PM Standard Form

SUPPLIER DOCUMENT COVER SHEET

Client:	**Alexion**	P/O No / Contract No:	**IE0311488-56-PO-0710**
PM Project No:	**IE0311488**	MR No:	**IE0311488-46-MR-0710**
Project Title:	**BDS Facility**		
Supplier:	**Cochran**		
Equipment Description	**Plant Steam Generation Package**		
PM Document Category: **G22**	Sequential No: **0001**	Revision: **C**	
Supplier Document No:	**35/6553-5/G22**		
Supplier Document Title:	**Process Description**		
PM Complete Number:	**IE0311488-S-46-0710-G22-0001**		

This document is relevant to the following Equipment Tag No(s):		**Comments**
BO-114101-3		

Notes:
1. A Supplier Document Cover Sheet shall be produced for each document identified in the agreed Supplier Document Index.
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Signature: .....

Date: 03/Nov/2017

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Alexion Pharmaceuticals

COCHRAN LTD CONTRACT No: 35/6553-5

Document No: 35/6553-5/G22/B

Process Description (Functional Design Specification)

for New Boiler Plant at Alexion Pharmaceuticals

*This document is a **general summary** of the functional design of the new steam boiler plant and is intended as guidance only. The appropriate sections should be read in conjunction with the O&M manuals.*

DOCUMENT ISSUE STATUS AND AMENDMENT RECORD

ISSUE	AMENDMENT DETAILS	PREPARED & SIGNED BY: **David Rodger**	DATE
A	First issue	David Rodger	18th November 2016
B	Second issue	David Rodger	8th March 2017
C	Third issue	David Rodger	4th August 2017
D			
E			
F			
G			

Process Description (FDS)
Boiler Number: 35/6553-5
Rev B
System Description:

1. Condensate Tank:

1.1. Description:

1.1.1. The tank is a stainless steel atmospheric hot water storage tank comprising the following:

- Plate and tube heat exchanger to heat incoming softened water supply to the tank. Controlled via a pneumatic inlet control valve (LCV-010 114101) and capacitance probe level control system (LT-010 114108-010).
- Level Gauges (LI-010 114108)
- Temperature indicators (TI-001 114108), temperature transducers (TT-001 114108, TT-002 114108, TT-012 114108, TT-011 114101, TT-010 114101), pressure indications (PI-001 114108, PI-009 114101, PI-007 1141018) and pressure transmitters (PIT-008 114108)
- Heat steam controls including temperature control (TCV-010 114101), sparge inlet and upstream condensate trap set.

1.1.2. The Condensate Tank is a unit is designed to:

- Maintain a standing water temperature of circa 90 DegC.
- Utilise Primary feed via condensate return.
- Top up to be via a softened water make up water inlet, pre heated through a heat exchanger from the tank vent.
- Feed water outlet to be fed to Deaerator via a transfer pump set (PU-114101 and PU-114102), the pumps being variable speed driven, operating on pressure.

1.1.3. The following connections on the tank are provided:

- Condense return (Pumped and Gravity)
- Drain
- Overflow
- Heat Exchanger flash steam outlet
- Temperature gauge (x1)
- Heat Exchanger flash steam outlet
- Steam Injection
- Low Level Switch
- Feed water outlet
- Level gauge (x2 connections)
- Temperature transmitter for Steam Injection (TT-001 114108)
- Heat exchanger water outlet
- Level probe
- Bleed return
- Flash steam
- Temperature transmitters (TT-012 114108 and TT-002 114108)
- Pressure gauges (PI-001 114108 and PI-007 1141018)
- Pressure transmitter (PIT-008 114108)
- Chemical Dosing (x3)

1.2. System Operation

1.2.1.Level Control

- Condensate Return from the Plant will be the Primary source of feed to the Condensate Tank.
- Softened Water make up will then top up this level accordingly via a level probe, controller and pneumatic control valve.
- The desired Condensate Level will be defined by the Operator via the Supervisor system HMI.
- There will also be an Operator configurable Condensate Tank Low Level Setpoint, which will be used to interlock the Transfer Pumps in the event of the actual level in the Condensate Tank dropping below the setpoint value. (N.B. The additional Low level switch LSL-002 114108) will also perform this function)
- In the event of the inlet valve failing to close, there is an overflow on the Condensate Tank.
- The Condensate Tank Level will be shown on the Supervisor HMI.

1.2.2.Temperature Control

- The Condensate Tank will be Temperature Controlled via the Steam Injection System, via temperature transmitter (TT-001 114108), control valve (TCV-010 114101) and panel mounted controller.
- The Condensate Tank Temperature will be displayed on the Supervisor HMI.

