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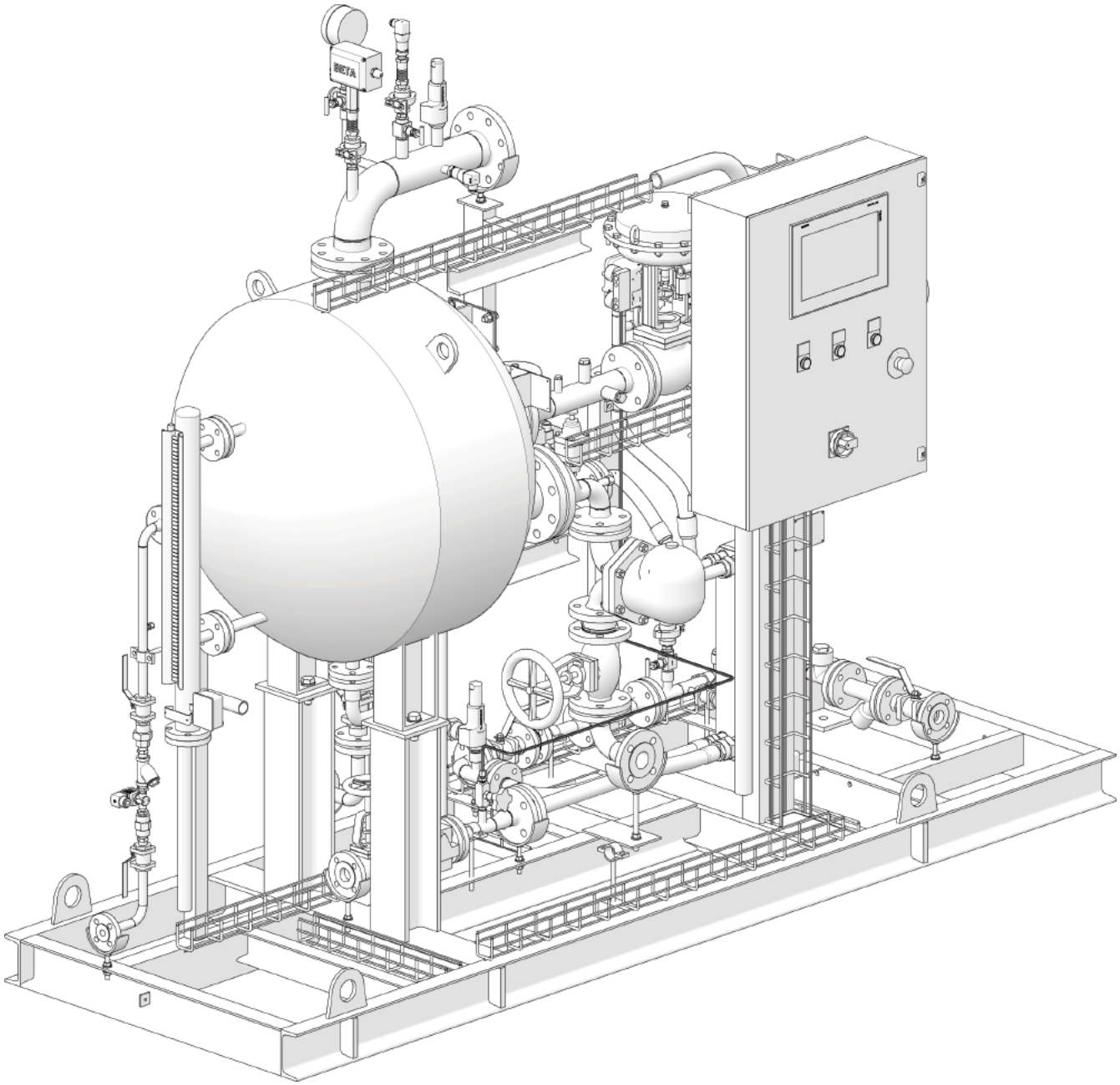
IM-P664-03
TES Issue 4

CSG-FBHP
Clean steam generation system for Food and Beverage
Installation and Maintenance Instructions



First for Steam Solutions

EXPERTISE | SOLUTIONS | SUSTAINABILITY

Contents

1. Safety information

In addition to putting your personnel at risk of death or serious harm, failure to comply with the instructions, recommendations and guidance set out in this document may jeopardise your warranty rights. Further, use of the product(s) otherwise than in accordance with this document will be undertaken entirely at your own risk. To the fullest extent legally permitted, Spirax Sarco excludes all responsibility and liability for any and all loss or damage caused in the event that the practices and procedures detailed in this document have not been followed.

Safe operation of these products can be guaranteed only if they are properly installed, commissioned and maintained by a qualified person (see Section 1.12) in compliance with the related operating instructions. General installation and safety instructions for pipeline and plant construction and also the proper use of tools and safety equipment must also be complied with.

General safety notes

This manual is intended to cover the installation, start-up and maintenance procedures of the CSG-FBHP indirect clean steam generator and must be read in conjunction with the installation and maintenance manuals (IM) of the single components of the unit and related additional safety notes.

Precautions when lifting the unit

The CSG-FBHP indirect clean steam generator must be lifted from the base using the lifting eye bolts installed on the base frame.

 **Caution or Warning**	Do not lift the CSG-FBHP indirect clean steam generator by any other part except from the base. Note: always leave sufficient space around the system for future maintenance operations.

Warnings

1. The unit is designed and constructed to withstand the intensity of work in ordinary use.
2. Use of the product for any other purpose, or failure to install the product in compliance with these Installation and Maintenance Instructions, may damage the product and also cause serious injuries to operating personnel.
3. Before carrying out any installation and maintenance procedure, always check that all primary steam, condensate and water return lines on the secondary have been isolated.
4. Make sure that residual pressure in the system and in pipework has been vented to atmospheric level.
5. To avoid the risk of burns, allow parts to cool before carrying out any type of operation.
6. Always wear suitable protective clothing before carrying out any installation or maintenance activity.
7. This product is intended to be connected into a system that can operate an EC1935 compliant process. To minimise the risk of non-intentionally added substances in the system, it is essential that an appropriate CIP (cleaning in place) cycle is carried out by the end user prior to first use in a food contact application. A list of the materials that could come directly or indirectly into contact with foodstuffs can be found in the Declaration of Compliance available for this product.

1.1 Intended use

Referring to the installation and maintenance instructions and the nameplate of the unit and the Technical Specifications, check that the product is suitable for intended use/application.
EMEA - The CSG-FBHP indirect clean steam generator complies with the requirements of the Pressure Equipment Directive (PED) and is CE marked.

America's - The CSG-FBHP indirect clean steam generator complies with the requirements of the ASME Pressure vessel code and ASME U Stamp upon request.

Asia Pacific - The CSG-FBHP indirect clean steam generator complies with the requirements of the Pressure Equipment Directive (PED or GB) Conformance to KGS / MOM and DOSH is available upon request.

i) **The product has been specifically designed for use on steam and water belonging to Group 2 of the above-mentioned Pressure Equipment Directive.**

ii) **Check suitability of material, pressure and temperature and related maximum and minimum values. If the maximum operating limits of the product are lower than those of the system in which it to be inserted, or if malfunction of the product could generate dangerous overpressure or overtemperature, always insert a safety device in the system to prevent exceeding of such limits.**

iii) **Determine the correct installation position and direction of flow of fluids.**

iv) **The product is not designed to withstand external stresses induced by the system in which it is fitted. The installer is responsible for taking into account such stresses and for adopting adequate precautions to reduce these to a minimum.**

v) **Prior to installation, remove protective covers from all connections and and also protective film and packaging elements.**

1.2 Pressure Equipment Directive (PED) classification

The clean steam generators CSG-FBHP series are classified as assembly according the European Pressure Equipment Directive (PED):

Product	Fluid Group	Category
CSG-FBHP-130	2	III
CSG-FBHP-185	2	III
CSG-FBHP-235	2	IV
CSG-FBHP-300	2	IV
CSG-FBHP-375	2	IV
CSG-FBHP-470	2	IV
CSG-FBHP-600	2	IV

For the category of bespoke units, refer to the “EC Declaration of Conformity" supplied with the product.
Other component parts of the assembly comply with the relevant European Directives, where necessary. Please refer to specific component literature for further details.

1.3 Access

Ensure safe access and, if necessary, a safe working platform (suitably guarded) before attempting any work on the product. Arrange suitable lifting gear if required.

1.4 Lighting

Ensure adequate lighting, particularly where detailed or intricate work is required.

1.5 Hazardous liquids or gases in the pipeline

Take into account what is currently in the pipeline or what may have been in the pipeline at some previous time. Consider: flammable materials, substances hazardous to health, extreme temperatures.

1.6 Hazardous environment around the product

Consider: areas with a risk of explosion, lack of oxygen (e.g. tanks, pits), dangerous gases, extreme temperatures, hot surfaces, fire hazards (e.g. during welding), excessive noise, moving machinery.
The place of installation of the assembly must be equipped with the fire-prevention devices required by current regulations.

1.7 The system

Consider the effect of the work to be carried out on the entire system. Consider whether the action proposed (e.g. closing of isolating valves, electrical isolation) may put any other part of the system or personnel at risk.
Hazards may include isolation of vents or protective devices or the rendering ineffective of controls or alarms. Ensure isolating valves are opened and closed gradually to avoid shocks to the system.

1.8 Pressure systems

Ensure that any pressure is isolated and safely vented to atmospheric pressure.
Consider double isolation (double block and bleed) and locking or labelling of closed valves. Do not assume that the system has depressurised even when the pressure gauge indicates zero.

1.9 Temperature

Allow time for temperature to normalise after isolation to avoid the risk of burns and consider whether protective clothing (including safety glasses) is required.

1.10 Tools and consumables

Before starting work, make sure you have suitable tools and/or consumables on hand. Use only genuine Spirax Sarco replacement parts.

1.11 Protective clothing

Consider whether you and/or others require protective clothing to protect against hazards, such as chemicals, high/low temperatures, radiation, noise, falling objects and danger to eyes and face.

1.12 Permits to work

All work must be carried out or supervised by a suitably competent person. Installation and operating personnel should be trained in correct use of the product according to the Installation and Maintenance Instructions. Any formal work permit system adopted must be complied with. Where no such system is applied, a person responsible should be informed of progress of the work and, where necessary, an assistant with primary responsibility for safety should be appointed. Post "warning signs" if necessary.

1.13 Handling

Manual handling of large and /or heavy products may involve a risk of injury. Lifting, pushing, pulling, carrying or supporting a load by bodily force may cause injury, particularly to the back. You are advised to assess the risks, taking into account the task, the individual, the load and the working environment and use appropriate handling methods according to the circumstances of the work to be carried out.

Note: if it is necessary to use slings for lifting, it is good practice to fit these around the plate of the base unit to avoid damage to the unit.

1.14 Storage

Note: If the Clean Steam Generator cannot be installed and put into operation immediately upon receipt at the jobsite, certain precautions are necessary to prevent deterioration during storage.
Responsibility for integrity of the heat exchangers must be assumed by the user. Spirax Sarco will not be responsible for damage, corrosion or other deterioration of heat exchanger equipment during transit and storage. Good storage practices are important, considering the high costs of repair or replacement, and the possible delays for items which require long lead times for manufacture. The followings suggested practices are provided solely as a convenience to the user, who shall make his own decision on whether to use all or any of them.

- **On receipt of the CSG-FBHP Steam Generation System, inspect for shipping damage to all protective covers. If damage is evident, inspect for possible contamination and replace protective covers as required. If damage is extensive, notify the carrier immediately and Spirax Sarco.**
- **If the CSG-FBHP is not to be placed in immediate service, take precautions to prevent rusting or contamination.**
- **Store under cover in a heated area, if possible. The ideal storage environment for CSG-FBHP and accessories is indoors, above grade, in a dry, low humidity atmosphere which is sealed to prevent entry of blowing dust, rain or snow. Maintain temperatures between 20 °C and 50 °C (68 °F and 122 °F) and humidity at 40% relative humidity or lower.**

Note: Ambient temperature of the place where the unit will be installed must be above 0 °C (32 °F) and below 40 °C (104 °F).

1.15 Freezing

Precautions must be taken to protect products that are not self-draining against frost damage in environments where they may be exposed to temperatures below freezing point.

