

4.2 Applicable Documents

4.2.1 238-47: Radiological Environmental Surveillance Requirements

4.2.2 Gill UVW Anemometer Instruction Manual

[redacted]

4.2.4 KAG-002: Koeberg Emergency Plan Training Programme Guide

4.2.5 KBA 000 NNS MA MET 01: Meteorological Measurement System Description

4.2.6 KEP-014: Emergency Planning Meteorological Support

4.2.7 KGG-001: Koeberg Severe Weather Guide

4.2.8 KSA-038: The Requirements for Quality Records

4.2.9 USG-00110-6: User Guide to the Meteorological Data Acquisition and Display System

5.0 REQUIREMENTS

5.1 Meteorological data is required at Koeberg Nuclear Power Station to assess the airborne trajectories of radionuclides in both routine, as well as accident conditions, as specified by the NNR license to operate Koeberg Nuclear Power Station, 238-54 and 238-52.

5.2 The meteorological systems shall be maintained to ensure a minimum critical monthly data availability of at least 99 % and a minimum monthly availability of at least 90 % for the other parameters, which include the remote weather stations and backup parameters.

6.0 RESPONSIBILITIES

6.1 The Emergency Management Senior Physicist (with support from the Emergency Management Manager) is responsible for ensuring that the meteorological programme is correctly implemented and maintained as well as providing the required infrastructure for the programme, including acquiring and maintaining critical equipment spares.

6.2 The designated Meteorologist is responsible for the execution of the meteorological programme processes as described in this procedure.

6.3 The Emergency Management Manager is responsible for the maintenance of the National Instruments field point acquisition systems, databases, data displays (including the MS Excel reporting tool), web servers, AWS software, AWS modem, and network infrastructure. The Emergency Management Manager is supported by the Emergency Management Technician (Electrical) with applicable work.

7.0 OVERVIEW

7.1 A detailed description of the meteorological monitoring system at Koeberg Nuclear Power Station is available in the Koeberg Meteorological Monitoring System Description – KBA 000 NNS MA MET 01.

7.2 The meteorological monitoring system consists of two instrumented masts [redacted] The system also consists of five off-site remote weather stations.

7.3 Meteorological data is gathered at various heights on the two towers. [redacted]

7.4 Rainfall and pressure are measured by both primary and backup systems.

7.5 The off-site remote weather stations are situated at [redacted]. Horizontal winds and temperatures are measured at these remote sites, which is [redacted]

7.6 The meteorological data is available for dissemination in real time via a web page interface to the Emergency Control Centre (ECC), Alternate ECC, Control Room and where required by the Emergency Management Manager.

7.7 A SHE programme at the Weather Station is managed as a part of the Emergency Management SHE programme.

8.0 OPERATING AND MAINTENANCE

8.1 General Maintenance

8.1.1 Routine checks and maintenance need to be performed on the meteorological system to ensure that data availability rates specified in Section 5 are met and to prevent system degradation.

8.1.2 A spares inventory shall be kept to ensure that an adequate supply of available spares and tools is maintained.

8.1.3 The meteorologists shall maintain an annual log / diary shall be used to record any system problems and corrective actions. The diary shall indicate proposed dates for quarterly calibrations and routine maintenance.

8.1.4 Wind Sensors are to be replaced with validated sensors on a quarterly basis. These old sensors are validated as specified in Section 9.

8.1.5 The period between replacements should not exceed 120 days.

8.1.6 Maintenance shall be performed on off-site remote stations at quarterly intervals in accordance with section 8.3.

8.1.7 All sensor replacements and change-outs needs to be captured in the relevant equipment maintenance or verification record.

8.1.8 Particulars of irregularities found during the routine maintenance inspections and corrective actions shall be kept in the Koeberg Weather Station Annual Diary or the relevant equipment maintenance record and shall be reported in the monthly operation status report.

8.2 Data Verification and Communication Checks

8.2.1 A routine verification inspection using the Meteorological VI interface in the Koeberg Weather Station shall be performed on each weekday. On Fridays it is to be done again before leaving the Weather Station. The verified values and discrepancies shall be recorded on the Data Verification, Availability and Occurrence Log (Appendix 1). Any faults found as well as the steps taken to correct the fault must be noted in the Data Verification, Availability and Occurrence Log.