1.2.3.Steam Injectors

- The Steam Injection Valve will be Fail Close
- The valve operates via a Temperature Transducer and controls the standing water temperature to 85 DegC.
- Position of the Steam Injector Valve will be shown on the Supervisor HMI.

1.2.4.General

- The Condensate Tank Pressure will be shown on the Supervisor HMI, as will the Condensate Pump Set Pressure.

1.2.5.Heat Exchanger

- The Heat Exchanger Inlet Flow (FIT-021-114101), Inlet Temperature (TT-010 114101) and Outlet Temperature (TT-011 114101) will all be shown on the Supervisor HMI.

2. Transfer Pumps:

2.1. Description:

2.1.1. There will be 2 Transfer Pumps (PU-114101 and PU-114102) controlled from the Supervisor System which will be used to feed the Deaerator.

2.1.2. The Pumps are VSD Controlled, with desired speed controlled by a Pump Pressure Transducer.

2.1.3. Each Pump will also have "Ready", "Running", "Fault" and Running Speed feedback to the Supervisor System, all of which will be shown on the HMI.

2.1.4. The Pumps will be interlocked if the Level in the Condensate Tank drops below the level at which the Low level switch level (LSL-002 114108) is fitted within the tank.

2.1.5. The Pumps can be configured to run as Duty/Standby or a single pump to running continuously, selection of which is made from the Supervisor HMI.

3. Deaerator:

3.1. Description:

3.1.1. The Pressurised Deaerator System shall condition the boiler feed water in a complete packaged unit which includes:

- Deaerator dome and Feed Water storage tank.
- All ancillary equipment and valves required to complete the system.
- Heating steam controls, including pressure control, internal distribution sparge pipe, overpressure safety valve (PSV-004 114019), vacuum breaker.
- Make-up water level control system and overflow control devices.

3.1.2. The Pressurised Deaerator shall be designed as a unit to:

- Remove oxygen efficiently from make-up water and condensate returns,
- Remove carbon dioxide and other incondensable gases,
- Maintain dissolved oxygen level in the Feed Water storage tank to less than 0.02 ppm by steam deaeration and keeping the water temperature at 107 ºC.
- Save substantial proportion of oxygen scavenging chemicals by efficient deaeration of the Feed Water and condensate mixture.
- Solve the problem of corrosion by constructing the deaerator dome in stainless steel throughout (Storage tank is Carbon Steel)

3.1.3. The maximum working volume of the tank shall be no more than 75% (18,000 litres) of the nominal volume.

- The remainder shall be occupied by the blanketing steam over the stored Feed Water.
- The main heating steam is supplied via a stainless sparge pipe running along the length of the tank.

3.1.4. Sparge pipes are designed to distribute the flows at low velocity, evenly across the tank area promoting good mixing.

3.1.5. The vessel is protected from being over-pressurised by the provision of a safety valve (PSV-004 114019) and the vessel is protected from external overpressure by the provision of a vacuum breaker.

3.1.6. The following connections on the storage vessel are provided:

- Deaerator dome
- Overflow
- Drain
- Manway
- Safety valve
- Vacuum breaker
- Level sensor (with protection tube)
- Level indicator
- Heating steam
- Dial thermometer
- 3 x Chemical injection
- Feed water outlet
- 3 x Spare

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3.2. System Operation

3.2.1.Level control

- Make-up water shall enter the dome via a valve train comprising of isolating valve, strainer, control valve (LCV-002-114109) and isolating valve and the control valve (Fail Closed) shall be pneumatically actuated type.
- An electronic displacer type level sensor (NI1341) (LT-001 1141019), outputting a 4-20 mA signal, directly mounted in the tank, is provided to control the make-up water control valve (CV-001 114109) via the level controller.
- The Level controller is a three point stepping controller with a 4-20mA position feedback to the controller from the modulating valve.
- The controller (RTK RE3953) operates the make-up inlet control valve (LCV-002 114109) , the 1st low and high alarm with Profinet feedback.
- Level sensor (NI1341) (LT-001 1141019), provides a 4-20mA input signal to the controller and the 4-20 mA signal represents the level sensor length.
- The overflow is a pneumatically operated butterfly valve (Fail Open) (XV-001-114109) and opens on high alarm by activation of a solenoid valve.
- 2nd low (LSLL-001 114109) and 2nd high (LSHH-002 114109) is via an independent level switch (LT-002 114109) (Gestra NRS1-52) and dedicated level probe.
- The Deaerator Level will be shown on the Supervisor HMI.