1.16 Disposal

As the product may contain PTFE and Viton, particular precautions must be adopted to avoid potential risks for health caused by decomposition or combustion of such materials. Unless otherwise indicated in the installation and maintenance instructions with regard to the materials of the seals, this product can be recycled and it is considered that no environmental risk exists deriving from disposal thereof provided that suitable precautions are adopted. However, its components can be checked to verify the possibility of safe disposal. Please visit the Spirax Sarco product compliance web pages https://www.spiraxsarco.com/product-compliance for up to date information on any substances of concern that may be contained within this product. Where no additional information is provided on the Spirax Sarco product compliance web page, this product may be safely recycled and/or disposed providing due care is taken. Always check your local recycling and disposal regulations.

PTFE:
- **This material can be disposed of only using approved systems and never in incinerators.**
- **PTFE waste to be disposed of must be stocked in separate containers and must never be mixed with other waste.**

Viton:
- **VITON waste can be sent directly to landfills when permitted and accepted by local and national regulations.**
- **VITON components may also be incinerated but a scrubber must be used to remove the hydrogen fluoride developed by the product, carrying out this procedure in accordance with local and national regulations. The components are insoluble in aquatic media.**

Electrical:

Unless otherwise stated, the electrical components within this product are recyclable and no ecological hazard is anticipated with its disposal providing due care is taken. The product should be recycled in line with local legislation.

Please visit the Spirax Sarco product compliance web pages
https://www.spiraxsarco.com/product-compliance
for up to date information on any substances of concern that may be contained within this product. Where no additional information is provided on the Spirax Sarco product compliance web page, this product may be safely recycled and/or disposed providing due care is taken. Always check your local recycling and disposal regulations.

1.17 Return of products

Customers and stockists are reminded that, under EC Health, Safety and Environment Law, when returning products to Spirax Sarco, they must provide information regarding any hazards and precautions to be taken due to contamination residues or mechanical damage which may represent a risk to health, safety or the environmental. This information must be provided in writing, including Health and Safety datasheets relating to any substances identified as hazardous or potentially hazardous.

2. General product information

2.1 Description

The CSG-FBHP indirect clean steam generator consists of a complete, safe and functional system package, ready for installation and able to produce up to 1300/1850/2350/3000/3750/4700/6000 kg/h of clean steam (at normal operating conditions) using industrial steam as a primary energy source.

The CSG-FBHP series of indirect clean steam generators are designed to produce clean steam for direct injection processes within the food and beverage industry sector, where steam is considered as an ingredient.

The heat exchange is indirect, for which there is no contamination between the primary steam and the 'clean' steam produced.

Models and applications

Size:	**CSG FBHP-130**	maximum production capacity	1350 kg/h	(2976 lbs/hr)
	CSG FBHP-185	maximum production capacity	1880 kg/h	(4145 lbs/hr)*
	CSG FBHP-235	maximum production capacity	2350 kg/h	(5180 lbs/hr)*
	CSG FBHP-300	maximum production capacity	3030 kg/h	(6680 lbs/hr)*
	CSG FBHP-375	maximum production capacity	3770 kg/h	(8311 lbs/hr)*
	CSG FBHP-470	maximum production capacity	4710 kg/h	(10,384 lbs/hr)*
	CSG FBHP-600	maximum production capacity	6050 kg/h	(13,338 lbs/hr)*
Versions/Applications:	**FBHP**	Food and Beverage steam injection for high pressure applications		

(*) max steam production at reference operating conditions: primary steam at 12 bar g (174 psi g), production at 8 bar g (116 psi g), feed water at 20 °C (68 °F).

2.2 Identification of the product

The product is identified by the nameplate fastened to the frame.

The CSG-FBHP unit, (Figure 1), comprises the following main parts:

1. Steam generator and instrumentation/accessories, protection and safety devices
2. Primary steam control
3. Condensate removal
4. Feedwater inlet
5. Electrical control panel

For a detailed list of equipment and specifications, refer to the PandID and documentation provided.

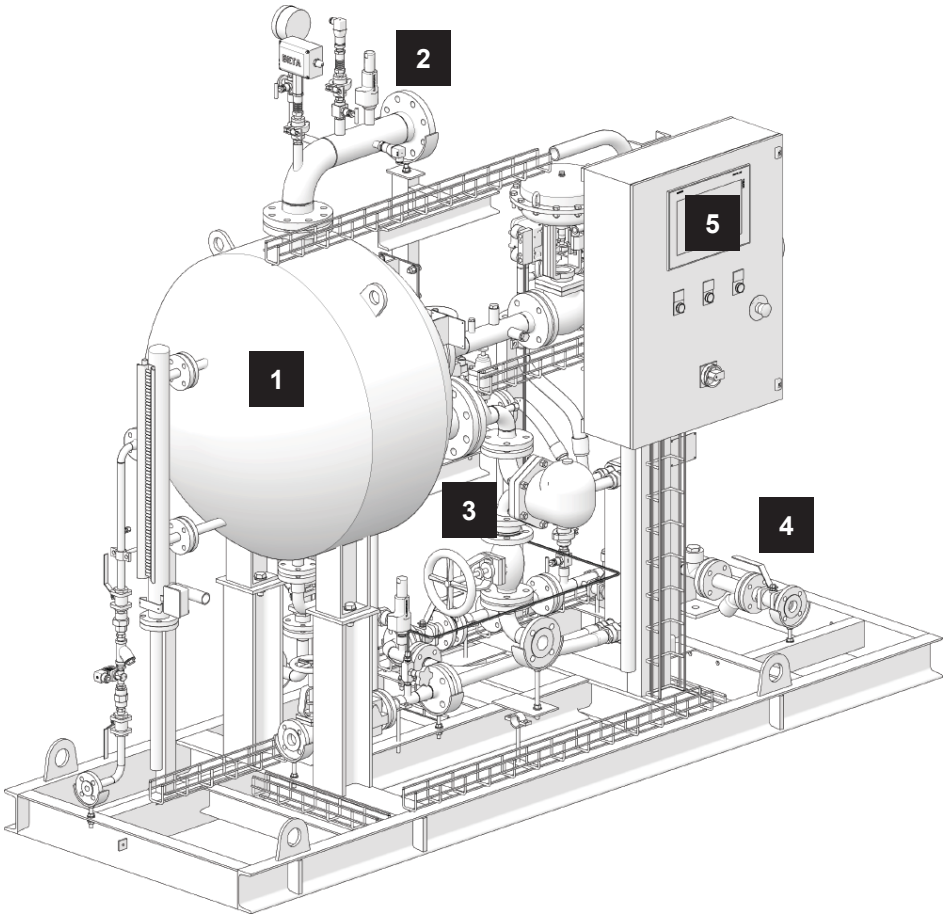


Fig. 1

Notes:

1. For further information concerning individual components refer to the specific technical documentation of each product.
2. Further technical information regarding the CSG-FBHP indirect clean steam generator can be found in TI-P664-05.

Example of nameplate:

1. **"CE" marking and Id. of notified body**

   Unit PED category

2. **Unit model**

3. **Product Nomenclature**
   - Series
   - Size
   - Configuration
   - Options

4. **Unit serial No.:**
   - YY: year
   - XXXXXX: identification number (6 or 9 digits)
   - ZZ: unit progressive number
   - Year of construction

5. **Electric and air supply specifications (where required)**

6. **Fluid group (PED), design conditions and circuit hydro test pressure**

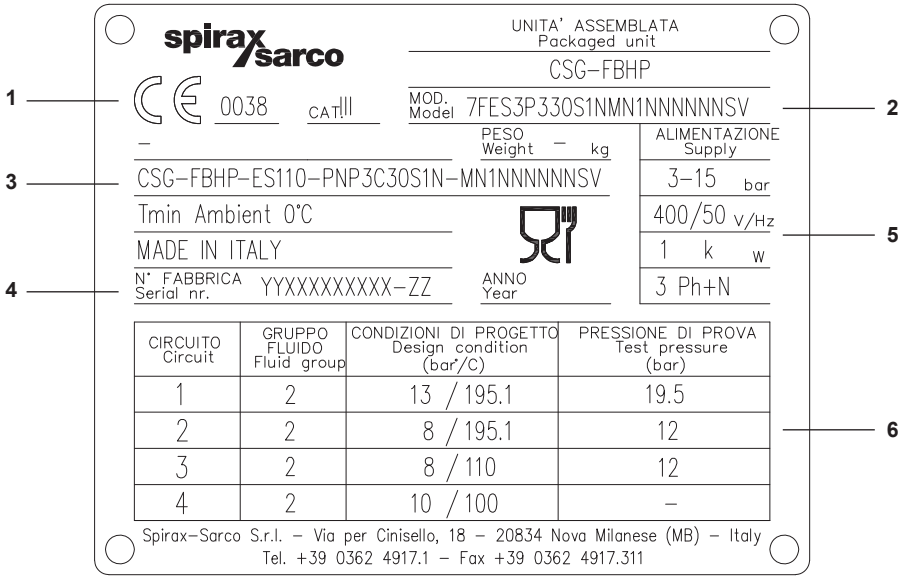


Fig. 2

Note: the pressure values in the nameplate are expressed in 'bar g'.

2.3 Product nomenclature and selection guide

The product nomenclature is based on the characteristics of the main elements and options, identified as follows:

Design code	E	EN	**E**
	A	ASME	
Shell Type	W	Welded – not openable	**W**
Unit Size	130	Up to 1350 kg/h (2976 lbs/hr)	**130**
	185	Up to 1850kg/h (4145 lbs/hr)	
	235	Up to 2350kg/h (5180 lbs/hr)	
	300	Up to 3030kg/h (6680 lbs/hr)	
	375	Up to 3770kg/h (8311 lbs/hr)	
	470	Up to 4710kg/h (10384 lbs/hr)	
	600	Up to 6050kg/h (13338 lbs/hr)	
	Plant steam K_v (C_v)	10, 16, 36, 46, 63, 100, 160 (12, 18, 42, 53, 73, 116, 185)	**10**
	Feedwater K_v (C_v)	1, 1.6, 2.5, 4, 6.3 (1.2, 1.8, 2.9, 4.6, 7.3)	**1**
Control Valve Actuation	PN	Pneumatic (fail safe)	**PN**
	EL	Electric (fail safe)	
Control	P1	ABB AC500 + 7" Display	**P1**
	P2	Allen-Bradley CompactLogix 1700 + 7" Display	
	P3	Siemens S7.1200 + 7" Display	
Communication interface	C0	None	**C0**
	C1	BACnet IP	
	C2	Profinet	
	C3	Modbus TCP/IP	
	C4	BACnet MSTP	
	C5	Profibus	
	C6	Modbus RTU	
	C7	BACnet (BTL cert.) IP	
	C8	BACnet (BTL cert.) MSTP	
Frame and cabinet	0	Basement and cabinet made of carbon steel, painted *	**0**
	3	Base and cabinet made of stainless steel (304)	
Control Panel Location	S	Side	**S**

Product nomenclature and selection guide continued on next page

2.3 Product nomenclature and selection guide (continued)

Insulation	1	Steam Generator Body only to EnEV (100 mm)	**1**
	3	Steam Generator Body to EnEV + Piping (50mm)	
	0	Not insulated	
Wheels and feet	N	None (plates with anchor holes provided)	**N**
	F	Adjustable feet	
Plant steam inlet shut-off	M	Manual stop valve	**M**
	AE	Automatic electric isolation valve*	
Plant steam line trapping	N	None	**N**
	T	Plant steam line trapping station with pocket	
TDS Control	1	Timed TDS Blowdown (no control)	**1**
	2	TDS Control with external probe (discontinuous metering)	
Sample Cooler	N	None	**N**
	S	Sample Cooler and Sampling Valve	
Feedwater pressurisation	N	None (water P = clean steam P + 2.0 bar g)	**N**
	P1	Pump with VFD (for 1 bar g clean steam)	
	P2	Pump with VFD (for 2 bar g clean steam)	
	P3	Pump with VFD (for 3 bar g clean steam)	
	P4	Pump with VFD (for 4 bar g clean steam)	
	P5	Pump with VFD (for 5 bar g clean steam)	
	P6	Pump with VFD (for 6 bar g clean steam)	
	P7	Pump with VFD (for 7 bar g clean steam)	
	P8	Pump with VFD (for 8 bar g clean steam)	
Plant protection	N	None	**N**
	V	Viscorol with low level limit switch	
Feedwater pre-heating	N	Pre-Heating by primary steam supply	**N**
Intelligent diagnostics	N	None	**N**
	I1	System Diagnostics	
	I3	Integrity test	
	I4	System diagnostics + Integrity test	

Product nomenclature and selection guide continued on next page

2.3 Product nomenclature and selection guide (continued)

Clean steam shut off	N	None	**N**
	M	Manual stop valve	
	AE	Automatic electric isolation valve*	
Test and certification	S	EU PED test and CE marking of the assembly	**S**
	R	UKCA	
Level indicator	V	Viscorol (Magnetic Level Indicator)	**V**

Product nomenclature example

CSG-FBHP E W 130-10-1 PN P1 C0 O S 1 N M N 1 N N N N N N S V

* Not all configurations are available in every country. Please contact your local Spirax Sarco representative for more details.