NOTE: *A CR shall be raised when the critical data availability requirement in section 5 is not met.*

8.2.2 The following items shall be checked as part of the daily verification:

- Wind: Wind values, current, 5 minute averages and extremes by comparing levels. Values and discrepancies are to be entered on the data verification sheet.
- Temperature: Check Temperature and Delta Temperature values, current and extremes by comparing levels. Compare the temperature difference between 2 levels with that of the delta temperature reading. Values and discrepancies are to be entered on the data verification sheet.
- Other: Check the Rainfall, Pressure values. Values and discrepancies are to be entered on the data verification sheet.
- Automatic Weather Stations: Check the wind direction, wind speed, wind direction variance (sigma θ), temperature, and the time of the last measurement (within 15 min of current time) of all the remote sites. Check the AWS communication log to spot any communication problems. Enter values and discrepancies on the data verification sheet.
- [redacted] Status: Access the alarm status, equations and parameters of all the sensors on these levels. Enter discrepancies on the data verification sheet.
- [redacted] Status: Access the alarm status, equations and parameters of all the sensors on these levels. Enter discrepancies on the data verification sheet.
- Power - Temperatures: View the power supplies to the temperature and delta temperature cards. Enter discrepancies on the data verification sheet.
- Power – Misc.: View the power supplies to the Met One Translator, fans in wind anemometers, compact field devices, pressure, rain. Enter discrepancies on the data verification sheet.
- Logs: Access to historical events which have affected the system. Enter problems on the data verification sheet.

8.3 Off-site Remote Weather Station Maintenance and Inspections

8.3.1 The Off-site Remote Weather Stations shall be inspected and maintenance done at quarterly intervals.

8.3.2 The Off-Site Automatic Weather Station Maintenance / Verification form (Appendix 6) needs to be completed for each inspection.

8.3.3 The following inspections and maintenance activities must be performed at each Off-Site Automatic Weather Station:

8.3.3.1 Meteorological Sensors

- Check all sensors for free movement (bearings free), all plug connections' weather seals, excessive corrosion, and physical damage.
- Verify the temperature, wind speed and wind direction readings. Replace sensors that show any form of deterioration.
- The wind sensors bearings shall be replaced annually.

8.3.3.2 Data Logger:

The logger plugs should be cleaned and sprayed with a water displacement aerosol.

NOTE: *If the CR10/CR10X logger must be replaced the MET Operations Manual should be consulted for guidance on re-entering the logger program.*

8.3.3.3 Battery

- Disconnect the power supply (solar or AC mains).
- Measure the voltage across the battery. This must be greater than 12,70 V.
- Measure the voltage across the battery while keying the radio at the same time. The voltage must be greater than 12,00 volts.
- If any problem exists then measure the output of the battery charger to confirm that the battery is being correctly charged.
- If a problem still exists with the battery, the battery must be replaced. Reconnect the power supply after the battery checks are done.

8.3.3.4 Radio

- Check antenna and antenna mounting bracket for any signs of excessive corrosion.
- Check that all coaxial joints are well sealed.
- Clean and spray all the radio plugs and connections with water displacement aerosol. The interior of the waterproof housing box must be sprayed with insect repellent.

8.3.3.5 [redacted] Modem:

- Check all cables, wires and mounting bracket for any signs of excessive corrosion.
- Check that the [redacted] MODEM is free from any insects e.g., ants.
- Clean and spray insect repellent all around the [redacted] MODEM and spray the connections with water displacement aerosol.

9.0 VERIFICATION AND CALIBRATION

9.1 Routine calibrations / verifications are performed on the meteorological sensors and equipment to ensure that equipment is operating accurately and within specifications outlined in 238-52: Emergency Planning: Meteorological Requirements for Nuclear Installations

9.2 Measurement and test equipment

9.2.1 A listing of all measurement and test equipment, including the calibration due date for each instrument, shall be maintained.

