

SPECIFICATION AND SCOPE OF SUPPLY FOR PURIFIED WATER SYSTEM FOR BOILER FEED

PROJECT: Kilkenny Power Station
Kilkenny
Ireland

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QUOTATION NO: WW16-3462/2/TQ

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Design Philosophy

Our system utilises the central purification method of Reverse Osmosis (RO) and electro-deionisation (EDI), with pre-treatment and control with other major components.

It must be noted that water feed for the plant most likely come from the 'Grey water' source – wastewater (SW-1).

The figure “for oils, fats and greases” is high in the waste water analysis. To treat this contaminant we have proposed 'Granular Activated Carbon' (GAC) media as a filter bed material. This media will require regular replenishment; say 12-18 months dependent on ongoing results.

We have added a UV unit with an automatic wiping system, designed for high UV dose and poor inlet water.

The carbon filters will also assist in the reduction of organic fouling on the RO membranes. We have included pre-RO UV units to aid in minimising organic fouling on the RO membranes particularly where the waste water is used as a source (cfu/ml >300).

Regarding plant redundancy, there are two 100% discrete streams, which can be run continuously as two 50% streams with ability to scale up to 100% as required. The other option is where the plant can be operated as two alternating streams.

We have not allowed for a raw water break tank or booster pumps as we would utilise the raw/fire water tank with a pumped supply to our plant inlet.

The treated water quality is taken as per the table, para 3.2 of GE Water Purity requirements apart from Sodium and Potassium which refers para 3.3 “to a total value derived from air fuel” etc... our treated water values for sodium and potassium will be consistent with a plant of this nature and the specified conductivity of $1.0\mu\text{S}$ @ 25°C.

As a consequence of the high raw water hardness, and relatively high flow rate the water softeners will require regeneration on a frequent basis. This will result in high salt usage and we would recommend using a Salt Saturator which can be filled with bulk salt (low cost) compared to bagged salt (high cost). There is the advantage of labour cost savings also i.e. handling etc.

We have shown this as an optional item. These would normally be located outdoors but can be internal also.

1.0 INTRODUCTION

The following proposal outlines the water purification system required, which is to be used to produce purified water for 'NOx' control within a power station.

2.0 RAW WATER

The raw water supply is as SW-I, which can have some organic and colloidal contamination, and for some oils, fats and greases.

3.0 TREATED WATER QUALITY

The treated water requirement is RO/EDI water to a conductivity of <1 micro siemens

4.0 SYSTEM DESIGN

The system proposed is divided into the following sections: -

- Pre-treatment
- Reverse Osmosis/Electro - deionisation.
- Control system.

4.1 PRE-TREATMENT

Whose purposes is to eliminate organics, chlorine, dirt and colloids, as well as softening for the raw water, which will produce water suitable for feeding to a RO/EDI System, which will have a target Silt Density Index (SDI) of 3 or better. Our recommendation is for the pre-treatment train to be, 20µ Bag filters, carbon filters, water softening and UV.

4.2 REVERSE OSMOSIS SYSTEM/ELECTRO DEIONISATION

This R.O. unit is a well tested, high rejection, single pass system with membranes, which will give a 99% rejection of ions resulting in high quality purified water. Water quality is monitored by way of an on-line Conductivity meter.

4.3 ELECTRO DEIONISATION UNIT

EDI module comprises EDI cell, power pack, rectifiers and control unit. EDI use RO feed to produce a low conductivity DI water.

5.0 WATER FLOW RATES AND VOLUMES

The system is designed on the basis of maximum initial hourly usage of 16.5m³/hour de-ionized water make-up to the storage system. To achieve this, a make up flow rate of 24.5m³/hour is required by the RO/EDI units.

UTILITIES

Electrical	415 V 50 Hz 40 A 3 phase and neutral isolated supply
Feed Water	Flow 25000 litres normally. Up to 20000 litres during Carbon filter backwash, taken from dedicated backwash water tank Pressure 5.0 Bar Usage 600m ³ /day
Drainage	4900 l/hr approx normally, up to 26000 litres/hr during RO flush/filter backwash System materials chemical resistant.
Air	Flow 2 CF Pressure 6 bar Quality Instrument Standard

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Item No. 1 Duplex Bag Filters

A bag filter will remove dirt, pipe scale and suspended matter to give a filtration rate of 20 micron and so protect the equipment downstream.