3.2.2.Pressure Control

- Steam shall enter the dome / storage vessel via a valve train comprising of isolating valve, control valve and isolating valve and there is an upstream steam separator and condensate trap fitted.
- The control valve (Fail Closed) (PCV-021 114101) shall be the pneumatically actuated type.
- The controller (RTK- RE3953) is a three point stepping controller with a 0-1000 ohm position feedback to the controller from the modulating valve.
- The controller operates the steam injection modulating valve (PCV-021 114101), the low and high pressure alarm and sequence panel provides Profinet feedback.
- There is pressure sensor/gauge station (DR1226) (PIT-001 114109) which serve the pressure controller and the 4-20 mA signal represents the pressure sensor range of 0 to 4 BarG.
- The Deaerator Pressure will be shown on the Supervisor HMI.

4. Supervisor System:

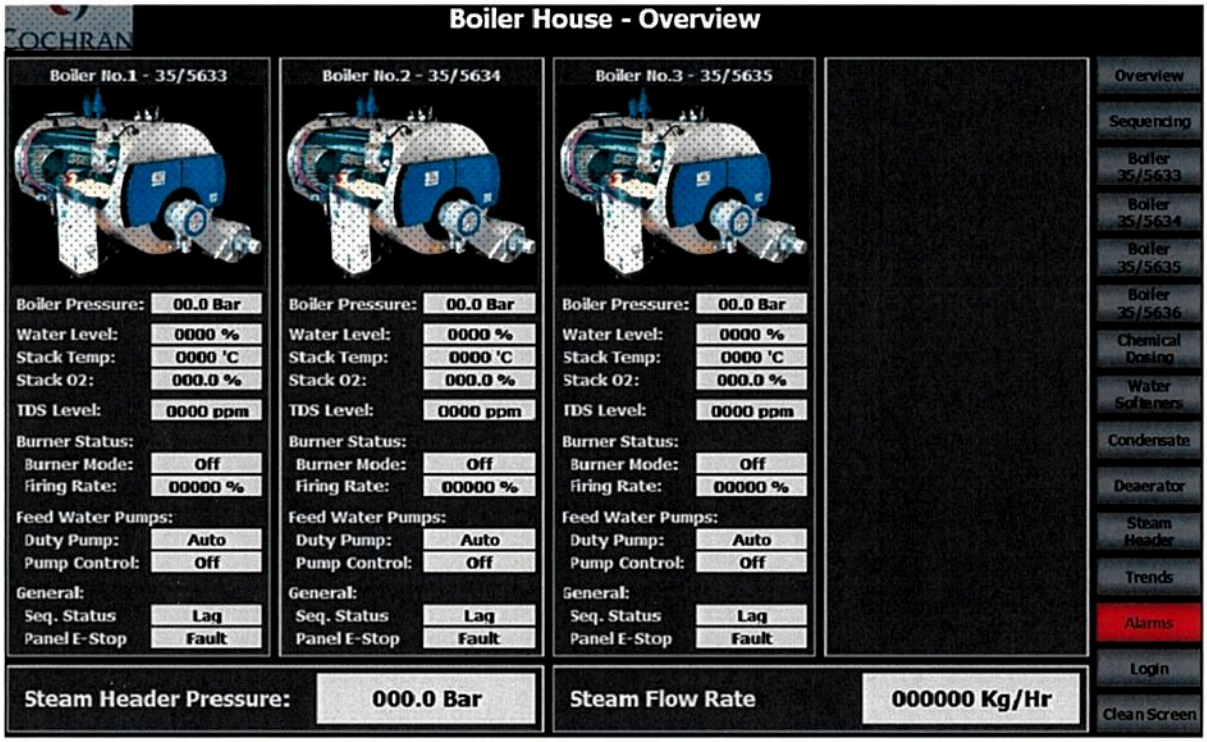
4.1. PLC Description:

4.1.1. A Siemens S7-1215 PLC will be used to gather information from each of the 3 Boilers Panels via Modbus TCP/IP.

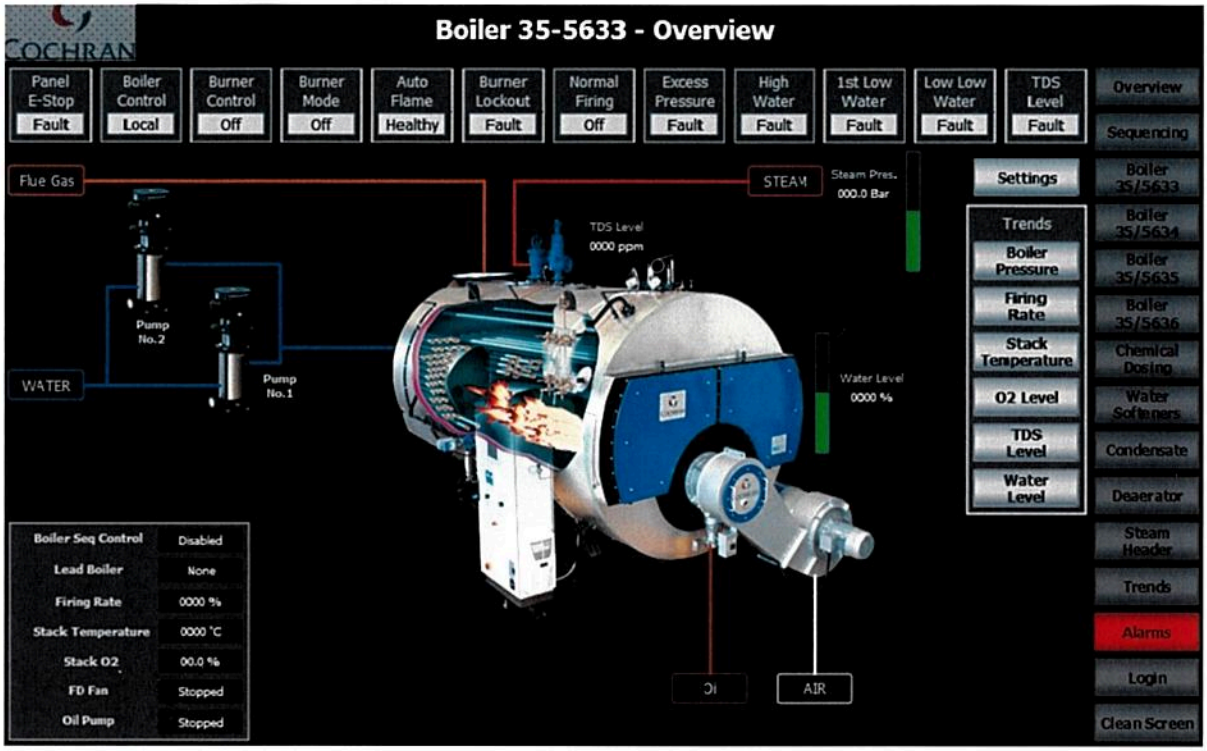
4.1.2. The Supervisor System will also control the Transfer Pumps, as well as providing feedback from the Deaerator and Condensate Tank.

4.2. HMI Description:

4.2.1. The HMI will show an overall system Overview showing general details of each of the 3 Boilers. An example of this can be seen below.



4.2.2. There will also be a detailed "Boiler Overview" showing more specific information of each individual Boiler. Again an example of this can be seen below.



4.2.3. Information on the Condensate Tank, Deaerator and other external equipment will also be shown.

4.2.4. Any Alarms/Interlocks will be shown on the Alarm Screen.

5. Boiler Sequencing

5.1. Description

5.1.1. The boiler sequencing panel is designed to control three steam boilers to maintain a desired pressure in a common steam header, which will ensure that the Boilers are fired in a controller manner.

5.1.2. Each Boiler must be supplied with its own 4-20mA analogue input representing common steam header pressure.

5.1.3. The sequencer will determine the number of boilers required to meet the system demand based on the pressure in the header.

5.1.4. An Engineer settable Lead Boiler Firing Rate percentage will be provided, e.g 70%.

5.1.5. This will be used to indicate the starting point at which the Lag Boiler will being to increase its Firing Rate. This will ensure that the Lead Boiler doesn't reach 100% Firing Rate before assistance from the Lag Boiler is provided.

5.1.6. The Lag boiler will be kept warm allowing it to be brought up to pressure quickly in the event of an increase in Steam demand.

5.1.7. The selection of Lead, Lag and Standby Boilers will be made manually by the Operator via the Supervisor HMI.

6. Boiler System

6.1. Description

6.1.1. The Cochran Ltd Thermax Packaged Steam Boiler is of the twin furnace 'Three Pass Wet Back' design. The furnace being the first pass in which combustion gases flow through the boiler with the second and third passes being two nests of small bore smoke tubes. The boiler is of welded construction throughout and is designed and manufactured to BS EN12953. The shell is thermally insulated with mineral wool and clad in aluminium.