9.2.2 All measurement and test equipment need to be controlled in accordance with [redacted], therefore:

- When measuring and test equipment is found to be out of calibration, the validity of previous inspections and the acceptability of items inspected or tested since the last calibration need to be confirmed.
- A M&TE device must be deemed as out-of-calibration when the calibration due date has passed without recalibration or if the device is producing results known to be in error.
- Out of calibration M&TE device must be tagged defective to prevent use until recalibration.
- Results obtained from using a test equipment since its last valid calibration need to be assessed if the test equipment is found to be out of calibration. The assessment shall include determining the acceptability of data collected using the equipment and items previously inspected; and shall be documented in the most relevant meteorological report.
- M&TE devices consistently found to be out of calibration during the recalibration process shall be repaired or replaced.

9.3 Verification / Calibration

9.3.1 Calibrations and verifications on the meteorological system components shall be performed as described in sections 9.4 to 9.8.

9.3.2 Sensor calibration or verification shall be performed quarterly. The temperature probes (ambient and delta temperature) can be verified on the mast quarterly (using Appendix 7) but should be calibrated either annually by the meteorologist or at the frequency required by the calibration laboratory when calibrated by them.

9.3.3 A specific calibration/verification action applies to each sensor of the same type.

9.3.4 The EM Senior Physicist will check the calibration outputs (calibration / verification forms) on a quarterly basis by reviewing the applicable forms and using the MET Quarterly Oversight Sheet.

9.3.5 The specified calibration/verification forms for each sensor/module (see Appendices) must be completed during calibrations/verifications. The following information must be captured on all calibration / verification forms (Appendix 2 – 5 & 7):

- Calibration / Verification data and results
- Calibration / Verification date
- Calibration / Verification equipment used and the equipment calibration due date
- Any actions taken for out-of-calibration or nonconforming equipment.

9.4 [redacted] UVW Anemometer Calibration

9.4.1 The maintenance and calibration of the U V and W anemometer system consists of replacing the bearings, cleaning the anemometer and verifying the output of the dc tachometer generator and wind speed starting threshold.

When serviceable, all wind sensors are interchangeable.

Anemometer Calibration Equipment

9.4.2 Perform the Wind Anemometer Maintenance steps:

- Check the anemometer housing and propeller for cracks or damage.
- Clean anemometer and unscrew the shaft housing assembly.
- Replace flange bearings as described in the [redacted] UVW Anemometer Instruction Manual.
- Put the anemometer together and follow both verification procedures below.

9.4.3 Perform the DC Tachometer Verification steps:

- Attach a coupling disc to the shaft of the anemometer.
- Mount clamp and bar fixture on sensor and tighten clamp.
- Attach motor to fixture and carefully align the anemometer and motor coupling. Tighten motor clamp.
- Select the switch on the display module unit to 200/1500/4000 rpm and measure and record the sensor's output in mV.
- The tolerances for the measurements are as follows:
    - 200 rpm: 52.8 to 58.3 mV (5% error)
    - 1500 rpm: 405.6 to 427.7 mV (0.2 m/s error)
    - 4000 rpm: 1100 to 1122.2 mV (0.2 m/s error)
- If the tolerance exceeds the specifications above or if the output is erratic, then the DC generator must be replaced as per the [redacted] UVW Anemometer Instruction Manual.
- Do the calibration in both the CW (clockwise) and CCW (counter-clockwise) rotations, with the CCW reading negative values.
- Note the anemometer number, calibration date and calibration values on the calibration form (Appendix 2).
- Loosen all clamps and release the anemometer from the coupling disc.

9.4.4 Perform the Wind Speed Starting Threshold Verification:

- Select torque value for the type of instrument to be checked and the desired maximum threshold. Add weights to torque disk and install disc on anemometer.
- Disc must rotate freely downwards with the weights in a horizontal position. Failure to rotate indicates anemometer requires a service.
- Place calibrated sensor into secure storage. This sensor will be used when the sensors currently on the tower are replaced every quarter.
- Note discrepancies on the calibration form (Appendix 2).