2.4 Design conditions

			EMEA	Americas
Primary side	Design pressure		13 bar g	(188 psi g)
	Design temperature		200 °C	(400 °F)
Secondary side	Design pressure		12 bar g	(180 psi g)
	Design temperature		200 °C	(400 °F)
	Safety valve set pressure		10.8 bar g	(15.6 psi g)
Feedwater	Design pressure		12 bar g	(180 psi g)
	Design temperature	without pump	200 °C	(400 °F)
		with pump	80 °C	(176 °F)

2.5 Operating limits

	Without pump		With pump
Production	Clean saturated steam, up to 8 bar g/175 °C (Clean saturated steam, up to 125 psi g /353 °F)		
Primary side	Plant steam, up to 13 bar g/196.6 °C (Plant steam, up to 188 psi g/358 °F), see safety valve protection		
Feedwater	P min. ≥ P clean steam + 2 bar g (P min. ≥ P clean steam + 29 psi g)		Net positive suction head required (see IM)
	P max 12 bar g/T max 200 ºC (P max 174 psi g/T max 392 ºF		P max 12 bar g/T max 100 ºC P max 174 psi g/T max 212 ºF
Safety valve protection	Safety Valve with 5% overpressure	MAAP: 13 bar g (188.5 psi g) MAWP: 12.38 bar g (180 psi g) Set pressure: 12.38 bar g: (180 psi g)	Note, it is recommended to install a safety valve upstream of the CSG-FBHP to ensure that overpressure can never be supplied to the package. Design pressure of the generator is equivalent to the MAAP (max allowable accumulated pressure). Depending on the type of safety valve used, the MAWP and set pressure can be defined. Normal working pressure to be defined by operator but often 90% of set pressure may be used. Spirax Sarco safety valves are typically 5% overpressure
	Safety Valve with 10% overpressure	MAAP: 13 bar g (188.5 psi g) MAWP: 11.8 bar g(171.1 psi g) Set pressure: 11.8 bar g (171.1 psi g)	

Minimum pressure of the feedwater at the inlet flange of the units equipped with pump, to avoid cavitation (NPSHR) = P' min. + dP
dP: pressure drop along the water feed pipework, at maximum flow-rate. P' min. depending on the water temperature:

T	°C	≤ 85	90	95	100	105	110	(*) Under water head
	(°F)	(185)	(194)	(203)	(212)	(221)	(230)	
P' min.	bar g	0*	0.05	0.20	0.35	0.50	0.70	
	(psi g)	(0)	(0.72)	(2.90)	(5.07)	(7.25)	(10.15)	

Minimum ambient temperature: 0 °C (32 °F).
Maximum ambient temperature: 40 °C (104 °F)
Unit designed for indoor installation, protect from freezing.

To ensure the correct operation of the clean steam generator, the inlet feed water should have the following characteristics. An excess on these values can compromise the lifetime, maintenance and efficiency of the steam generator.

pH 5.5 ÷ 7.5 (at 20 °C)
(5.5 ÷ 7.5 (at 68 °F))

Hardness ≤ 0.02 mmol/l

Chloride Please refer to table below

Conductivity ≤ 20 µS/cm

Chlorides concentration limit in inlet feed water

Blowdown set	Inlet feed water pH		
	pH = 5,5	pH = 6,5	pH = 7,5
5%	≤ 0,5 mg/l	≤ 1 mg/l	≤ 3 mg/l
10%	≤ 1 mg/l	≤ 2 mg/l	≤ 6 mg/l

* All the other characteristics and values of feed water are up to end user of the plant.
In addition to the above, for monitored TDS blowdown, a maintained concentration below a maximum of 100uS/cm is required during operation.

2.6 Dimensions and weights approximate in mm (inches) and kg (lbs) of a standard unit

	Dimensions mm (inches)			Weights kg (lbs)		
	L Length	W Width	H Height	Empty	In operation	Maximum
130	2800 (110)	1000 (39)	2400 (94)	2100 (4630)	2250 (4960)	2400 (5291)
185	3100 (122)	1000 (39)	2450 (96)	2346 (5172)	2500 (5512)	2700 (5952)
235	3400 (134)	1100 (43)	2550 (100)	2573 (5672)	2750 (6063)	2900 (6393)
300	3700 (146)	1100 (43)	2060 (81)	2800 (6173)	3000 (6614)	3200 (7055)
375	3900 (154)	1100 (43)	2070 (81)	4968 (10953)	5200 (11464)	5400 (11905)
470	4000 (157)	1100 (43)	2080 (82)	5095 (11233)	5300 (11685)	5600 (12346)
600	4200 (165)	1100 (43)	2090 (82)	5350 (11794)	5600 (12346)	5900 (13007)

Indicated dimensions are the maximum dimensions for a specific configuration of the package.

For detailed dimensions of the unit, size and position of the connections, weights and other constructive information, refer to the specific general arrangement drawing of the product.

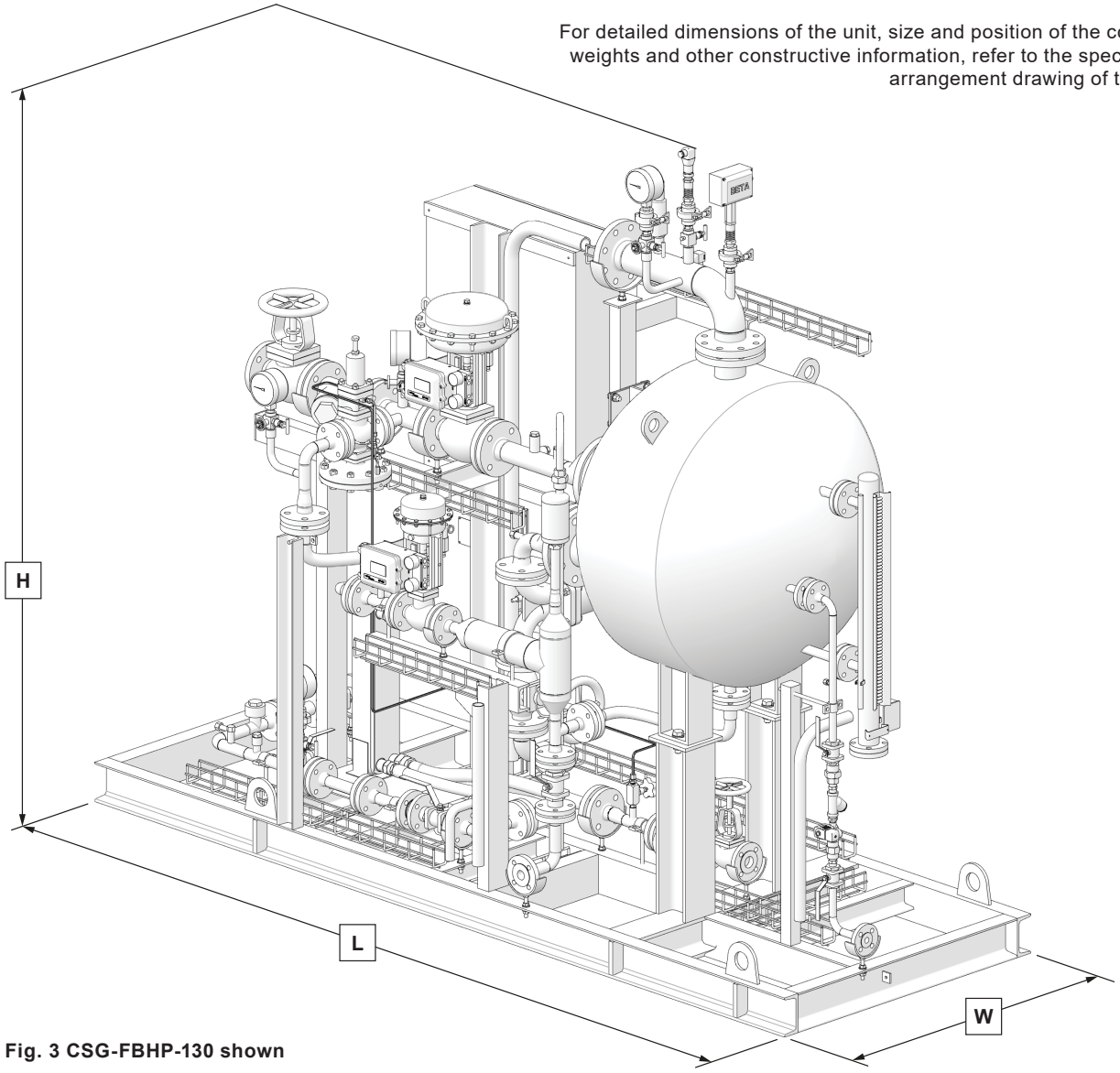


Fig. 3 CSG-FBHP-130 shown

3. Installation

3.1 Installation site

The CSG-FBHP unit is designed for installation indoors with a minimum ambient temperature of 0 °C (32 °F). Installation outdoors is permitted provided that the unit is suitably protected against adverse weather conditions and freezing.

The unit is not suitable for installation in potentially hazardous zones classified as ATEX. Specific solutions can be provided on request.

3.2 Handling

The CSG-FBHP unit must be lifted from the lifting eyebolts mounted on the base of the unit.

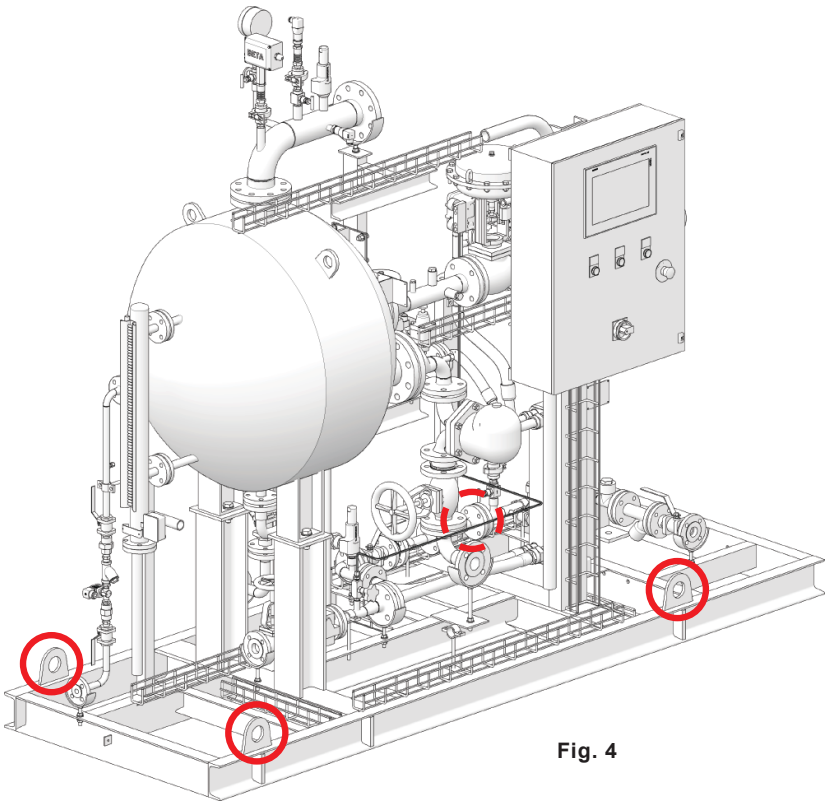


Fig. 4

Do not lift the unit by other parts or in any manner other than as indicated above.

During lifting, take into account the high centre of gravity of the unit and adopt all the necessary precautions to avoid accidental tipping over of the unit.

3.3 Positioning and fastening

The unit must be positioned on a completely flat, horizontal surface able to support its entire weight at full load. For access to the unit, provide at least one metre of clearance around, and 0.5 m (1.64 ft) above. A space for tube bundle removal has to be considered.

3.4 Process pipework and vents

Each unit is provided complete with drawings indicating the position and specifications of connections to be made according to configuration and options ordered.

The main connections of the unit are as follows:

UNI-EN 1092-1 PN16/25/40 connection flanges
ASME/ANSI B16.5 connection flanges
For other pipework, according to options installed, refer to the dimensional (or G.A.) drawing of the unit provided.