Specification:

Manufacturer	:	Eurowater
Filter Model	:	2-EF5-SS
No of Units	:	2 No
Bag Type	:	25MYPP
Bag No.	:	1
Inlet/outlet connections	:	2" BSP
Material	:	Carbon Steel plastic coated

Scope of Supply:

2 No. Filter housing complete with drain, to suit 1 No 20" 20 micron bags

2 No. Filter bags, felt PP type, rated 20 micron porosity

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Item No. 2 Backwash Tank & Pump Set

The backwash tank and pump set allows water to be pumped to the carbon filter during the backwash cycle.

Specification:

Backwash tank Capacity	:	5000 litres
Manufacturer	:	Sturdy Products
Inlet/Outlet Pipe Size	:	3.0"
No. of Pumps	:	2 No.
Pump Type	:	Grundfos Model CR15-1
Flow Rate	:	20m ³ /hr
Pressure	:	Average 1.0 Bar

Scope of Supply.

- 1 No. Backwash tank of 5000 litres capacity. Tank is manufactured from MNPE and is complete with top slip on cover as well as inlet/outlet and drain connections. The tank is also complete with 1" ball float inlet valve.
- 1 No. Float switch top mounted for pump low water protection, Kasuga mercury tilt type
- 2 No. Centrifugal pump manufactured by Grundfos or equal with TEFC motor 1.1kW 380v/50hz/3phIP55. Pump duty 20m³/hr. at 10m total dynamic head.
- 1 No. 3" Drain valve for tank.
- 1 No. Set of delivery pipework in 3" Class E ABS with isolating ball valves and non return valves.

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Item 3 UV Disinfection Unit Pre Carbon Filters

Specification:

Manufacturer	:	Wedeco AG
Model No.	:	LBX20
No of Units	:	1 No.
Design Flow rate	:	30m ³ /hr
Dosage at 8.3l/s. filtered water	:	40 mJ/cm ²
Vessel Material	:	316 L stainless steel
Operating Pressure max	:	10 bar
Inlet/Outlet	:	DN 50
Drain	:	1 "
No. of Lamps	:	6
No. of quartz sleeves	:	6
Lamp power	:	80 watts

Scope of Supply:

1 No. Ultraviolet Unit comprising of the following:

- Disinfection chamber constructed of 316L stainless steel on all wetted parts and radii are ground smooth. Chamber complete with inlet and outlet connections as well as drain connection.
- Ultra Violet Disinfection lamp complete with quartz sleeve.
- Standard type control panel complete with Hours Run Meter, LED Lamp Operational Display. Lamp-out circuit and power on Indicator. Volt Free contacts available for remote alarm.
- UV intensity measuring system with two limit switches.
- Automatic Wiper system

Item 4 Duplex Carbon Filters

These units are designed to remove oils, fats and greases, some organics and any chlorine present from the water supply, without which could result in membrane fouling and microbial growth on the RO. The units use a GAC media to achieve this. The unit's backwash on a duty/standby basis with electronic timer control.

Specification

Manufacturer	:	Eurowater
Model No	:	TFB25
No. of Units	:	2 No.
Min. Flow Rate	:	800l/hr
Max. Flow Rate	:	26000l/hr
Design Flow	:	25000l/hr
Pressure range	:	1-4 bar
Pressure Vessel Size	:	1500mm

Scope of Supply:

2 No. Eurowater TFB25 Carbon filters fully automatic backwash and each complete with the following equipment:

- 1 No. Pressure Vessel manufactured from carbon steel epoxy coated internals and externals. Vessel is complete with inlet/outlet ports and internal bottom plate media support nozzles
- 1 No. Filling of Acid Washed GAC media.
- 1 No. Side mounted valve manifold with 5-cycle operation will allow full backwash and rinse cycles. Manifold with C. C. Type inlet and outlet.
- 1 No. Automatic Backwash Electronic Controller

Item No. 5 Duplex Water Softeners

The units are designed to exchange Calcium and Magnesium ions for Sodium for use on R.O. make up supply. This reduces the potential for calcium carbonate fouling of the membranes and EDI Module. The units regenerate on a duty standby basis using volumetric control.

