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Operator Training Program

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Enhancing decision making for sustainable development

PILOT RURAL DESALINATION PLANT USING RENEWABLE POWER AND MEMBRANE TECHNOLOGY AT GRÜNAU WATER SUPPLY SCHEME, //KARAS REGION

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1 Introduction

This document was compiled to provide NamWater with a brief description of each of the activities that will be completed with operator/s at the water treatment plant in Grünau.

The best way to learn is to do and operator/s will familiarise themselves with all the processes by completing each process/task until they fully understand and feel confident in completing the tasks.

2 RO Plant Operator/s

Operational staff will be responsible for:

- Daily operational procedures as per plant requirements
- Daily water quality sampling and operational water quality analyses and reporting of the same
- Daily plant and process optimisation based on operational data (pH, NTU, etc.)
- Daily maintenance of the plant diary relating to operational and site events
- Daily calibration tasks
- Daily maintenance tasks
- General cleaning of the plant and site
- Other general tasks as per the norm for NamWater operational requirements.

A shift roster of process controlling staff will be required to attend 20 hours per day and 7 days per week initially during the commissioning stages. Once operation has been stabilised it should be possible to attend to site 8 hours per day and 5 days per week with reduced hours over weekends. Personnel should remain on call and be available to respond to the plant within 1 hours of a call for attendance or in response to an alarm.

It is likely that 2 persons will be required to achieve the above.

Basic qualification requirements: Diploma in Water Care, Chemistry or Chemical Engineering with operational experience (>2yrs) at a conventional potable water treatment plant. The identified personnel must be in attendance during the commissioning and the initial guarantee operations period in order to receive direct instruction from the contracting team.

3 Introduction to the WTP

First, the operator will be introduced to the WTP of Grünau. This will include detail explanation of the P&ID diagram of the plant and to make sure the operator understands the P&ID diagram and each process that is shown on the P&ID.

The operator will learn all the practical information necessary to thoroughly understand the RO water treatment plant and how to apply his / her knowledge gained while operating the RO plant.

The following processes and topics will be covered:

- Water Contaminants Overview
- Semipermeable RO Membranes
- Osmosis and Reverse Osmosis

- Membranes
- Membrane Elements
- Pressure Vessels
- RO Units
- RO Unit Operation
- Potential Problems
- Brackish water pretreatment to minimize problems
- Chemical Cleaning of units

After the operator has familiarised himself / herself with the P&ID and the above processes it is proposed to provide an introductory tour of the physical plant installed on site, going through each process on site.

Estimated time for this is two (2) days for the introduction and one (1) day for the tour on site.

4 Loading of Pressure Vessels

The operator will be provided with procedures to load the membranes and will be physically shown how to load the membranes. This will include working with a special tool as well as the preparation beforehand.

Estimated time for this activity is approximately half (1/2) a day.

5 Start-up and Shutdown Procedures

The contractor will go through the start-up and shutdown procedures of the WTP in detail.

Estimated time for this activity is approximately half (1/2) a day.

6 Monitoring

6.1 Online Instrumentation

This will include the operator to familiarise themselves with each of the online instrumentation installed in the plant. The operator will be taken through the WTP plant showing them the instrumentation and explaining their function. The operator will also be provided with operating and maintenance manuals of each of the instrumentation to study.

Estimated time for the tour is one (1) day and for the studying of manuals is two (2) weeks.

6.2 Handheld Instrumentation

This will include the operator to familiarise themselves with each of the handheld instrumentation provided for the plant. All the handheld instrumentation will be shown to the operator and an explanation of their workings will be provided to the operator. Their function will also be explained. The operator will also be provided with operating and maintenance manuals of each of the instrumentation to study. This will include the following:

- Turbidity
- pH
- Conductivity
- Fluoride
- Chlorine

- SDI samples (actual tests will be done by an accredited laboratory)

Estimated time for the introduction to the instrumentation is half (1/2) a day and for the studying of manuals is one (1) week.

6.3 Daily Monitoring

The operator will be taken through the plant and shown where daily readings should be taken of the following parameters:

- Pressures
- Flows
- Conductivities
- Temperature

These readings will be used to complete weekly trending and can also be compared to online readings and reporting data.

Estimated time for this activity is approximately one (1) day.

6.4 Weekly Trending

This will include the calculation of normalised flows, salt passage (conductivity) and pressure with the data obtained during the daily monitoring. This will then be compared to a baseline (when the membranes were new, replaced or cleaned).

A minimum data of two (2) weeks must be obtained before this activity can commence. The actual training will not take longer than one (1) day.

7 Chemical Dosing (Pre- and Post-treatment)

7.1 Flocculation

The following will be conveyed to the operator:

- Chemical to dose (Ferric Chloride (42.5 %))
- How to dilute the chemical and at what concentration
- How much to dose depending on the turbidity and SDI before and after the pressure filters using the information obtained from the data recorded
- Show how to adjust dosing pump rate

7.2 pH Adjustment Dosing Pre-Treatment to RO Plant

The following will be conveyed to the operator:

- Chemical to dose (Hydrochloric Acid (38 %) / Sodium Hydroxide (46 %))
- How to dilute the chemical and at what concentration
- How much to dose depending on the pH before the RO process from the information obtained from the data recorded
- Show how to adjust dosing pump rate

7.3 Anti-Scaling

The following will be conveyed to the operator:

- Chemical to dose (Sodium Hexametaphosphate (100 %))

- How to dilute the chemical and at what concentration
- How much to dose depending on potential scaling from the information obtained from the data recorded
- Show how to adjust dosing pump rate

7.4 Biocide Dosing

The following will be conveyed to the operator:

- Chemical to dose (Sodium Metabisulfite (98 %))
- How to dilute the chemical and at what concentration
- How much to dose depending on biological fouling potential from the information obtained from the data recorded
- Show how to adjust dosing pump rate

7.5 Remineralisation

The operator will be educated and show how to use the remineralisation tanks depending on the pH readings (CCPP values) after the RO process and blending. The remuneration process can be bypassed if the blended water is stable.