9.5 Temperature probes, Delta Temperature probes and SCUs

9.5.1 Temperature and delta temperature probe accuracy is verified on the mast using Appendix 7 and following these steps:

a) Prepare the following equipment before ascending the mast:

i. An insulated flask filled with water at room temperature.

ii. Thermometer with a valid calibration tag (i.e., traceable to a national standard).

b) You need an individual on the tower and an individual in the server room at the same time.

c) On the tower:

i. Remove the relevant ambient / delta temperature probe from the radiation shield.

ii. Place the applicable sensor and the calibrated thermometer in the water flask.

iii. Wait for the thermometer reading to stabilise.

iv. Communicated the thermometer reading to the individual in the server room. Record the reading if required.

d) In the server room:

Ambient temperature probes

i. Record the thermometer reading reported by the person on the tower (if reported).

ii. Record the MET system interface readout of the relevant ambient temperature probe.

Delta temperature probes

iii. Remove the incoming connection for both the ambient temperature sensor and the delta temperature sensors at the relevant level from the wire distribution frame.

iv. Plug the applicable delta temperature sensor wires into the ambient temperature slot on the distribution frame.

v. Record the thermometer reading reported by the person on the tower (if reported).

vi. Record the MET system interface readout of the ambient temperature of the relevant tower level, which will actually be the temperature readout of the delta temperature probe.

vii. Repeat steps iv to vi for all the other delta temperature sensors at the applicable tower level.

viii. Restore the wiring as before the calibration.

e) Perform steps c) & d) until all the probes' accuracy have been verified.

f) Complete the applicable calibration form (Appendix 7).

9.5.2 The time of calibration/verification of each sensor and signal conditioning unit, and any discrepancies found during the process, should be noted in the MET diary to assist in the subsequent data processing.

9.5.3 Temperature and delta temperature probes can be calibrated by the calibration laboratory in accordance with their processes, or by the meteorologist using a MET ONE calibration interface and the guidance in 9.5.4 to 9.5.6.

9.5.4 The following is required to perform the temperature probe calibrations:

a) Certified thermometer, a

b) Calibrated DMM, a

c) Insulated flask, and a

d) Flat point (precision) screwdriver.

9.5.5 The ambient temperature sensor calibration is performed by following these steps:

a) Insert the ambient temperature signal condition card into the METONE calibration slot that will be used.

b) Connect the ambient temperature sensor to the input of the specific calibration slot.

c) Connect the DMM to the first output / test point (TP 3 / V1 output), and switch the DMM to the voltage measurement mode.

d) Prepare the applicable calibration form (Appendix 3).

e) Fill the one flask with water at room temperature.

f) Place the sensor and a thermometer in one of the flasks.

g) Hold the ZERO (s1) switch upwards and adjust the Zero adjust screw (Z1) as close as possible to a zero mV output; note the mV output on the calibration form (Appendix 3).

h) Hold the FULL SCALE (s2) switch upwards and adjust V1 FULL SCALE screw to get as close as possible to a 1000mV output; note the mV output on the calibration form (Appendix 3).

i) Wait for the TP 3 (V1) output voltage to stabilise. Log the certified thermometer temperature and the DMM output voltage on the calibration form (Appendix 3).

j) Calculate the “expected temperature” by multiplying the DMM measured voltage by 100, and then subtracting 50. Note this result on the calibration form (Appendix 3).

k) Place both the probes in a flask at a temperature that differs at least 15 °C with the original flask and repeat the steps 0 and j).

l) In both cases the difference between the actual “measured temperature” and the “expected temperature” must be less than 0.5 °C.

m) If the difference is larger the ZERO and FULL SCALE outputs are adjusted to provide an “offset” and the calibration process is repeated. Log all results on Appendix 3.

n) If the difference is still larger than 0.5 °C then MET server software system needs to be used to determine a new calibration formula.