6.1.2. As a 'Packaged' unit, the boiler is supplied with all pre-requisite items of plant and control equipment that are factory fitted. They include; Burner, Boiler, Control Panel, Economiser and associated Pipework; Valves; Duty / standby Feed pumps, TDS & Intermittent blowdown systems, Self monitoring water level control equipment, all items are pre-wired as a packaged unit. The burner is suitable for firing either gas or distillate oil. The flue gas Economiser will elevate the feed water temperature and increase efficiency.

Boiler design specification as follows:

Rating	- 12 500 kg/hr F&A 100 degC
Operating Pressure	- 8.5 barg
Design Pressure	- 11 barg
Boiler Safety valve set pressure	- 9.5 and 10 barg

Only recognised suppliers throughout the industry and well proven equipment have been used for the boiler valves and fittings. The main valves and suppliers are listed as follows:

Combustion Equipment	- Dunphy
Main steam stop valve	- Ari Armaturen
Safety valve	- Ari Armaturen
Feed water isolation	- Ari Armaturen
Level Gauge	- Klinger
Feed water pumps	- Grundfos
Water level control system	- Gestra
TDS & Intermittent blowdown	- Gestra

7. Boiler Operation

7.1.

Each boiler is fitted with 1 off fully modulating, dual fuel burner, manufactured by Dunphy. They are part of the well established TD640 range, finished to a high quality. For optimum control, per burner, a variable speed driven FD Fan has been supplied with a direct drive combustion air fan. To reduce noise, an air inlet silencer is fitted with acoustic foam lining and a sound absorbing hood to limit the operating noise level. Flame surveillance is monitored by a self checking UV cell. Control of the burner is by means of the Ratiotronic electronic air / fuel ratio control system giving direct digital control of air and fuel drive servo motors. The servo motors are fitted on the air inlet damper, gas butterfly valve and oil metering valve. The accuracy of the servo motors is controlled to 0.1 degrees angular. The burner gas train is constructed to BS 5885 and comprises of double gas valve actuators, valve proving system (XV-006&008 114102) and pressure transmitter (PT-003 114102).

Full details of the Burner control and management system are contained with the O&M Manuals.

The boiler furnaces receive radiant heat from the burner flame and the hot gases from the flame give up heat to the tubes in the second pass as they travel to the front chamber or smokebox. Gases turn in the front chamber and give up more heat to the tubes in the third pass as they travel to the rear chamber. The gases leave the boiler by the chimney at the rear of the boiler via a flue gas economiser.

On the generation of steam, pressure rises in the boiler; the pressure is indicated on a dial gauge (PI-001 114101) mounted on top of the boiler. Pressure is controlled by a self checking pressure transducer (PT-002 114101) that maintains pressure within a commissioned control band and adjusts the firing rate of the burner. The 'transducer' measures variation in boiler pressure which proportionally changes the position of burner servo motors to increase or decrease the quantity of fuel and air to meet steam load demands.

***NOTE** – It is recommended that where possible, the differential pressure cut in and cut out should be kept to less than 20% of the normal operating pressure*

Should pressure continue to increase beyond limiting set points, the boiler safety valve will lift and relieve excess pressure discharging steam to atmosphere thus preventing any further rise in boiler pressure. The boiler safety valves are set to 9.5 and 10 barg respectively (PSV-001 114101 and PSV-002 114101)

The boiler is fitted with Gestra high integrity, self monitoring water level controls from the SMT series. The system consists of sensors mounted on the shell that monitor the water level within the Boiler and regulate the flow of feed water entering it thus maintaining the level within fixed limits. The flow is regulated by an electrically actuated control valve (LCV-003-114101). The control valve actuator will 'stay put' in the event of a power failure. The system is also provided with safety interlocks to 'lockout' the boiler in the event of low water conditions. In accordance with the requirements of BS EN12953, there are two independent conductivity level probes both initiating a 'lockout' alarm. If a 2nd or 3rd 'low water' (LS-004 114101 & LS-005 114101)alarm does occur, manual intervention by site operatives will be required to restart the boiler. A 1st low is obtained from the NRG26-21 probe (LT-003 114101) as an audible warning.

Duty / standby centrifugal feed pumps PU-114103, PU-114104) (provide the Boiler with feed water which flows through the Economiser before entering the Boiler. In the event of the duty feed pump failing, a manual switch changeover to the standby pump would be required.

The feed water is preheated as it passes through the Economiser by recovering sensible heat from the exhaust gases. The economiser incorporates a manual water bypass system that allows the operator to mechanically isolate the water supply to and from the economiser. This could be used if a problem occurred with the economiser as this system would still allow the operator the option of operating the boiler without the economiser in circuit. The economiser flue gas damper is provided with a temperature controlled damper actuator (XV-004 114101), for plume suppression.