Specification

Manufacturer	:	Whitewater
Model No	:	WBX 48CC
No. of Units	:	2 No.
Min. Flow Rate	:	400l/hr
Max. Flow Rate	:	3,000l/hr
Design Flow	:	25,000l/hr
Unit Capacity	:	320m ³ at 300mg/l CaCO ₃
Salt/Regeneration	:	200kg
Pressure Range	:	2 – 6 bar
Pressure Vessel Size	:	1200mm diameter

Scope of Supply:

2 No. Whitewater WBX 15 Water Softener fully automatic regeneration and complete with the following equipment.

- Pressure Vessel manufactured from composite material with polypropylene internals and GRP outside. Vessel is complete with inlet/outlet ports and internal resin support nozzles. Vessel designed with a 4: 1 safety factor for minimum burst pressure.
- Filling of Purolite Monosphere Resin.
- Side mounted valve manifold with 5 cycle operation to allow full regeneration and rinse cycles. Manifold with ABS type inlet and outlet to ISO 727.
- Automatic Regeneration via Volumetric Controllers and pulse head water meter.
- Brine tank complete with salt platform, brine valve and necessary tubing.

Item 7 UV Disinfection Unit Pre RO

Specification:

Manufacturer	:	Wedeco AG
Model No.	:	BX30
No of Units	:	2 No.
Design Flow rate	:	25m ³ /hr
Dosage at 6.9l/s. filtered water	:	40 mJ/cm ²
Vessel Material	:	316 L stainless steel
Operating Pressure max	:	10 bar
Inlet/Outlet	:	DN 80
Drain	:	1"
No. of Lamps	:	3
No. of quartz sleeves	:	3
Lamp power	:	80 watts

Scope of Supply:

2 No. Ultraviolet Units comprising of the following:

- Disinfection chamber constructed of 316L stainless steel on all wetted parts and radii are ground smooth. Chamber complete with inlet and outlet connections as well as drain connection.
- Ultra Violet Disinfection lamp complete with quartz sleeve.
- Standard type control panel complete with Hours Run Meter, LED Lamp Operational Display. Lamp-out circuit and power on Indicator. Volt Free contacts available for remote alarm.
- UV intensity measuring system with two limit switches.

Item No. 8 Reverse Osmosis Systems

The Reverse Osmosis Unit is designed on the basis of a computer-aided selection for this application. The R.O. unit will run constantly and has a facility to open a tank fill valve in conjunction with using a recycle valve as well as a dump valve. The unit will also shut down in the event of low water levels on the feed side. The permeate and feed flow conductivity are measured on the main instrument / controller, which can be calibrated. Inlet, Concentrate and Re-Cycle flows are measured by VA flow meters

Specification

Manufacturer	:	Eurowater
No. of RO Units	:	2 No
Model No	:	03-15
No. of pressure vessels	:	5 No.
No. of membranes	:	15 No.
Make Up Flow	:	24500l/hr
Permeate Flow at 15°C	:	16500l/hr
Pump kW total	:	30 kW

Scope of Supply

2 No. Eurowater Water Reverse Osmosis Unit Model No.03-15 complete with the following equipment:

- Inlet temperature gauge and pressure switch.
- Inlet pre-filter – 5 micron bag.
- Inlet pipework in ABS plastic complete with Inlet Automatic valve.
- Membrane pressure vessels complete with end caps and connectors.
- Thin film composite membranes 15 No.
- Concentrate pressure pipework in ABS and polypropylene.
- Concentrate and re-cycle needle control valves constructed in Stainless Steel.
- Panel mounted pressure gauges for inlet, inter-stage concentrate, and system flow rates.
- Inlet, concentrate and re-cycle flow meters variable area type.
- Permeate outlet pipework and valves in A.B.S
- Sample and CIP valves diaphragm type with PTFE seals.
- Control Panel complete with conductivity monitor and programmable controls for the following functions;
 - Conductivity Indication x 2 (supply feed and permeate)
 - % Percentage reduction to T.D.S.
 - Conductivity Alarm
 - Time Delay Alarm
 - Low Inlet Water Feed Alarm
 - Auto Dump Facility
 - Treated Water conductivity output 4-20mA (Optional)

Item 9 Duplex EDI Modules

An EDI system is used after an RO unit for 'polishing' of demineralised water to obtain low levels of conductivity, silica and total organic carbon (TOC)

The EDI uses ion exchange membranes, ion exchange resins and electricity to produce high quality water with no regeneration down time.