9.5.6 The delta temperature sensor calibration is performed using the following guide:

a) Insert the delta temperature signal condition card into the METONE calibration slot that will be used.

b) Connect the two matched delta temperature sensors to the input of the specific calibration slot.

c) Connect the DMM to the first output / test point (TP 4 / V1 output), and switch the DMM to the voltage measurement mode.

d) Prepare the applicable calibration form (Appendix 4).

e) Fill the one flask with water at room temperature.

f) Place both sensors as close together as possible the flask.

g) Hold the ZERO (s1) switch upwards and adjust the ZERO adjust screw as close as possible to a zero (0) mV output; note the mV output on the calibration form (Appendix 4).

h) Hold the FULL SCALE (s2) switch upwards and adjust V1 FULL SCALE screw to get as close as possible to a 1000mV output; note the mV output on the calibration form (Appendix 4).

i) Wait for the TP 4 (V1) output voltage to stabilised. Log the certified thermometer temperature and the DMM output voltage on the calibration form (Appendix 4).

j) Calculate the delta temperature by multiplying the DMM measured voltage by 15, and then subtracting 5. Note this result on the calibration form (Appendix 4).

k) Place both the probes in a flask at a temperature that differs at least 15 °C with the original flask and repeat the steps i) and j).

l) In both cases the temperature difference should be lower than 0.1 °C.

m) If the difference is larger than 0.1 °C then another reading should be taken with each of the probes in different flask, where the temperature difference between the flasks are at least 15 °C. The DMM measure voltage and the temperature difference between the flasks should be noted.

n) The MET server software system needs to be used to determine a new calibration formula using the information gain in step m).

9.6 Pressure

Two types of pressure sensors units can be used for pressure measurements– the [redacted]

When performing verifications first verify the analogue output of the interface unit of the sensor by measuring the voltage potential between AGND (signal ground) and V_{OUT} (output signal) of the interface unit. Compare this output with the temperature corrected pressure obtained from the Kew Mercury Barometer using the relevant formula for the specific type of pressure sensor.

[redacted] [redacted]

$$P = 500hPa + \frac{600hPa}{2.5volt} \times V_{OUT} \qquad P = 600hPa + \frac{460hPa}{2.5volt} \times V_{OUT}$$

Where *P* = Pressure in hPa, and

V_{OUT} = Output voltage in volt

If the pressure discrepancy is more than 1.0 hPa then the manufacturer's assistance is required else an adjustment of the [redacted] barometer is needed.

To do the adjustments proceed as follows: Adjust the trimmer potentiometer inside the sensor housing to obtain the correct output reading (making only small individual adjustments). Ensure that the cover is closed before taking a reading as this affects the reading by as much as 3 hPa. Note the values on the calibration form (Appendix 5).

9.7 Rain Gauge Calibration

9.7.1 The calibration on the electronic tipping bucket rain gauge consists of pouring a specific volume of water into the tipping bucket and verifying the amount of tips. One tip is equal to 0.1 mm of rain. As the diameter of the receiving orifice is 200 mm, 200ml is necessary to produce 100 tips or 10mm of rain:

- Measure 200ml of water in a measuring glass (obtainable from the ESL).
- If no record of the calibration is needed on the computers, disconnect one output lead from the sensor.
- Very slowly pour the 200ml of water into the tipping bucket while counting the number of tips. One hundred tips is the correct amount for 200ml of water.
- If the number of tips counted is less than 103 but greater than 97 then the accuracy is within 2% and acceptable. If, however, the accuracy does not fall within these limits, follow the steps below.
- Adjust the sensitivity of the rain gauge by adjusting the counterweight screw underneath the moving tipping assembly.
- A complete calibration should be performed once any adjustments have been made. Note the values on the calibration form (Appendix 5).

9.8 Off-site Instrumentation Verification

Verification of the Off-Site monitoring stations consists of the following parts: Verification of wind direction, temperature and ascertaining correct operation of wind speed sensor. After a maintenance check proceed as follows.

9.8.1 Wind Direction:
With the sensor operational, select the wind direction monitoring function. Lower the AWS boom / pole and point the anemometer vane down. The anemometer direction reading attained at each station should be within 5 degrees of the pole direction stipulated in the respective AWS information sheet / file.

Enter the value for each station in the appropriate space on the calibration form (Appendix 6).