3.5 Connections

3.5.1 Metric

		130	185	235	300	375	470	600
A	Plant steam Inlet	DN50* PN16	DN65 PN16	DN80 PN16	DN80 PN16	DN100 PN16	DN100 PN16	DN100 PN16
B	Preheater Condensate Outlet	DN25 PN16	DN25 PN16	DN25 PN16	DN25 PN16	DN25 PN16	DN40 PN16	DN40 PN16
C	CSG Condensate Outlet	DN40 PN16	DN40 PN16	DN40 PN16	DN40 PN16	DN40 PN16	DN40 PN16	DN50 PN16
D	Feedwater Inlet	DN25 PN40	DN25 PN40	DN25 PN40	DN32 PN40	DN32 PN40	DN32 PN40	DN32 PN40
E	Drain Outlet	DN25 PN40	DN25 PN40	DN25 PN40	DN25 PN40	DN32 PN40	DN32 PN40	DN32 PN40
F	Blowdown Outlet /TDS	DN15 PN40	DN15 PN40	DN15 PN40	DN15 PN40	DN15 PN40	DN15 PN40	DN15 PN40
G	Clean Steam Outlet	DN80 PN40/PN25 **	DN100 PN40/PN25 **	DN125 PN40/PN25 **	DN125 PN40/PN25 **	DN150 PN40/PN25 **	DN150 PN40/PN25 **	DN200 PN25
H	Clean Steam Safety Valve Discharge Outlet	¾" NPT-F	¾" NPT-F	¾" NPT-F	1" NPT-F	1" NPT-F	1" NPT-F	1" NPT-F
I	Plant Steam Condensate Outlet (Drain)	DN15 PN40						
L	Comp. Air Line for Integrity Test	¼" NPT-F						
M	Pneumatic Air Supply Inlet	¼" BSP-F						
N	Sampling system (cooling water in/out-sample out)	½" BSP- 6mm						
Options								

* If the Auto Plant Steam Isolation is selected, then this should be PN40.

** Clean steam outlet connection is PN40 or PN25 on sizes 130, 185, 235, 300, 375 and 470, depending if the option of automatic clean steam isolation is selected. However, PN25 and PN40 flange connections on these sizes are interchangeable

The steam supplied to the CSG-FBHP unit must be as dry and clean as possible in accordance with the guidelines of sound steam engineering practices. It is also necessary to verify that all pipes are suitably supported without any excessive loads or stress.

Before making any connection, check that all pipework is clean and free of foreign material or scale that may adversely affect functioning and/or the performance of the unit.

The steam supplied must always be maintained within design operating pressure and temperature limits. The unit shall not work above the design pressures and temperatures indicated on the name plate on the package.

The drawings provided in this manual are for guidance purposes only. For connections of the unit, always consult the attached drawings.

For imperial connections, see page 20

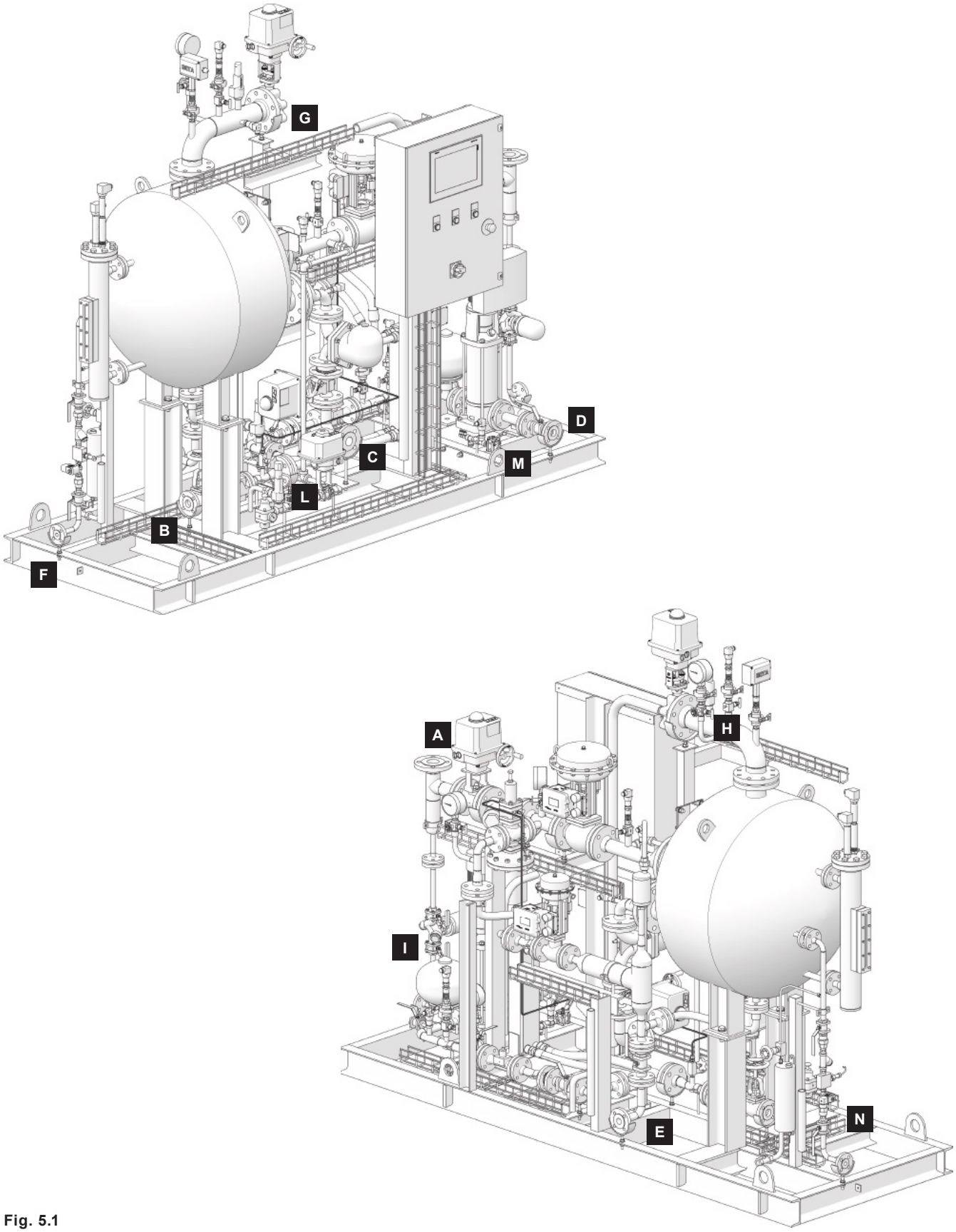


Fig. 5.1

3.5 Connections

3.5.2 Imperial

		130	185	235	300	375	470	600
A	Plant steam Inlet	2" * ANSI 150	2½" ANSI 150	3" ANSI 150	3" ANSI 150	4" ANSI 150	4" ANSI 150	4" ANSI 150
B	Preheater Condensate Outlet	1" ANSI 150	1" ANSI 150	1" ANSI 150	1" ANSI 150	1" ANSI 150	1½" ANSI 150	1½" ANSI 150
C	CSG Condensate Outlet	1½" ANSI 150	1½" ANSI 150	1½" ANSI 150	1½" ANSI 150	1½" ANSI 150	2" ANSI 150	2" ANSI 150
D	Feedwater Inlet	1" ANSI 300	1" ANSI 300	1" ANSI 300	1¼" ANSI 300	1¼" ANSI 300	1¼" ANSI 300	1¼" ANSI 300
E	Drain Outlet	1" ANSI 300	1" ANSI 300	1" ANSI 300	1" ANSI 300	1¼" ANSI 300	1¼" ANSI 300	1¼" ANSI 300
F	Blowdown Outlet /TDS	½" ANSI 300	½" ANSI 300	½" ANSI 300	½" ANSI 300	½" ANSI 300	½" ANSI 300	½" ANSI 300
G	Clean Steam Outlet	3" ANSI 150**	4" ANSI 150**	5" ANSI 150**	5" ANSI 150**	6" ANSI 150**	6" ANSI 150**	8" ANSI 150**
H	Clean Steam Safety Valve Discharge Outlet	¾" NPT-F	¾" NPT-F	¾" NPT-F	1" NPT-F	1" NPT-F	1" NPT-F	1" NPT-F
I	Plant Steam Condensate Outlet (Drain)	½" ANSI 300						
L	Comp. Air Line for Integrity Test	¼" NPT-F						
M	Pneumatic Air Supply Inlet	¼" BSP-F						
N	Sampling system (cooling water in/out-sample out)	½" BSP - 6 mm						
Options								

* If the Auto Plant Steam Isolation is selected, then this should be PN40.

** Clean steam outlet connection is PN40 or PN25 on sizes 130, 185, 235, 300, 375 and 470, depending if the option of automatic clean steam isolation is selected. However, PN25 and PN40 flange connections on these sizes are interchangeable

The steam supplied to the CSG-FBHP unit must be as dry and clean as possible in accordance with the guidelines of sound steam engineering practices. It is also necessary to verify that all pipes are suitably supported without any excessive loads or stress.

Before making any connection, check that all pipework is clean and free of foreign material or scale that may adversely affect functioning and/or the performance of the unit.

The steam supplied must always be maintained within design operating pressure and temperature limits. The unit shall not work above the design pressures and temperatures indicated on the name plate on the package.

The drawings provided in this manual are for guidance purposes only. For connections of the unit, always consult the attached drawings.

For metric connections, see page 18

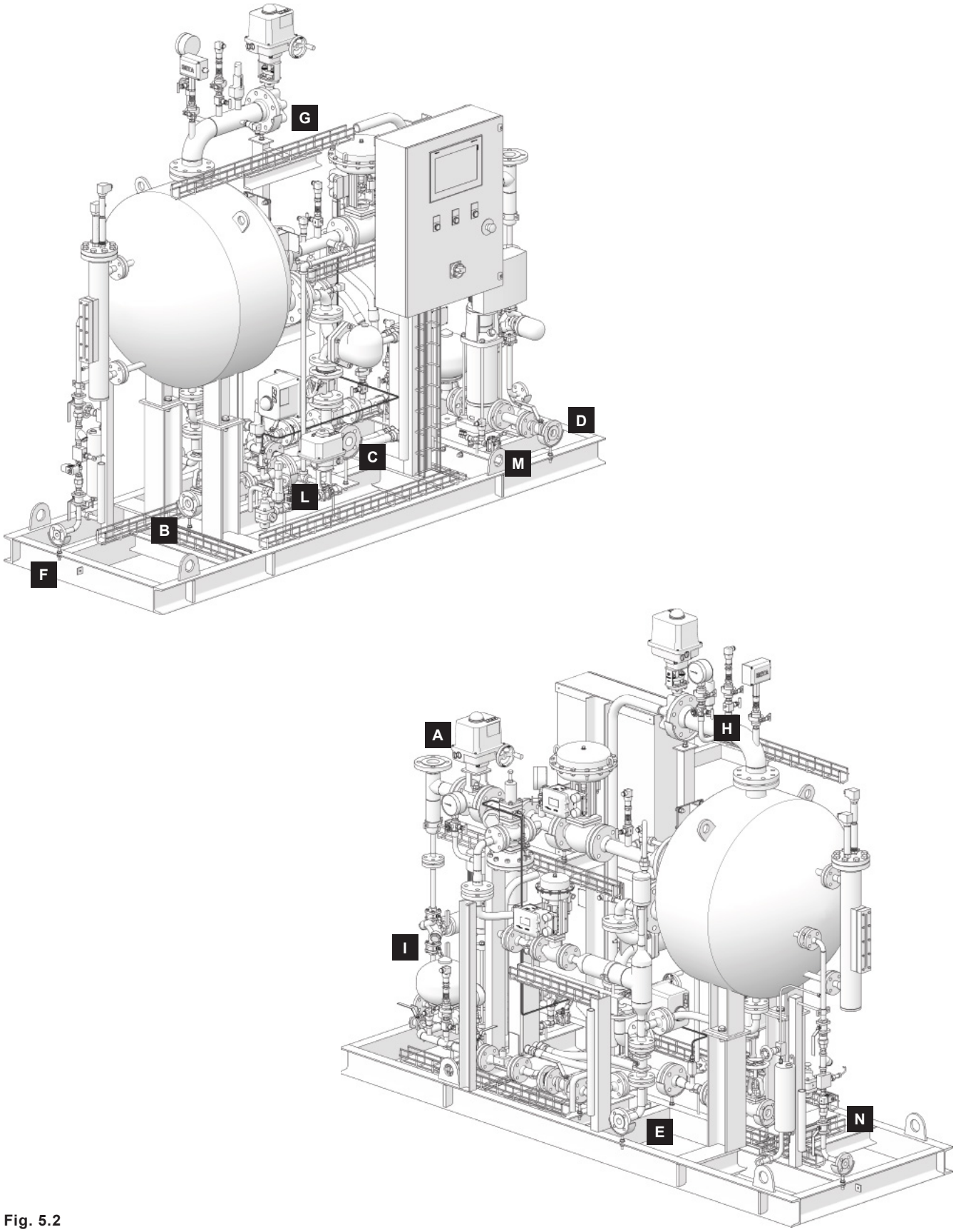


Fig. 5.2

3.5.3 Feedwater inlet
The first step of the installation procedure consists in connecting the unit to the cold feedwater line. The manual isolating valve on the feedwater control line of the unit must remain closed until installation has been completed. The precise position of the feedwater inlet connections, the pipe diameter and size of the attachment flange can be deduced from the drawings provided with the unit.