Possible steaming of the feed water within the Economiser during no-flow conditions is prevented by the inclusion of an automatic bleed valve (XV-003 114101). During periods of low steam demand, the electrically actuated feed water control valve (LCV-003-114101) will drive to the closed position, via an auxiliary switch on the valve; the bleed valve will open allowing water to re-circulate to the Deaerator tank.

Each boiler is supplied with dedicated gas (FIT-003 114102)and water meters (FIT-001 114101) fitted and wired on the boiler skid and a steam meter (FIT-001 114101) supplied loose for fitting within doiwnstream pipework. Each meter provides facility to measure mass and instantaneous flow, the water and steam meter readings are used as part of the 3 element water level control system to provide an accurate position an control of the feed water inlet valve (LCV-003-114101). Each meter output is available on the Dunphy touchscreen HMI and over comms back to the site BMS.

Each boiler has a zirconia probe (AT-002 1114101) to measure O2 in the flue gas, fitted in the rear smokebox. On the basis of the O2 reading, this trims the air / fuel servo motor positions to ensure O2 is kept at optimum levels for combustion.

The economiser has flue gas inlet and outlet temperature probes fitted (TT-003 114101 & TT-004 114101) and feed water inlet and outlet temperature probes fitted (TT-001 114101 & TT-002 114101). These provide relevant temperature readings on the Dunphy HMI screen and over comms link, allowing the operator to check economiser performance through temperature.

7.2 Boiler Operation

The boiler is supplied with its own dedicated Control panel mounted on the side of the boiler skid protected to IP54. The panel houses all necessary components such as relays, level controllers to provide full functionality and 1 ph control of the boiler.

The panel incorporates the Dunphy Ratiotronic control system incorporating a touch screen display. The system complies with the latest standards for burner management control, EN298:2003 with amendments effective from the end of 2007. The system will provide both electronic control of the burner management and fuel / air ratio. It offers graphical representation of the burner with active display of the valves and motors and operation of various burner functions. The Ratiotronic system 5000 includes event log and alarm history, maintenance history and safety test history, all invaluable to the operator. A safety test system is incorporated to aid operators safely through the regular checks including testing the flame failure and false flame are working correctly and ensuring the pressure control and excess limit control are operating safely. The panel is fitted with an emergency stop button to remove all local power to the panel when pressed.

The Boiler Control Panel also provides interface to the remote BG01 alarm and sequence control system panels

General functionality of main items located within or interfaced to the Boiler Control Panel described as follows:

(a) **Alarm sounders** provide an audible warning in the event of a Burner lockout condition, e.g. 2nd Low Water. This alarm can be muted via the panel touch screen but this action will not cancel the alarm condition. As with all lockout alarm conditions, manual intervention is necessary to investigate the cause and reset the Boiler accordingly.

Faults that initiate a lockout condition are Low Gas Pressure; High Gas Pressure; Gas valve proving fault; low combustion air pressure; low oil pressure, high oil pressure, false flame, flame failure, low and extra low water.

Location – Mounted externally on Boiler Control Panel side

(b) **Boiler Self checking Steam Pressure Transmitter (PT-002 114101)**, monitoring pressure from within the boiler shell and transmitting a 4 – 20mA signal directly into the management control system to initiate and control the Burner Firing Rate.

Location – Mounted on top of Boiler on pressure switch header at front end

(c) **Boiler pressure Limit stat (PS-003 114101),** monitoring pressure, cuts out burner on limit of working pressure. (Burner cuts back once pressure decays to lower set point)

Location – Mounted on top of Boiler on pressure switch header on top of water gauges

(d) **Fan and filter** to provide ventilation to the control panel for the extraction of heat generated by the control equipment.

Location – Mounted inside Boiler Control Panel

Mounted on Boiler Control Panel fascia:

(e) **1 No. System 5000** burner management and air / fuel control system.

(f) **1 No. URB50 (HMI for TDS control)**. Operates in conjunction with TDS conductivity probe to provide TDS and trending information. Also provides timer function for bottom blowdown.

Location – Boiler Control Panel fascia

(g) **1 No. URB50 (HMI for Water level control)** Operates in conjunction with boiler mounted NRG26-21 Capacitance probe and 2 x NRG16-50 level probes to provide modulation control indication, 1st high alarm and 3 low water alarms.