9.8.2 Wind Speed:
As this is a digital instrument, no adjustments can be made. If the bearings etc, are in good condition select the display and verify the counter increments.
Note the sensor's performance on the verification form (Appendix 6).
This verification as described can be done in conjunction with maintenance,

9.8.3 Temperature:
Verify the temperature as displayed with the calibrated thermometer, both probes placed in a flask of water. Enter the results on the verification form (Appendix 6) against that specific station.
A temperature reading within a tolerance of 0,5°C is acceptable.
Complete the outstanding parts of the verification form, (Appendix 6).

10.0 EMERGENCY PLAN SERVICES

10.1 A professional meteorological service is provided in accordance with KEP-014.

10.2 The availability of competent meteorological persons with the FFD clearance to Koeberg is provided to support the Emergency Plan.

10.3 Training of emergency response aspects of the meteorological service is covered under KAG-002: Koeberg Emergency Plan Training Programme Guide.

10.4 One meteorologist is on standby with a response time of 1 hour.

10.5 All meteorologists need to participate in all Emergency Plan Exercises as required by the Emergency Management Manager.

10.6 A professional forecasting service is provided for the Emergency Plan.

10.7 The meteorologists will issue severe weather warnings if required in accordance with KGG-001: Koeberg Severe Weather and Natural Events Guidelines.

11.0 CHEMISTRY SERVICES

11.1 Chemistry use meteorological data to determine sampling locations for various environmental samples as part of operational radiological environmental monitoring described in 238-47.

12.0 RECORDS

12.1 Monthly Data Licensing reports, annual reports and calibration data, are considered permanent records for the purposes of this procedure and must be retained in accordance with KSA-038 and the EM QRL.

12.2 Meteorological data is verified, corrected and processed to hard copy and electronic format (CD or any other electronic format deemed acceptable by records management) on a monthly and annual basis. This data is forwarded to the NNR and the Emergency Management Senior Physicist. The annual report consists of a review of the past year's weather patterns, trends, and events related to site meteorology.

12.3 All meteorological records, including reports, verification sheets and forms shall be signed by the responsible technician / meteorologist.

13.0 ATTACHMENTS

Appendix 1 – Data Verification, Availability and Occurrence Log

Appendix 2 – [redacted] UVW Anemometer Maintenance and Tachometer Verification Form

Appendix 3 – Ambient Temperature Card and Sensor Calibration Form

Appendix 4 – Delta Temperature Calibration Form

Appendix 5 – Pressure and Precipitation Calibration Form

Appendix 6 – Off-Site Automatic Weather Station Maintenance / Verification Form

Appendix 7 – Quarterly Verification of Temperature Probes

Appendix 8 – Justification

APPENDIX 1

DATA VERIFICATION, AVAILABILITY AND OCCURRENCE LOG

Data Verification, Availability & Occurences Log (KAG-006 Rev 7)

1) Data Verification

[redacted]		Rain RG		Rain PC		Pressure		Time	
	Wind Dir	Wnd Spd	Temp	Delta T (PC)	Delta T (Manual)	Diff	W		

			Rain PC		Pressure		Time	
	Wind Dir	Wnd Spd	Temp	Delta T (PC)	Delta T (Manual)	Diff	W	

	Wind Dir	Wind Spd	Temp	Max Bat Volt	Min Bat Volt	Time	Comments/Actions

2) [redacted]Availability

			Stability					
	Wind Dir	Wnd Spd	Temp	Horiz	Vert	Rainfall	Pressure	Time	

3) Severe Weather Warning KGG001 (www.weathersa.co.za)

SW Cape Only SAWS issued Y/N Koeberg Issued Y/N

4) Fire Index Value

5) Comments

Name: …… Signature: …… Date: ……

APPENDIX 2

[redacted] UVW ANEMOMETER MAINTENANCE AND TACHOMETER VERIFICATION FORM

[redacted] UVW ANEMOMETER SERVICE AND VERIFICATION (KAG-006 Rev 7)