3.5.4 Clean steam outlet
The next step in the installation procedure is to connect the clean steam outlet of the generator to the clean steam distribution network of the plant. The precise position of the clean steam outlet, the pipe diameter and size of the attachment flange can be deduced from the drawings provided with the unit. A manual isolating valve (if option is not selected) should be installed downstream of the unit on the clean steam line to permit isolation of the generator. This valve must remain closed until installation has been completed.
Note: In the case of units installed in parallel with another generator(s) (common clean steam distribution line), a check valve must be installed on the steam outlet of each generator.

3.5.5 Primary energy source (industrial steam)
Connect the inlet of the primary fluid of the unit to the technological steam distribution network of the plant. The manual (if fitted) isolating valve installed on the primary fluid control line must be closed and remain closed during installation. The precise position of the primary fluid connection, the pipe diameter and size of the attachment flange can be deduced from the drawings provided with the unit.

Potential risk of injury and/or fatality

3.5.6 Condensate removal
Transfer of heat from the primary steam to the produced clean steam generates condensate. The condensate removal from the unit must therefore be connected to the condensate return line of the plant. The manual isolating valve installed on the condensate removal line of the unit must be closed and remain closed during installation. The precise position of the condensate removal connection, the pipe diameter and size of the attachment flange can be deduced from the drawings provided with the unit.
Note: The preheater and the generator condensate return lines should be no greater than 0.5 bar

3.5.7 Piping the pressure relief valve to vent and drain
As required by current regulations, CSG-FBHP unit generators are equipped with a pressure relief valve to protect against the risk of overpressure. Venting of the pressure relief valve (steam) shall be directed towards a safe area to avoid injuries or damage. In most applications, the pressure safety valves should be vented to atmosphere (generally through the roof). The piping used in the vent system shall be of adequate size to handle the capacity of the pressure safety valve. The vent piping system shall be suitably drained to prevent formation of condensate inside this. **The vent pipe of the pressure relief valve shall not be intercepted in any way or even partially obstructed.** For further information and prescriptions regarding connection of the vent piping of the pressure safety valve, refer to the related use and maintenance manual. Venting of the pressure relief valve shall comply with current legislation. The purchaser/installer is responsible for such conformity.

3.5.8 Drainage of the generator
The CSG-FBHP steam generators are equipped with a drain/bottom blowdown line with manual valve installed on the lower part of the vessel. The blowdown from this valve is at the same pressure and temperature of the generated steam and can cause severe injury or death if not properly piped. In accordance with local regulations or standards, it is recommended that the blowdown lines be connected to a blowdown vessel or condensate cooler before being discharged to drain.
The precise position of the drainage of the generator connection and also pipe diameter and size of the attachment flange can be taken from the drawings supplied with the unit.
The drains of the generator cannot be placed back in the circuit return condensate or feedwater.

3.5.9 Other blowdown, venting, drainage facilities (where required)
The CSG-FBHP is equipped with a system for blowdown, drainage and venting. Optional is a TDS control system and primary steam drainage line. In accordance with current legislation, blowdown from the TDS control system should be connected to a blowdown vessel or condensate cooler before being discharged to drain. TDS blowdown shall not be connected to the condensate return line. Primary steam trapping should be connected to the condensate return line of the plant.
Condensate from the primary circuits and/or TDS blowdown should not be integrated in to the feedwater storage tank.

3.6 Connection of the power supply

For voltage connections, consult the wiring diagram provided for the unit.

	Possible injury or death **Before connecting the power supply, check that the main power switch and system start selector are off (0 position).**

Where indicated in the wiring diagram, single phase or 3 phase power supplies are to be connected directly to the main isolation switch. Earth points are provided and must always be connected. Power supplies and earth connections must pass through the appropriate number of cable glands to maintain the IP rating for the electrical panel.

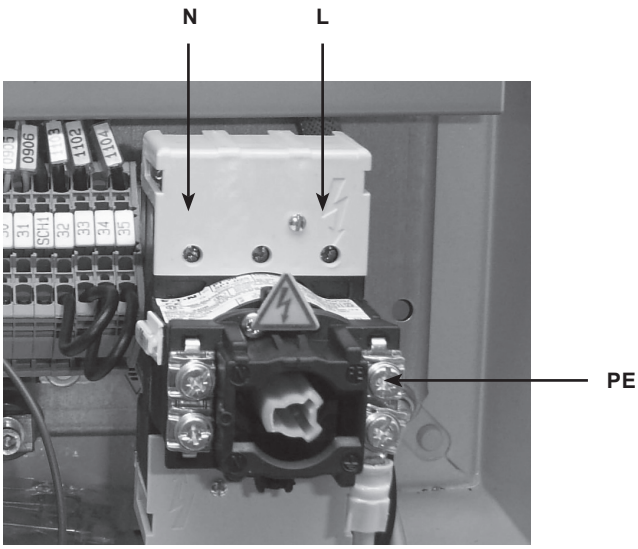


Fig. 6
Version with single-phase power supply

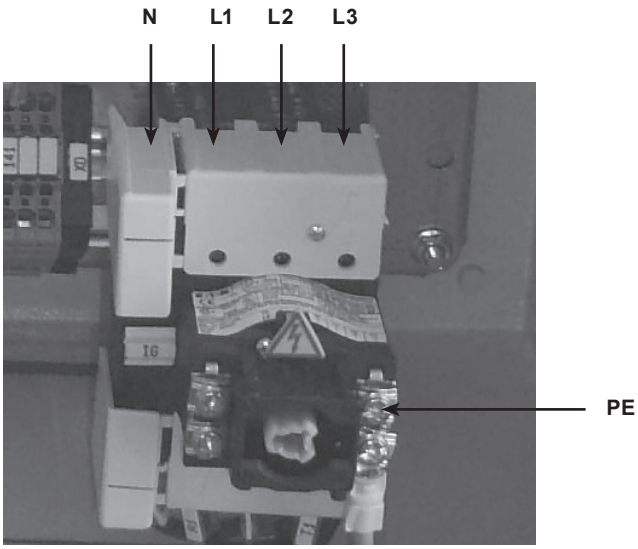


Fig. 7
Version with three-phase + N power supply

	All electrical connections must be made by qualified electricians. **The user is responsible for the suitability of electrical connections outside the unit and for their conformity with current legislation.** **Before drilling holes in the cabinet of the control panel to connect the power cables and any interface with an external system, open the door very carefully and check that there are no obstacles inside the cabinet. Ensure that there is no contact between electrical cables inside the panel with drilling residues or with metal.** **Signal cables must not be laid together with power cables outside the unit to avoid disturbances and interference during operation. Failure to comply may cause also irreparable damage to the equipment.** **The user must install a device between the power supply and control panel able to cut off the power if necessary. It is important to check compatibility of the mains supply with that required by the control panel, verifying correspondence with voltage and frequency data indicated on the nameplate.** **Unused wires in conduit must be grounded at both ends to avoid a possible shock hazard caused by induced voltages.** **The user is responsible for power connections outside the unit and their compliance with current legislation.**

3.7 Connection of air supply (where necessary)

If pneumatic actuators or integrity test options are selected, the compressed air must be as dry and clean as possible in accordance with the guidelines of sound engineering practice.
Connect the compressed air supply (minimum 5 bar g-maximum 7 bar g (72.5 psi g-101.5 psi g)) to the pressure regulators fitted on the valves (CV1 and CV2).

So, before starting, adjust the downstream pressure reducers at least 1 bar g above the spring range of pneumatic actuators (if any):

Actuator spring ranges	Primary steam control valve CV1 with electro-pneumatic positioner SP400 (SP500 as option)	Feedwater control valve CV2 with I/P converter (positioner SP500 as option)
130	2 – 4 bar g (29-58 psi g)	2 - 4 bar g (29 - 58 psi g)
All other sizes	2.5 – 3.5 bar g (36.2-50.7 psi g)	

3.8 Electrical specifications

For detailed electrical information, consult the wiring diagram supplied with the unit.

Phase	Voltage ranges	Pump capability	Rated power	Suggested supply protection
Single Phase	90 - 132 V AC 180 - 264 V AC	No	0.4 kW	8A, C Curve MCB
Three Phase *	200 - 460 V AC	Yes	(0.37 kW - 5.5 kW) + 0.4 kW depending upon package size and csg pressure	32A, C Curve MCB

*** Note :** A single leg is taken from the three phase supply to power the PSU, ensure the single leg will have a voltage in the range required for single phase

3.9 Digital inputs/outputs (on all versions)

For wiring, consult wiring diagram provided with the unit.

The control system for the CSG-FBHP can provide signals to the customer to enable monitoring of the processes. This is facilitated by the use of industrial communications. The communications protocols are included in the nomenclature and are listed below.

4. Commissioning

For correct commissioning, we recommend the service and support of a Spirax Sarco engineer. Please contact your local Spirax Sarco representative for more details.

4.1 Cleaning before first use

This product is intended to be connected into a system that can operate an EC1935 compliant process. To minimise the risk of non-intentionally added substances in the system, it is essential that an appropriate CIP (cleaning in place) cycle is carried out by the end user prior to first use in a food contact application.

A list of the materials that could come directly or indirectly into contact with foodstuffs can be found in the Declaration of Compliance available for this product.

4.1.1 Pre-commissioning inspection (initial start-up)

- Upon receipt of CSG-FBHP complete the SAT check (Site Arrival Test).
- Most of the new installations during the construction of pipelines and the installation of the system, may inadvertently collect dirt particles inside the pipes. It is essential to carefully remove any residual impurities and dirt in them before starting the commissioning, see 4.1.1 Cleaning before start-up.
- Check that all the manual isolating valves (on primary stream, on condensate blowdown, on clean steam intake and on feedwater) are closed.
- Clean the filters upstream of the regulation valves.
- Check that the bottom drain valve VM11 (or VE11) of the unit is closed.
- Make sure that the unit power supply is disconnected.
- Check that primary steam and feedwater design conditions do not exceed the rated values of the unit.
- Check that the design conditions of the downstream system, clean steam side, are not lower than the rated data of the unit or in any case not lower than the calibration pressure of the safety valve installed on the unit, secondary side.
- Check that the feedwater line is properly pressurised and has been vented.
- Check that the supply steam (primary) line is properly pressurised and has been drained/ vented.
- Check that the clean steam line has been drained/vented.
- Check that the air supply line, if any, complies with system requirements.
- Check that the power supply complies with the system requirements.
- Make a double check to verify that all connections to steam, condensate and water lines have been made correctly.
- Check that the bolts of the flanged attachments are correctly torqued, see 11. Appendix.
- Check that all the electrical connections outside and inside the unit, are verifying compliance with the wiring diagram (see wiring diagram supplied with the unit).
- Check the air supply of the filters/reducers of the valves (actuated pneumatically where established) and that it complies with the system requirements.
- Check that the preheater clean steam pressure reducing valve (VU33) is fully wound off (no steam can flow).
- Check that the air vent drain is routed to a safe place (if this is vented externally, consider including a tee that can be isolated (see 4.5)

4.1.2 Cleaning before start-up

The clean steam generator is supplied after a pickling and passivation cycle.

Before the first use a purge cycle must be performed. This takes place after a CIP (cleaning in place) or other procedure that may be required by the process/plant directives. This is done by following the process in the below table that shows the time each cycle should last for in order to sufficiently flush the CSG.

Clean Steam Pressure (bar g)	No. of 30s open, 30s off intervals (full minutes for test)
1	16
2	11
3	9
4	8
5	7
6	6
7	6
8	6

4.2 On-site commissioning procedure

The CSG-FBHP control system has an integrated commissioning sequence designed to guide the user through configuring, starting and tuning the systems PID settings from factory.

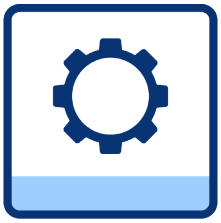
It is assumed at this point that all required pipe connections and services have been connected. To begin the commissioning sequence, all connected services must be available and all critical alarms must be cleared.