Location – Boiler Control Panel fascia

7.3 Level controls

The supply of Boiler Feed Water is controlled automatically by use of the Gestra SMT32-50eLL high integrity, self monitoring level control system. The system complies with the requirements specified in BS EN12953 and BG01. The low level alarms are of the high integrity type and whilst a trained boiler attendant should check the plant daily, he does not need to be on site at all times. There should however, always be someone available on site who is suitably trained to respond to alarms and take appropriate action.

The Boiler Water Level Control System consists of the following equipment:

(a) **1 off Gestra URB50**

Key features – Modulating control of boiler water level, LCD graphic display and keypad, manual alarm test buttons, inbuilt infrared communication port, switchable integral action.

Location - Boiler Control Panel fascia

(b) **1 off NRG26-21 Capacitance Probe** (LT-003 114101)

Key feature – Can sense conductivities down to 10µS/cm at 25°

Location - Boiler mounted, top platform level

(c) **1 off NRS1-50 Level Switch**

Key features – The level switch NRS 1-50 is used in conjunction with 2 x level probe NRG 16-50 to limit the water level and provide 2nd and 3rd low level indications.

Location - Boiler Control Panel DIN Rail

(d) **1 off NRG16-50 2nd Low Water Conductivity Probe** (LS-004 114101)

Key feature – Can sense conductivities down to 30µS/cm at 25°, cyclic self test of the probe, cable and electronic circuit, fail safe design, double fault safe.

Location - Boiler mounted, top platform level

(e) **1 No. NRG16-50 3rd low water Conductivity** (LS-005 114101)

Key features – No moving parts and minimal maintenance, cyclic self test of the probe, cable and electronic circuit, manual alarm test buttons, inbuilt infrared communication port, fail safe design, double fault safe.

Location - Boiler Control Panel fascia

(g) **1 off Gestra Feed water Control Valve** (LCV-003 114101)

Key feature – Linear output, fitted with auxiliary limit switch for bleed control, can be fitted with a positioner input card. In the event of power failure, the actuator will 'Stay put'

Location – Installed in Boiler feed water line

Operation of the boiler water level control system is described as follows:

The capacitance probe (LT-003 114101) is immersed in the boiler water is powered by the water level controller and produces a dc voltage proportional to the actual water level. The proportional signal (4-20mA) from the water level controller in turn regulates the Feed water Control Valve to control the flow of water from the feed pumps thus maintaining the water level within pre-determined limits. The high integrity low level probes monitor the water level on the probe tip, where resistance to earth is low. If the water level falls below the tip, resistance to earth becomes high, activating the low level alarm and initiating a boiler 'lockout'.

7.4 Boiler Blowdown (Bottom and TDS)

The boiler has two types of Blowdown system to enable the operator to remove any sludge or solid waste from the boiler via a timed controller (Intermittent) and to maintain the level of suspended dissolved solids within pre-determined 'Set Points' (TDS).

The blowdown systems consist of the following equipment:

(a) **3 off Manual Bottom Blowdown valves (HV -114102 029/030/044)** used for sludge removal and boiler draining purposes. Under normal operating conditions with the timed blowdown system **(XV-007 114101)** in operation, manual valves **(HV -114102 029/030)** would be closed and **(HV -114102 044)** would be open.

(b) **1 off Gestra MPB24C Automatic Bottom Blowdown Valve (XV-007 114101)** is a pneumatically operated valve used in conjunction with the URB50 controller. This is part of the bottom blowdown system.

Key features – Pneumatic actuator for rapid response, spring return for fail safe operation.

Location – Installed in the Boiler main blowdown line

(c) **1 off Gestra URB50 Timed Bottom Blowdown controller** panel mounted unit that operates in conjunction with the MPB24C Automatic Bottom blowdown valve that allows up to 3 blowdown cycles per day, precisely when required. This is part of the Main TDS blowdown system.

Key features – Real time clock & calendar, three timers can be assigned for each day, variable valve closing and opening times, manual valve open / close, inbuilt infrared communication port, switchable alarm latch.

Location - Boiler Control Panel fascia

(d) **1 off URB50 TDS controller** panel mounted HMI unit for TDS level setting that operates in conjunction with the TDS probe. This is part of the TDS blowdown system.

Key features – Calibration reminder, real time clock, variable alarm hysteresis with latch, isolated 4-20mA re-transmission signal, pulsed cleaning cycle, inbuilt infrared communication port.

Location - Boiler Control Panel fascia

(e) **1 off Gestra LRG16-4 TDS Probe (AT-001 114102)** boiler mounted probe for measuring conductivity levels of boiler water that operates in conjunction with the LRR1-52 TDS controller / URB50. This is part of the TDS blowdown system.