	sensor number (WGAXXX)	Location removed (P xx/x or B xx/x)	Date removed (dd-mm-yy)	Service History (note 1)	Date serviced (dd-mm-yy)	200rpm_CW (52.8 to 58.3 mV)	1500rpm_CW (405.6 to 427.7 mV)	4000rpm_CW (1100 to 1122.2 mV)	200rpm_CCW (-52.8 to -58.3 mV)	1500rpm_CCW (-405.6 to -427.7 mV)	4000rpm_CCW (-1100 to -1122.2 mV)	Date Calibrated (dd-mm-yy)	Date installed (dd-mm-yy)	Location installed (P xx/x or B xx/x)
1		P 10 U												
2		P 10 V												
3		P 50 U												
4		P 50 V												
5		P 50 W												
6		P 85 U												
7		P 85 V												
8		P 120 U												
9		P 120 V												
10		P 120 W												
11														
12		B 10 U												
13		B 10 V												
14		B 50 U												
15		B 50 V												
16		B 50 W												
17														
18														
19														
20														

Note 1 1=Bearings replaced; 2= Generator replaced; 3=Shaft replaced; 4=Other M&T Equipment Number :.....

Note 2 Output voltage must be within 1% of calculated value M&T Equipment Due Date: .....

Removed by:..... Serviced by:..... Verified by:..... Installed by:.....

Remarks:

Compiled by:..... Signature..... Date:.....

Reviewed by:..... Signature..... Date:.....

Authorised by:..... Signature..... Date:.....

APPENDIX 3

AMBIENT TEMPERATURE CARD AND SENSOR CALIBRATION FORM

SCU Card No.: _____ Sensor No.: _____

Thermometer M&TE No.:_____ Due Date: _____

	Expected (V)	Actual (V)	Adjusted to (V)
Zero Scale	0.000		
Full Scale	1.000		

	Thermometer reading (°C)	DMM Reading (V)	Calculated Temp (°C)	Error (°C)	New Error (°C)
Flask 1					
Flask 2					
Flask 3 (as applicable)					
Flask 4 (as applicable)					

Temperature Calculation Formula: T = 100*(DMM Reading) – 50 °C

Error Margin: ± 0,5 °C

COMMENTS: _____

_____

_____

_____

_____

_____

Calibrated By: _____ Signature: _____ Date: _____

Reviewed By: _____ Signature: _____ Date: _____

Approved By: _____ Signature: _____ Date: _____

APPENDIX 4

DELTA TEMPERATURE CALIBRATION FORM

SCU Card No.: _____ Sensor Pair No.: _____

Thermometer M&TE No.:_____ Due Date: _____

	Expected (V)	**Actual (V)**	**Adjusted to (V)**	**Re-Adjusted to (V)**
Zero Scale	0.000			
Full Scale	1.000			

	Thermometer Reading (°C)	**DMM Reading (V)**	**Calculated Delta Temp / Error (°C)**
Flask 1			
Flask 2			
Flask 3 (as applicable)			
Flask 4 (as applicable)			

Delta Temperature Calculation Formula: $\Delta T = 15*(\text{DMM Reading}) - 5\ °C$

Error Margin: $\pm$ 0,1 °C

	Flask 1 Thermo Reading (°C)	**Flask 2 Thermo Reading (°C)**	**Flask Delta T (°C)**	**DMM Reading (V)**	**Calculated Delta Temp (°C)**	**Error (°C)**
Setup 1 (if needed)						
Setup 2 (if needed)						
Setup 3 (if needed)						

COMMENTS: _____

_____

_____

_____

Calibrated By: _____ Signature: _____ Date: _____

Reviewed By: _____ Signature: _____ Date: _____

Approved By: _____ Signature: _____ Date: _____

APPENDIX 5

PRESSURE AND PRECIPITATION CALIBRATION FORM

Pressure and Rainfall Calibration/Verification Form (KAG-006 Rev 7)

PRESSURE

Kew Pressure		Hpa	
Kew Temperature		Deg C	
Correction		Hpa	
Corrected Pressure		Hpa	
Actual Sensor Pressure		Hpa	Hpa
Adjusted		Hpa	Hpa
Calibration Instrument No.		Due Date	
Calibrated By		Signature	Date

RAINFALL

Check Connection Leads	GOOD/BAD	GOOD/BAD	
With 200ml water, pour in Raingauge, count number of tips **Limits: 97 < Count < 103**			
First Tip Count			
Satisfactory	YES/NO	YES/NO	
Adjustment Made	YES/NO	YES/NO	
Final Tip Count			
Calibration Instrument No.		Due date	
Calibrated By		Signature	Date
Comments			