1. Using the Bolt torque table, ensure that all fittings and flanges are tightened to their correct settings. Ideally, these should be identified with a marking compound to allow checks before proceeding, see 11. Appendix.
2. Close all manually operated steam isolation valves and provide steam to that part in the line. If automated isolation valves have been fitted, open all manually operated steam isolation valves.
3. Open all manually operated condensate valves from the customer's connection.
4. Open any manually operated valves downstream of the TDS valve VE12.
5. If Integrity test option is fitted, open any manually operated valves connected the Drain Valve VE11.
6. Open any manually operated valves upstream water inlet to the CSG-FBHP.
7. Ensure that all trip switches inside the control panel are set to on.
8. Switch the control panel isolator to the On position.
9. Check that all pneumatic positioners (if fitted) are set to Auto.
10. Power on the control panel and wait for the Spirax Sarco welcome page.
11. Tap the welcome page to view the Home Screen.

12. At the home screen, select the Main Menu button.

PLC platform	Login level	User login	Password
Allen Bradley	User level login	Not required	Not required
	User level operator	User	1111
	Customer engineer	Engineer	7452
Siemens	User level login	Not required	Not required
	User level operator	Not required	1111
	Customer engineer	Not required	7452
ABB	User level login	Not required	Not required
	User level operator	Not required	1111
	Customer engineer	Not required	7452

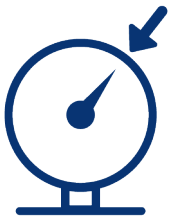
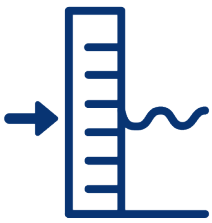
13. Select the System Menu button.



14. Select the Service screen button.

15. Select "First Start Up" button and confirm.

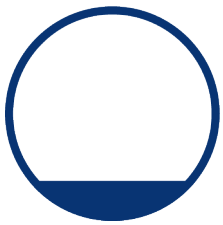
16. Input the correct clean steam pressure set point

 and water level  and press the start button.

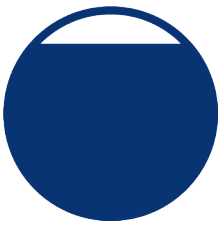
17. Follow the on screen instructions.

18. If, as part of an integrity test, a leak is detected, repair the leak and repeat the test. It may be necessary to turn off the control panel to fix the leak. Repeat steps 17-21 to restart the commissioning sequence and re-check for any leaks.

19. At the PID Tuning screen, the control system can now simulate high loads and low loads to allow the PID settings to be changed to ensure correct running of the unit.



Low demand simulation button



High demand simulation button

20. At least one high demand simulation and one low demand simulation is required to complete the commissioning sequence. Select the green tick button to complete.

The commissioning sequence is now complete and the unit will continue to run at the selected pressure and level set points.

The default settings loaded during the commissioning sequence should be sufficient for the majority of simple applications. However, process settings and alarm settings should always be adjusted to suit individual applications and installations.

Once the commissioning sequence has been completed, the settings should be saved from the Factory settings screen. These settings can be updated or loaded from the Factory settings screen on the HMI.

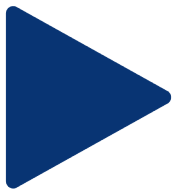
21. Once the CSG-FBHP is running at the operating flow required for the process, set the VU33 preheater valve

22. Once the CSG-FBHP is running at the operating pressure, the CAH01 Blowdown Controller can be calibrated. Refer to IM-P693-39 BCR3150 Blowdown Controller to do this.
Note - If the operating pressure of the CSG-FBHP is changed, the CAH01 Blowdown Controller will need to be recalibrated. See 4.6 Changing the operating pressure

4.3 Start-up procedure

Once the commissioning procedure is complete, the CSG-FBHP can now be started from the Home screen.

- If automated plant steam isolation valves have been selected, open any manually controlled valves upstream.
- Follow any on screen instructions.



4.4 Shut-down procedure

Once the unit has begun its start-up sequence, the start button is replaced with the Stop button.

- Follow any on screen instructions.

4.5 Setting the VU33 control valve

The VU33 should be set on commissioning and whenever either the clean steam pressure or the primary pressure has been changed. The VU33 preheater temperature control valve should be set once the CSG-FBHP is running and has been tuned to the operating load for the process. This is because the VU33 valve set point should be set according to the feedwater flow rate.
If the primary pressure of the installation has increased, the VU33 can continue to be adjusted from its previous set point. If, however, the primary pressure on the installation is decreased, shut the VU33 valve and then slowly adjust it to bring it to the target temperature.

To set the VU33 valve, first ensure that the valve is fully wound off (no steam can pass). Slowly open the VU33 valve to raise the temperature of the preheater. Set the VU33 to 0.6 bar above the clean steam pressure.

Following this, ensure that the TA11 temperature matches the target temperature for the process. The below table can be used to establish the correct temperature. The HMI home screen can be used to view the TA11 temperature by pressing below the CSG-FBHP image.

Clean steam pressure (BAR gauge)	TA11 target temperature
1	120.42
2	133.13
3	143.75
4	151.96
5	158.92
8	175.43

Finally, check for small amounts of steam emitting from the degasser vent. If the degasser is vented externally or at a distance to the degasser, consider installing a tee that can be isolated next to the degasser. With this method, the degasser can be vented next to the degasser for the steam check during commissioning and then isolated and vented externally afterwards.

4.6 Changing the operating pressure

When a change is required to the CSG-FBHP operating pressure, some of the equipment will need recalibration. Ensure the following points are met every time there is a change to the operating pressure:

- Set pressure in Babystar expansion vessel to 0.7x pump pressure (only when pump is specified)
- Set DP27E according to operating pressure/temp
- Calibrate TDS blowdown controller (when conductivity probe is spec'd)
- Tune PID settings for the operating conditions
- May require different valve trims in feedwater control valve and plant steam control valve

Contact Spirax Sarco to discuss changes in operating clean steam pressure to determine valve trim requirements

Note: Max output capacity of clean steam generator will be reduced if the clean steam set pressure is reduced.

4.7 Ambient conditions

When the unit is out of service in a low ambient temperature space, with a risk of freezing, it is necessary to completely empty the unit.

Ice inside the generator and inside primary steam line/condensate and feedwater can severely damage the equipment

5. System controls

The CSG-FBHP control system has a range of controls and functions to ensure the safe and stable running of the unit. Not all functions are available depending upon the configuration of the CSG-FBHP, these are denoted by the * symbol.

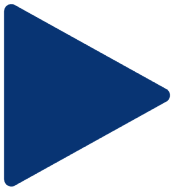
5.1 Runtime controls

Runtime controls affect the response of the CSG-FBHP and are only active whist the unit is 'running'. During standby, these controls are not enabled.

5.1.1 Automated start-up

The Automated start-up sequence controls the safe start-up of the CSG-FBHP from cold and empty condition all the way through to fully pressurised and correct water level.
Detailed instructions can be provided by a Spirax Sarco engineer, however a simplified sequence can be found below.

- Raise water level to set point.
- Open automated clean steam outlet isolation valve (if fitted).
- Open automated plant steam isolation valve (if fitted).
- Control valve opens a small amount to warm up unit.
- 105 °C (221 °F) clean steam temperature is measured.
- 0.5 bar g (7.25 psi g) clean steam pressure is measured.
- Ramp up pressure to set point.
- Check for pressure and water at correct set point.
- Open preheater supply valve
- Check for preheater temperature
- End sequence and start run mode



5.1.2 Automated recovery

If the CSG-FBHP is still hot or pressurised from previous use, the control system can restart the unit without having to gently warm up the heating coils.
Detailed instructions can be provided by a Spirax Sarco engineer, however a simplified sequence can be found below.

- Maintain current water level or raise to set point.
- Open automated clean steam outlet isolation valve (if fitted).
- Open automated plant steam isolation valve (if fitted).
- Ramp up pressure to set point.
- Check for pressure and water at correct set point.
- Open preheater supply valve
- Check for preheater temperature
- End sequence and start run mode

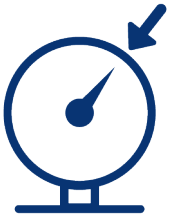
5.1.3 Automated sequenced shut-down

The automated shut-down sequence ensures that he unit is in an optimal condition such that, when it begins the start-up sequence, the time taken is to reach running conditions is as little as possible.
This includes reducing the water level to the 'low level' so that less time is required to reach saturation temperature.

Detailed instructions can be provided by a Spirax Sarco engineer, however a simplified sequence can be found below.

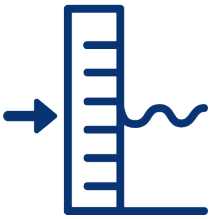
- Ramp down steam set point to 0.
- Close automated plant steam inlet (if fitted).
- Wait for water temperature to drop below 110 °C (212 °F).
- Stop water control.
- Close outlet isolation valve (if fitted).
- Close preheater supply valve.
- End sequence and start standby.

5.1.4 Clean steam pressure control



Control of the clean steam pressure is maintained by use of a PID control loop program in the PLC using pressure sensor PA21 as the process variable. See section 9 for component map. The steam PID set point (set during commission sequence) can be adjusted from the Process Settings screen. The steam PID control value is sent directly to the steam control valve VB31.
The Steam PID set point value can be overridden by the PLC during several processes. These include Ramp up/down (see section 5.1.7), Forward controls (see section 5.1.8) and PID tuning (see section 5.3).

5.1.5 Water level control



Control of the water level within the clean steam side of the CSG-FBHP in maintained by use of a PID control loop program in the PLC using level sensor LA11 as the process variable. The water level PID set point (set during commissioning sequence) can be adjusted from the Process settings screen. The water level PID control value is sent directly to the water control valve VB01.
The water level PID set point can be overridden by the PLC during several processes.
These include Forward controls (see section 5.1.8), Automated start-up (see section 5.1.1), Automated recovery (see section 5.1.2) and Automated shutdown (see section 5.1.3).
During normal operation the valve will maintain a minimum opening. This can be configured in the settings sheet.

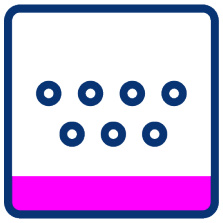
Two other settings factor into water level control.

Set the pump pressure difference.
This should be set between 0.8 - 2bar and is used to ensure the feedwater pressure is greater than the clean steam pressure, to ensure flow through the system. The pressure difference should be great enough to ensure sufficient flow to the steam generator to maintain the water level at the set point.

Set the VB01 minimum opening %.
This should be sufficiently small to not increase the water level at minimal load condition.

5.1.6 TDS control

Some TDS controls are only available with the correct options fitted when ordering the CSG-FBHP. The following options may be available on screen if fitted. All automated TDS controls are only enabled when in Run mode. All settings are accessible from the TDS Settings screen in the Process settings area.

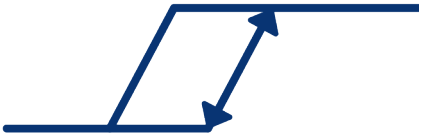


5.1.6.1 Interval control

Available across all TDS control options, Interval control relies on 2 timers to open and close the TDS valve VE12.
If either of the conductivity sensor options are fitted, a limit value for the TDS will still be set on screen and used for process diagnostics.

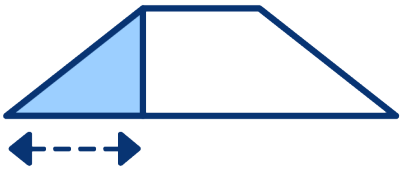
5.1.6.2 Pulsed hysteresis control*

With the inclusion of a conductivity sensor CA11 fitted in the TDS blowdown line of the CSG-FBHP, the conductivity of the water can only be monitored when the TDS valve VE12 is open. The interval and duration of these checks must be set to allow a reliable TDS value to be read.
If, whilst the TDS valve is open, the conductivity reading is above the TDS set-point, the valve will remain open until the conductivity reading reduces by the Hysteresis set-point.



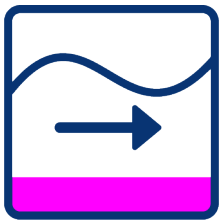
5.1.7 Ramp up/down

At the initiation of the Clean Steam pressure control, the set-point sent to the PID program is always ramped up from 0 to the desired set-point over a period of time. This ramp up is used in the automated start-up and recovery sequences.
Similarly, if the clean steam pressure set-point is altered whilst the CSG-FBHP is running, the ramp sequence will alter the set-point over the ramp period.
The ramp up and ramp down time period can be altered on the Process Settings screen.