7.6 pH Adjustment after Remineralisation

The following will be conveyed to the operator:

- Chemical to dose (Hydrochloric Acid (38 %))
- How to dilute the chemical and at what concentration
- How much to dose depending on the pH before the remineralisation from the information obtained from the data recorded
- Show how to adjust dosing pump rate

7.7 Inline Calcium Hypochlorite Dosing

The operator will be shown how to load the hypochlorite tablets.

The estimated duration of the above activity is approximately five (5) days.

8 Cleaning and Sanitization

8.1 CIP

The operator will be shown how and when to start a cleaning in place (CIP) procedure. This is a more complicated activity and requires several steps to achieve the desired cleaning. The operator will be taken through the process step by step to ensure all the following activities are understood and ensure the operator is familiarised with each step:

- Which chemical to use (Low pH to remove inorganic precipitates and high pH cleaning to remove organic fouling)
- Mixing procedure
- Heating the solution
- Low flow pumping
- High flow pumping
- Recycling
- Soaking

- Flushing
- Importance of pH levels during the cleaning phase and how to measure it

The estimated duration of the CIP is approximately three (3) days.

8.2 Sanitizing RO Membrane Systems

The sanitization of RO membrane systems is the application of biocidally effective solutions or hot water to the membranes while the system is offline, i.e., not in production mode.

The estimated duration of the sanitizing process is approximately half (1/2) a day.

9 Handling, Preservation and Storage

The operator will be shown how to handle the membranes, store as well preservation of the membranes. Preservation will include preparing a storage solution of 1 to 15 % SMBS and a procedure on how to soak the membranes in the solution. The importance of the pH level (not higher than 3) during storage will also be explained.

The estimated duration of the above activity is approximately two (2) days.

10 Replacement of Cartridge Filters

The operator will be shown when and how to replace the RO membranes depending on their condition.

The estimated duration of the above activities is approximately one (1) day.

11 Trouble Shooting

11.1 Approaching to Troubleshooting

The operator will be shown how to troubleshoot a water quality or plant performance problem by following a fixed strategy which will be based on the following sequence:

1. Can you trust what the instrument is telling you? What to check for and what to verify.
2. Is the pre-treatment acceptable and are pre-treatment targets met?
3. Are plant elements being operated as required in terms executing the necessary operations at the necessary frequencies?
4. Are all plant elements fully maintained as needed and operating as needed?

The appropriate corrective response will become clear if troubleshooting is sequenced in this manner.

Estimated time for this activity is approximately four (4) hours.

The operator will need a series of records and tools to ensure troubleshooting can be done effectively. The following paragraphs indicate how some of these are compiled.

11.2 Visual Inspection

The operator will be provided with visual inspection procedures and taken through the plant.

Estimated time for this activity is approximately two (2) hours.

11.3 Profiling

The operator will be shown how to complete profiling by obtaining TDS / Conductivity reading from individual vessels to localise any problem.

Estimated time for profiling is estimated to be half (1/2) a day.

11.4 Probing

The operator will be shown how probing is done and the physical procedure will be completed with the operator.

Estimated time for this activity is approximately two (2) days.

12 Hybrid Power inspection and maintenance

The operator will be shown the basic components and operation of the Hybrid system. This includes detailed explanations of the complete Solar PV system and Wind Turbine working together with the applicable drawings.

Once the operator has a sound knowledge of the system, the operator will be able to perform maintenance, inspection and troubleshooting during operation of the plant.

12.1 PV Solar system

The operator will be shown in detail the layout of the PV Solar panels and how they are configured to the Solar Charge Controller. This will be followed by the Lithium Ion battery operation and connection details to the 3 x 1-phase 5kVA Inverters.

The following will be conveyed to the operator:

- Charge regulator Shutdown and start-up procedures
- Maintenance of the Solar Panels
- PV System controller operation
- Full system shutdown and Start-up, including that of the Wind turbine

Estimated time for this activity is approximately two (1) days.

12.2 Wind Turbine

The operator will be taught the operation and charging characteristics of the wind turbine as well as the auxiliary equipment, namely the diversion load resistor and the wind turbine MPPT controller.

12.3 Inverters and Battery

The operator will be given a full rundown of the inverter connections, operation and setup. The inverter operation will be demonstrated to the operator on the PV System controller. Both the inverter and Lithium Ion battery shutdown and start-up procedures will be explained in detail should any faults occur. Possible faults will also be explained, to make the operator aware as well as steps to follow to restore the system to normal operation.

13 Weather Station

The operator will be shown the basics of the weather station sensors as well as telemetry. All equipment general maintenance will be provided to ensure that data capture is accurate during operation. In summary, the operator will understand and execute the following:

- Cleaning of sensors from dust and sand
- Replacement of bearing of the Anemometer
- Cleaning and priming of the Rain gauge
- Inspection of cabling and connections

14 MCC

The operator will receive training on the operation of the MCC unit as well as all functions explained:

- HMI – operation and plant control
- Power distribution – Pumps, Actuators, Sensors, lighting, plugs and equipment
- System shutdown and start-up
- Emergency generator connection and power changeover