Please Note: Recalibrate raingauge after any adjustments

Reviewed By		Signature	Date
Authorised By		Signature	Date

APPENDIX 6

OFF-SITE AUTOMATIC WEATHER STATION MAINTENANCE/VERIFICATION FORM

AWS Maintenance and Verification Form (KAG-006 Rev 7)						
Station Name						
[redacted]						
TEMPERATURE	Actual					
	Logger					
	Error					
	Accept					
WIND DIRECTIO	Actual					
	Logger					
	Error					
	Accept					
WIND SPEED	Actual					
	Logger					
	Error					
	Accept					
CHECKLIST (Yes or No + comment)						
Are all the bearings on sensors free moving						
All connections w eather proofed						
Battery w ater level OK if aplicable						
Insect control sprayed						
Radio volume turned dow n						
Antenna mounted securely						
Winch w orking correctly						
Communications OK						
All cables fixed to pole securely						
Additional remarks	Calibration Instrument No and Due Date:					
Performed By						
Date						
Reviewed By		**Signature**		**Date**		
Authorised By		**Signature**		**Date**		

APPENDIX 7

QUARTERLY VERIFICATION OF TEMPERATURE PROBES

Thermometer M&TE No.:_____ Cal. Due Date:_____

Ambient Temperature Probes

Error Margin: ± 0,5 °C

	Level	Sensor #	Thermometer Reading (°C)	MET Display Readout (°C)	Calculated Error (°C)
[redacted]	[redacted]				
	[redacted]				
	[redacted]				
	[redacted]				
[redacted]	[redacted]				
	[redacted]				

Delta Temperature Probes

Error Margin: ± 0,2 °C

	Sensor Level	Associated Level for ΔT	Sensor #	Thermometer Reading (°C)	MET Display Readout (°C)	Calculated Error (°C)
[redacted]	[redacted]	[redacted]				
		[redacted]				
	[redacted]	[redacted]				
	[redacted]	[redacted]				
[redacted]	[redacted]	[redacted]				
	[redacted]	[redacted]				

COMMENTS: _____

_____

_____

Calibrated By: _____ Signature: _____ Date: _____

Reviewed By: _____ Signature: _____ Date: _____

Approved By: _____ Signature: _____ Date: _____

APPENDIX 8

JUSTIFICATION

Revision 6

1. Changed the person responsible for the MET programme from the EM Manager to the EM Senior Physicist to align with KSH-010: “Functional Responsibilities for Radiation Protection at Koeberg Operating Unit”
2. Re-wrote the temperature sensor calibration method to be more practical and sustainable. The associated calibration forms (Appendix 3 & 4) were also updated as part of this change.
3. Added a temperature sensor accuracy verification method so that the temperature sensor accuracy can be verified on a quarterly basis.
4. Added the requirement for the EM Senior Physicist to perform quarterly oversight of the meteorological contractor output using an oversight check sheet.
5. Various editorial changes to improve clarity of intent and readability.
6. Updated the method of assessing the battery voltages at the remote weather stations since the previous method was not adequate.
   This is to close out action GC 13748-003 CA.
7. Added a quarterly temperature probe verification form (Appendix 7).

Revision 7

1. Updated reference document revision numbers
2. Moved the Process Computing Technology’s responsibility to the Emergency Management Manager.
3. Changed the SHE requirements to make the MET SHE programme part of the Emergency Management SHE programme.
4. Made minor editorial error corrections and changes throughout the document: specifically the correction to the reference [redacted].
5. Added the statement that ambient and delta temperature probes can also be calibrated by the calibration laboratory, and not only the meteorologist, and that the calibration frequency for the calibration laboratory is as per their requirements.
6. Added the statement that the maintenance and verification forms are reviewed by the EM Senior Physicist.
7. Redefined the anemometer generator verification / calibration tolerances to a more understandable format and correct a small error in the calibration sheet.
8. Added a reviewer and authoriser/approver signature to the maintenance, calibration and verification forms.