5.1.8 Forward controls

Forward controls are used to anticipate extra-ordinary running conditions in order to ensure safe and reliable running of the CSG-FBHP. There are two conditions that are monitored and two respective controls processes designed to handle them. The Forward Controls settings page can be found in the Process Settings area.



5.1.8.1 Rapid high demand

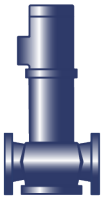
If a significant and prolonged period of high demand results in a drop of Clean Steam pressure PA21, then the water level set-point is temporarily raised. This is designed to anticipate the rapid level loss due to flash boiling of the water in the CSG-FBHP due to the drop in pressure.
The values used for the Clean Steam pressure drop, duration of the drop, the raise in water level set-point and the duration of the set-point raise can all be set from the Forward Controls settings screen.

5.1.8.2 Rapid low demand

If a rapid spike in Clean Steam pressure PA21 is detected, then the set-point used for the Clean Steam pressure is temporarily lowered. This is designed to reduce the amount of energy in the CSG-FBHP and reduce the risk of over-pressurisation.
The values used for the Clean Steam pressure raise rate, reduction of the Clean Steam pressure set-point and duration of the set-point raise can all be set from the Forward Controls settings screen.

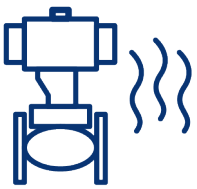
5.1.9 Water pump*

If the integrated booster pump is fitted, CSG-FBHP can independently control water pressure fed directly to the Clean Steam side. The control signal sent to the pump is a target pressure to which the pump drives to. The target pressure is calculated as the pressure currently detected Clean Steam Pressure PA21 + Pump offset. The pump can also be set to maintain a continuous pressure rather than an offset. This is option is only available at commissioning by a Spirax Sarco Engineer. The Pump offset or fixed setpoint can be set from the Water PID settings page in the Process Settings area.
As the pump has its own control system, no bypass loop is required to prevent over-pressurisation.



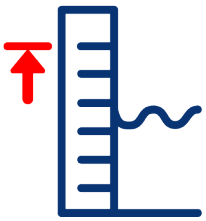
5.1.10 Ball Valve anti-binding*

The ball valve anti-binding sequence ensures that ball valves which are subjected to prolonged periods in the open position do not stick. To do this, any ball valves fitted to the CSG-FBHP that are in the open position at midnight each day are given a closed signal for 1 second. After this 1 second closed signal, valves will return to their open position.



5.1.11 High water level control

If, whilst in Run mode, the water level in the CSG-FBHP triggers the Control Band high alarm (see section 6.1), the TDS valve VE12 is opened. When the water level returns to the operating set-point, the TDS valve closes.



5.2 Manual controls

All manual controls are accessible from the Override screen in the System area. All fitted automated valves fitted to the CSG-FBHP are able to be controlled manually whist the system is in Standby mode. Whilst the system is in any other mode, manual controls are not available.
On/off valves can be opened or closed using their respective toggle button on the screen. Control valves can be moved to a specified position once the valve has been enabled. Disabling the valve will return the valve to closed position.
Whist manual controls are enabled, the CSG-FBHP will not begin Automated Start-up or Recovery. All manual controls must be reset before continuing.
A warning is displayed if the clean steam temperature inside the CSG-FBHP has exceeded 100 °C (212 °F). This is to prevent accidental discharge of hot water or steam.

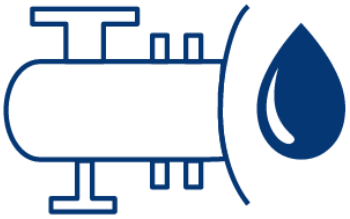
5.3 PID Tuning

PID Tuning is a series of processes that allow the system to simulate loads rises and drops on a running CSG-FBHP. In order to do this, the PID Tuning sequence reduces the current Clean Steam Pressure set-point by 1 bar g (14.5 psi g).
Once the CSG-FBHP is running at the PID Tuning set-point, the user can either instantaneously; increase the set-point by 0.5 bar g (7.3 psi g) to simulate high demand, or decrease the set-point by 0.5 bar g (7.3 psi g) to simulate low demand. With either of the simulations, the PID controller will now react accordingly allowing the user to set P, I and D values for both water control and steam control to ensure safe and stable running.
The PID Tuning screen is accessible as part of the commissioning sequence, from standby by selecting the 'PID Tuning Sequence' button, and whilst running by selecting 'Running PID Tuning'.
If PID tuning is initiated from standby or commissioning, the CSG-FBHP will start normally using the Automated Start-up sequence as described in section 4.2.
If Running PID tuning is selected, the system will reduce the clean steam pressure set-point by 1 bar g (14.5 psi g) and the PID tuning screen will be visible.

5.4 Optional functions

All functions in this section are part of the optional features packs and will not be available without the correct configuration.

5.4.1 Integrity test*



The integrity test option includes all the necessary valves and measurement equipment to fully isolate the inlet steam side of the CSG-FBHP from the Steam Control valve VB31 to the Condensate Isolation valve VE51 and perform a pneumatic pressure decay test. This test, when selected will be conducted at the beginning of the next Automated Start-up sequence.
At the end of a failed Integrity Test, the user will be prompted to either re-test, stop the start-up sequence or ignore the test and continue the Automated Start-up. Successful test will not provide any feedback and continue with the Automated Start-up sequence.

An Integrity test will always be performed at the First Start-up as part of the commissioning sequence. This test cannot be ignored. The Integrity test can only be re-started or stop the Automated Start-up sequence entirely.

5.4.2 Service sequence*

In order to facilitate the safe and easy maintenance of the CSG-FBHP, a guided service sequence is available to give a servicing engineer the ability to verify valve operation and clean the heating elements.
Whilst the service sequence is in operation, the CSG-FBHP cannot go into run mode or begin Automated Start-up.
The Service Sequence initialisation is located in the Service screen in the System area. Operators are instructed to manually isolate all external connections to and from the CSG-FBHP. This includes plant steam, drain, water, condensate and clean steam lines.
In order to ensure that components are safe to operate independently, a series of temperature and pressure sensors are located throughout the CSG-FBHP. If a temperature above 25 °C (77 °F) or pressure of 0.1 bar g (1.45 psi g) is detected at any point, all controls are automatically set to a safe position and the service sequence is halted.
Prior to and during the 'Cleaning' phase, the screen will indicate a safe (green), not safe (red) indicator next to each sensor monitored around the CSG-FBHP to allow the engineer to identify if it is safe to remove components on the unit. At this stage, if the control panel is powered down, the service sequence is retained within the memory of the controller and will return to the same point when power is returned to the panel. This ensures that the Automated Start-up sequence cannot be initiated if components are missing from the CSG-FBHP.

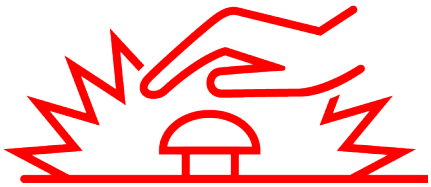
5.4.3 Performance monitoring*

Performance monitoring is a series of sampling, calculation and comparison algorithms that map the performance of the CSG-FBHP over the full range of operation flow ranges. The flow ranges for each model of the CSG-FBHP are preloaded into the program and are automatically loaded during the commissioning sequence. With a performance map, the performance of the CSG-FBHP can be monitored for leaks in or scaling on the heating elements.

The sampling period is limited to a maximum of 10 samples over the flow range or 100 hours of running. After this period the CSG-FBHP is assumed to no longer be operating under best conditions. Without a minimum of 3 samples, the calculation and comparison algorithms will not operate. Once sufficient data has been collected and the calculation algorithm has been allowed to run, the comparison algorithm can now compare the current run conditions with the ideal model created by the sampling algorithm.
The Performance Ratio Fault Tolerance value is a percentage difference when comparing the mapped value to the current sampled value. Sample exceeding the positive tolerance value are experiencing a drop in performance (typically due to scale build up), while samples dropping below the negative tolerance value are experiencing abnormal increase in energy transfer (typically due to a leak from the plant steam directly into the clean steam). Respective alarms are shown in the alarm screens when tolerances are exceeded. Settings, live readouts and mapped data from the Performance Monitoring algorithms can be found on the Performance Data area of the HMI.
HINT: Key to the accuracy of the Performance Monitoring is the accuracy of the sample data. Specifically ensuring that the measured water flow is as steady as possible. To facilitate this, a series of data filters are available to ensure that flow readings are kept free from anomalous spikes and drops.

5.5 Emergency stop

The emergency stop program constantly monitors a set of diagnostic systems and will prevent the running of the CSG-FBHP if any of these diagnostics triggers and alarm. The emergency stop can only reset and allow the running of the system when the cause of the alarm is cleared. In addition to the cleared alarms, the Reset pushbutton must also be pressed to clear the Emergency Stop.



When the emergency stop is triggered, the status of the CSG-FBHP is changed directly to 'Emergency Stop', overriding any previous run status. Additionally, all automated isolation valves are reset, control valves are closed and the water pump (if fitted) is disabled. The diagnostics systems monitored vary depending upon the current run status. For any run status other than Running (i.e. Automated start-up, restart, sequenced shutdown, integrity test and standby) the systems are listed below. See section 6 for more details on individual diagnostics.

- Emergency stop push button
- Major Instrument failure
- Steam control valve failure
- Water control valve failure
- Water pump failure*
- Process limit switches
- Air pressure failure*
- Water supply failure.*
- Electric valve condition alarm

When the CSG-FBHP is in Running mode, the following alarms are monitored:

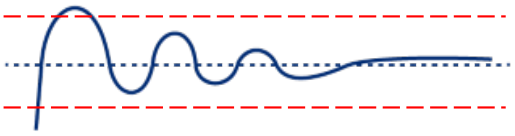
- Emergency stop push button
- Major Instrument failure
- Steam control valve failure
- Water control valve failure
- Water pump failure*
- Process limit switches
- Air pressure failure*
- Water level low limit*
- Electric valve condition alarm
- Supply pressure failure*
- Water level control failure
- Water supply failure*
- Water level high limit
- Optional E-stops
- Preheater temperature low
- Preheater temperature high

6. Diagnostics

Not all diagnostics are available depending upon the configuration of the CSG-FBHP, these are denoted by the* symbol.

6.1 Control bands

Clean Steam Pressure Control and Water Level Control are both monitored by separate Control Bands, however both control bands operate the same way.



Control Bands monitor their respective process value and compare to the set-point. Upper and lower bands are defined by percentage value from the set-point. If the process value exceeds either the high or low band tolerances a timer is started. If the timer exceeds the Band Alert time a Control Band Alert is issued to the Alarms screen.

If the process value continues to exceed the band tolerances and the timer continues past the Band Alarm time, then a Control Band Alarm is issued to the Alarms screen. If the process value returns to within the band tolerances, the timer is reset.
Control Bands only monitor in Run mode and not in the PID Tuning sequence. Alarms and Alerts reset when the process value returns to within the upper and lower bands.

Note: Control Band alarms are used by other diagnostic systems. Correct setup at commissioning is critical to robust controls, accurate diagnostics and reduction of nuisance alarms.

6.2 Control capacity

The Control capacity diagnostic monitors both the control value from the PID program and the Control band high alarm for the respective process. This provides engineers with a tool to identify if the capacity of either of the control system is at it's limit and thus impacting performance of the CSG-FBHP.

Clean steam pressure control and Water level control are both monitored by separate Control Capacity diagnostics, however both operate the same way.

If the control valve is fully open for a period of time and the Control band high alarm is active, then the Control Capacity alarm is triggered. If the control valve is fully open for a period of time and the Control Band high alarm is not active, the Control capacity alert is triggered.

Alarms and Alerts reset when the control valve closes from being fully open.

6.3 Water Level Failure

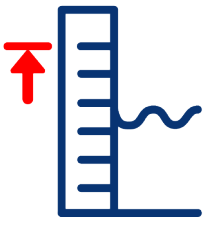
The Water Level Failure diagnostic monitors the High Water Level Control system (see section 5.1.11). If the High Water Level cycle is triggered a number of times within a certain time period, the Water Level Failure alarm is triggered.

The number of repeated triggers and timer period are editable on the HMI.

The alarm is only reset when the Reset pushbutton is pressed.

6.4 High water limit

The High water limit diagnostic monitors the Level sensor LA11 to stop the CSG-FBHP over filling. When the water level sensor reads the measurable limit, the High Water Level alarm is triggered.



The alarm is reset when the water level reduces below the measurable limit.