Specification:

Manufacturer	:	Eurowater
EDI Model	:	EDI3-3400i
No of Units	:	2 No.
Flow rate make up	:	14,320l/hr
Flow rate products	:	13,600l/hr
Recovery	:	95%
Connections Inlet/Outlet	:	DN50
Drain	:	DN15
Skid Dimensions	:	800Wx1200Dx1880H

Scope of Supply:

2 No. Eurowater EDI units, model EDI3-3400 (each) complete with the following equipment:

- PVC pipe system
- Flow Meters for product.
- Conductivity Transmitter
- Temperature Transmitter
- Sensors PLC
- Frame in 304 stainless steel

Item 10 Electrical Control System

We include for the provision of a main control panel, which will require 3phase 415 volt supply. The panel will be complete with indicators and instruments as well as power supplies for the carbon filters, softeners, UVs, starters for RO backwash pumps and supply to RO control panel and EDI module utilising Siemens PLC with HMI.

We include for a panel mounted alarm system with a facility for up to six alarm conditions with accept and reset buttons

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Item No 11 Mechanical Installation Commissioning & Supervision

Commissioning & Supervision

All of the equipment will have been pre-tested and a FAT will be carried out prior to arrival on site.

We include for installation and assembly of the complete package as per our proposal between the raw water inlet to the plant room and inclusive of all items as specified in this quotation, up to treated water outlet from the plant room.

All pipework, valves and fittings on the equipment will be 2/3" ABS Class E.

After completion of installation, we include for commissioning/certification of the system and instruction and training of plant operators. Supervision of ring main installation and liaison with the mechanical contractor.

Pure Water Storage & Distribution

The main distribution will be installed by the customer, as will all pipework outside the main plant room.

- Plant Room wiring

We include for all wiring out from wall mounted isolated spur boxes (by others). This wiring will be provided in/on suitable conduit or cable tray. Local isolators, as required, will also be provided (by others)

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Item No 12 Equipment Documentation Deliverables

Documentation Deliverables

The Whitewater package will be inclusive of extensive 'Data information File'. This manual will be provided to the client in full on the completion of the commissioning period. Each item of equipment specified in the commissioning document will have a relating dedicated section in the data information file. Separate sections will be dedicated to instrumentation, valves, cable schedules, PLC documentation, pipework documentation and relevant standard operating procedures.

The data information file sections for each item of equipment will include a data sheet, and operating and maintenance manual, certificates of conformity/compliance and material certificates where applicable.

Three copies of the data information file will be handed over to the client on completion of the validation, one of which will contain original certificates and manuals. The other two copies will be exact copies of the original. The data information file will include signed off copies of all Whitewater documents, the signed off P & ID and walk down copies of the relevant drawings. In addition the Whitewater service department will be available to the client for consultation service department will be available to the client for consultation on the generation of daily maintenance and operating documentation.

Proprietary Documentation

The main documentation supplied by Whitewater as standard is as follows:

- The data information file index will be issued to the client prior to handover and an updated version handed over as part of the data information file.
- A Whitewater health and safety statement.
- A manual of commissioning reports.
- A comprehensive equipment tag schedule
- An instrument list
- A valve list
- A document list
- * P & ID drawings
- General arrangement drawings
- Wiring schematics

All documentation as referenced above will be handed over at the end of the commissioning period.

PRICE SUMMARY

Item No 1	Duplex Bag Filters
Item No 2	Backwash and Pump set
Item No 3	UV Disinfection Unit
Item No 4	Duplex Carbon Filters
Item No 5	Duplex Water Softeners
Item No 6	Hardness Monitor
Item No 7	UV Units Pre RO
Item No 8	Reverse Osmosis system
Item No 9	EDI Modules
Item No 10	Electrical Control Panel
Item No 11	Mechanical Installation
Item No 12	Equipment Documentation Deliverables

Total price including delivery site:

PRICE: €

OPTIONAL ITEMS

Silica Analyser

1 No. Hach Lange series 5000 Silica Analyser for measuring inline silica values in the process water stream. Unit has two set point alarms and R5232 and 4-20µAllo

PRICE: €

Bulk Salt Saturator

1 No. Forbes Salt Saturator Model 21/18 in GRP material, complete with internal under drain systems, gravels, bulk inlet pipe, salt dust arrestor.

PRICE: €

- Delivery 8-10 working weeks
- Installation 3 working weeks
- Commissioning 1 week
- Training 2 days or 4 x ½ days