Key features – Cleaning cycle, all wetted parts in austenitic stainless steel, can sense conductivities down to 10µS/cm.

Location – Directly mounted into Boiler shell

(f) **1 off Gestra BAE Continuous TDS Blowdown valve (XV-002 114101).** Electrically actuated valve that operates in conjunction with the TDS panel mounted controller. This is part of the TDS blowdown system.

Key features – Adjustable by limiting the spindle stroke to regulate the number of orifice that are uncovered, specifically designed to minimise seat erosion to ensure tight shut-off plug at the base of the valve body to allow a water sample cooler to be fitted. Spring return to close for fail safe operation

Location – Installed in Boiler TDS line

(g) **1 off Gestra SCC2 Sample cooler** is used to cool samples of boiler water and consists of a stainless steel coil through which the sample flows. The coil is encased within a stainless steel body through which cooling water flows in the opposite direction. This is part of the TDS blowdown system.

Key features – Stainless steel body and coil to minimise corrosion, counter current flow for efficient cooling. **Location** – Piped in the base of the Automatic TDS Blowdown valve

Operation of the boiler blowdown systems are described as follows:

The **Automatic bottom blowdown system** is timer controlled via the URB50 controller mounted on the Boiler Control Panel fascia. In conjunction with the clients' water treatment provider, the time and duration of each 'blowdown' can be set into the controller. The URB50 blowdown timer is a dual voltage cyclic timer for the control of blowdown intervals and there duration. A time delay can be programmed to prevent different boilers blowing down in rapid succession. This feature also avoids the possibility of overloading the blowdown vessel which could lead to water being discharged to drain at high temperatures. Time controlled bottom blowdown can bring many benefits to boiler plant by minimising energy loss from boiler blowdown.

Boiler feed water can contain a high level of dissolved solids. Water treatment can chemically modify the form of the dissolved solids but will not usually remove them completely. As steam is evaporated, the TDS (Total dissolved solids) level increases in the boiler water, if the TDS is allowed to increase above normal limits then carryover of the boiler water with steam can occur with the potential for serious damage. In order to limit the TDS levels, a **TDS Blowdown Control system** has been installed; this operates by constantly measuring the electrical conductivity of the boiler water. A conductivity probe is inserted directly into the boiler shell and continuously monitors the conductivity level of the boiler water, from that, the level is displayed on the URB50 controller mounted on the Boiler Control Panel fascia. In conjunction with the clients' water treatment provider, the set point is inserted into the controller; conventional boilers are normally operated with the TDS ranging between 2000ppm and 3500ppm. The measured value is constantly compared with the set point in the controller, if it is lower than the set point the Blowdown valve (XV-002 114101) will remain closed, if it is higher, the valve will open until the measured value drops below the set point. A sample cooler is also provided as part of the system enabling the operator to obtain a sample of boiler water at any time to analyse its quality and residual properties. A boiler water sample is taken by firstly ensuring that cold water is passing through the cooler body by opening the inlet isolation valve. When you can visually see water discharging into the open tundish, a sample can then be taken by opening the valve and collecting a sample from the spout.

The main Blowdown and drain lines from each boiler are piped to a Blowdown vessel (TA-114101) which reduces the contained water temperature to an acceptable level before discharging to the site drainage system.

The Blowdown vessel (TA-114101) is a storage vessel for waste water taken from the boiler system, the waste water is temporarily stored in this vessel until it has cooled sufficiently before discharging to the site drainage system. The Blowdown vessel is designed to BS 5500 category 3 and is designed to operate in accordance with the HSE Guidance Note PM 60.

The low pressure drain from the outlet of the sample cooler and the safety valve chest discharge drain are piped to a common drain manifold and routed to a surface drain.

The Blowdown vessel cooling water system consists of a self acting control valve (TCV-004 114101) that operates in conjunction with a temperature element (TE-002 114101) mounted directly into the vessel. Cold water supply from the Site water system (WPO) is connected to the self acting valve. The temperature element sensing the stored water within the vessel will open and close the self acting valve to maintain the storage water at an acceptable temperature. Water should not be discharged from the vessel into the Site drainage system at temperatures exceeding 43°C. The temperature element is fitted with a set point adjuster that allows the operator to adjust the desired stored water temperature within the blowdown vessel.

A flash vessel (VE-114 101) per boiler is provided to accept blowdown discharge from each TDS system. The Flash vessel steam discharge is designed to be piped to a feed water storage tank for water preheating and the drain is designed to be piped a Blowdown Vessel. Each flash vessel is provided with its own over pressure relief valve (PSV-004 114101).