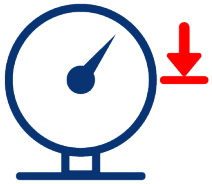
6.5 Panel temperature limit

The panel temperature of the CSG-FBHP is monitored by a PT100 temperature sensor located inside cable trunking of the electrical panel TAX1. If the temperature exceeds the maximum ambient operating temperature of 55 °C (131 °F), the Panel Temperature Alarm is triggered.

The alarm is reset when the measured temperature reduces below 50 °C (122 °F).

6.6 High pressure limit

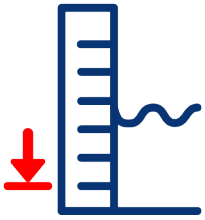
Each CSG-FBHP is fitted with a mechanical pressure switch PD21 set to the maximum operating pressure for the unit. This switch is set by the manufacturer prior to dispatch. This pressure switch triggers the Process limit switch alarm.



The alarm is reset when the clean steam pressure is low enough for the mechanical pressure switch to reset.

6.7 Low water level limit*

The Low water level limit diagnostic prevents the exposure of the heating elements.

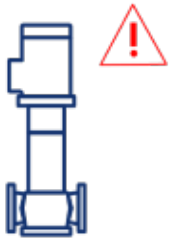


If the level sensor LA11 gives a reading of less than 40% the Low water level limit alarm is triggered.

The alarm is reset by the water level raising enough to be above 40% on the level sensor.

6.8 Water pump fault*

The optional integrated water pump MB01 provides an simple diagnostic feedback signal MD01 which is only triggered when there is a fault with the pump or the control of the pump pressure.



The alarm is cleared when the fault is cleared from the water pump.

6.9 Water supply failure*

The Water supply failure diagnostic monitors the water supply pressure PA01 and only activated when the integrated water pump is not fitted.

When active, the water supply pressure is compared to the control pressure that would be sent to the integrated pump (see section 5.1.9). If the supply pressure is below the control signal, the Water supply failure alarm is triggered.

The alarm is cleared when the supply pressure exceeds the control signal that is generated for the water pump.

6.10 Pneumatic supply failure*

When fitted, the Pneumatic supply pressure switch PDX1 is used to monitor the compressed air supply to the CSG-FBHP. If the air supply pressure drops below the minimum required pressure, the alarm is triggered.

The alarm is cleared when the pneumatic supply pressure increases above the minimum required pressure.

6.11 Supply steam failure*

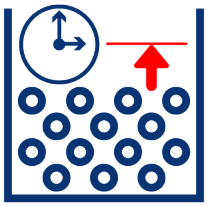
The Supply steam failure diagnostic monitors the control signal sent to the Steam control valve VB31 and the Steam inlet pressure PA13 whilst in the 'Running' state. When the control signal requests the control valve to be fully open for longer than 60 seconds and the Steam Inlet pressure is below the current clean steam oressure set-point. The alarm is triggered.

The alarm is cleared once the pressure rises above the clean steam pressure set-point.

6.12 TDS limit*

When fitted with a conductivity sensor CA11, the TDS limit diagnostic monitors the conductivity and will trigger an alarm if the TDS set-point is exceeded for a period of time.

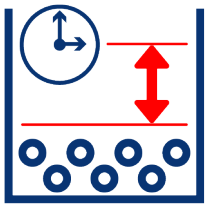
The alarm is cleared when the measured conductivity is reduced below the TDS set-point.



6.13 TDS hysteresis fault*

The TDS hysteresis fault diagnostic closely monitors the TDS control system, specifically the Hysteresis controls. When hysteresis is engaged and the TDS valve is opened, a timer is started. If the timer expires before the measured conductivity reduces by the hysteresis setting, the alarm is triggered.

The alarm is reset when the measured conductivity reduces by the hysteresis setting.



6.14 Trap alarms*

The Trap alarm diagnostics can be split into two conditions based around the two alarms.

The alarm for either condition is reset by pressing the Reset pushbutton.

6.14.1 Trap fail open

During normal running conditions, the trap of the CSG-FBHP will be constantly discharging condensate. As such a failed open trap would not be easily detectable. However, at low flow conditions, it is easier to identify the trap discharging excessive amount of condensate and eventually live steam.

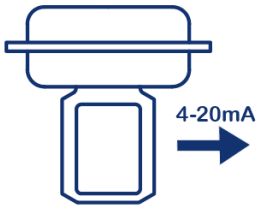
The Trap Failed Open alarm is triggered when the control valve is only open a small amount, and the condensate temperature sensor TA51 and the drain temperature sensor TA52 are similar temperatures.
The maximum valve temperature and maximum difference between temperature sensors can be set on the HMI.

6.14.2 Trap failed closed

The Trap failed closed alarm monitors the drain temperature sensor TA52. Based on the below calculation, the minimum operating temperature of the drain condensate after the trap can be determined. If, whilst in Running status, the condensate temperature drops below this temperature, the Trap Failed Closed alarm will activate.

Note: there are many causes of blockages in the condensate line that can cause the measured drain temperature to drop below minimum operating condensate temperature. If after investigation, the trap is operating properly, there may be another cause for the backup of condensate, including external to the CSG-FBHP.

6.15 Valve feedback*

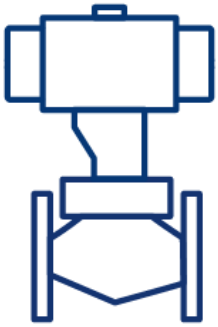


The Steam control valve VB31 and the Water level control valve VB01 are both monitored by separate Valve Feedback diagnostics, however both operate the same way. The valve feedback diagnostics are disabled during the Service Sequence (see section 5.4.2).

The valve feedback diagnostic monitors the control values sent to the control valve compares this to the valve feedback signal for their respective control valves (Steam control valve feedback VA31, Water level control valve feedback VA01). A positive and negative tolerance from the control signal is calculated. If the valve feedback is not within that tolerance, a timer is started. If the timer expires, the alarm is triggered.

The alarm is reset when the control valve feedback reads within the position tolerance.

6.16 Isolation valve feedback*



The Steam inlet VE31, Clean steam outlet VE01, Bottom drain valve VE11 are independently monitored by separate Isolation valve feedback diagnostics.

6.16.1 Fail closed

If the valve does not rotate enough to come off the valve closed limit switch within a time limit when commanded, the valve failed closed alarm is triggered.

The alarm is reset when the valve rotates enough to turn off the valve closed limit switch.

6.16.2 Fail open

If the valve does not rotate enough to come off the valve open limit switch within a time limit when commanded, the valve failed open alarm is triggered.

The alarm is reset when the valve rotates enough to turn off the valve open limit switch.

6.16.3 Partial open failure

If, when commanded, the valve takes too long to transition from closed to open, or from open to closed, the Partial open failure alarm is triggered.

The alarm is reset of the valve completes the rotation and triggers the correct limit switch.

6.16.4 Open speed

If, when commanded, the valve opens too quickly, the Open speed alarm is triggered. The alarm is reset when the correct valve opening speed is achieved.

6.17 Analogue input diagnostic

The Analogue input diagnostic is able to detect if an analogue input signal has been electrically disconnected from the system (sensor failure, wires disconnected, etc), or if the signal wires have been directly connected (wires pinched or damaged). The Open circuit alarm and Short circuit alarms are triggered respectively.

The alarms are reset when a correct input signal is detected.

6.18 Optional E-stop triggers

All alarms, not already included in the Emergency stop sequence (see section 5.5), have the option of triggering an emergency stop. When enabled, the alarms must be cleared before the emergency stop sequence can be reset.

6.19 Umbrella alarms

Umbrella alarms are not directly displayed on the Alarms page of the HMI. These alarms are collective names given to alarms used in the Emergency stop sequence (see section 5.5)

6.19.1 Major instrument fault

The Major instrument fault covers the analogue input alarms for all sensors that are essential the safe running of the CSG-FBHP. If any of these analogue input alarms are triggered, the Emergency Stop sequence will be started and will not be able to be reset until the alarms are cleared.

The following Analogue Input Diagnostic alarms are included in the Major Instrument Fault umbrella alarms:

- Clean steam temperature TA21
- Control panel temperature TAX1
- Water pressure PA01‡
- Clean steam pressure PA21
- Water level LA11

6.20 Steam control valve failure

The Steam control valve failure covers all diagnostics related to the Steam control valve VB31. If any of the alarms associated with these diagnostics are triggered, the Emergency stop sequence will be started and will not be able to be reset until the alarms are cleared.

The following diagnostic alarms are included in the Steam control valve failure umbrella alarm:

- Valve Feedback analogue input diagnostics VA31
- Valve Feedback diagnostic VA31

6.21 Water level control valve failure

The Water level control valve failure covers all diagnostics related to the Water level control valve (VB01). If any of the alarms associated with these diagnostics are triggered, the Emergency stop sequence will be started and will not be able to be reset until the alarms are cleared.

The following diagnostic alarms are included in the Water level control valve failure umbrella alarm:

- Valve feedback analogue input diagnostics VA01
- Valve feedback diagnostic VA01

6.22 Preheater Thermal Cycling

The TA11 sensor is used to monitor preheater thermal cycling. When a sufficient temperature change takes place within the preheater, this is recorded against the maximum number of thermal cycles the preheater can endure before it requires replacement. An alarm will be triggered when the preheater is due to be replaced.

6.23 Preheater temperature monitoring

The TA11 sensor is also used to monitor against over and under temperature, measured against the TA21 sensor. A low band alarm is generated if the preheater temperature drops below 2.5°, and a high band alarm is generated if the preheater raises above 2.5°. These settings are fixed and cannot be edited.

The alarm only appears if the measured temperature is outside of these limits for greater than 20 minutes. The monitoring has been developed to support effective preheating of the feedwater. Optimal removal of non-condensible gases (NCGs) are removed in the degasser only when the preheating target has been met. NCG removal is an important feature for the prolonged longevity of the main heat exchanger to reduce the risk of stress corrosion cracking. The alarm is used to identify that the preheating control valve (VU33) requires re-setting and thus the level of NCGs entering the main heat exchanger can be restored.

7. Troubleshooting

Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
1	ALA_PERF_ CACL	Heat exchanger scaling alarm	-	Begin to lose flow capacity	More primary steam required	Scale formation on heating element	
2	ALA_PERF_ LEAK	Supply steam leaking through to clean side alarm	-	-	Over pressure during low flow conditions	Leaking from primary to secondary side	
3	ALA_TEST_LEAK	Integrity test pressure rise alarm	-	Pressure check loop (x5)	Alarm displayed on HMI	Temperature in CSG causes air temperature to rise	
4	ALARM_SERV_ STOP	Temperature or pressure alarm in service sequence	Hot pipes		Temperature or pressure detected	System isolation not complete	
5	CA11_ANLG_ ALA_OPEN	Water conductivity Analog input alarm circuit open	Cables removed from sensor	-	Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
6	CA11_ANLG_ ALA_SHRT	Water conductivity Analog input alarm short circuit	Pinched cable from sensor	-	Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	-	-	-	-	-	Poor water quality/water hardness			Remove and clean heating elements
									Improve water quality
	-	-	-	-	-	Maufacturing fault			Replace heating element
						Fatigue			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
	PA31	Pressure sensor	Analogue input	3	1	Latent heat in CSG causes test air temperature and pressure to rise			Wait for test loops to complete or pass
	-	-	-	-	-	7	COND_TEMP_HI	Condensate temperature hot	Inspect isolation valves
						11	FEED_PRES_HI	Feedwater pressurised	
						12	FEED_TEMP_HI	Feedwater temperature hot	
						25	PRI_PRES_HI	Primary side pressurised	
						27	PRI_TEMP_HI	Primary side temperature hot	
						32	SEC_PRES_HI	Secondary side pressurised	
						33	SEC_TEMP_HI	Clean steam temperature hot	
						62	WASTE_TEMP_HI	Waste steam temperature hot	
						64	WASTE_TEMP_HI	Water in temperature hot	
	CA11	Conductivity sensor	Analogue input	1	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	CA11	Conductivity sensor	Analogue input	1	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller

Troubleshooting continued on next page

Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
7	COND_TEMP_HI	Condensate temperature hot	Temperature exceeds 40□C / 104□F	-	High condensate temperature alarm	System isolation not complete	
9	FA01_ANLG_ ALA_OPEN	Feedwater flow rate Analog input alarm circuit open	Cables removed from sensor	-	Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
10	FA01_ANLG_ ALA_SHRT	Feedwater flow rate temperature Analog input alarm short circuit	Pinched cable from sensor	-	Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	
11	FEED_PRES_HI	Feedwater pressurised	Pressure exceeds 0.1 bar g/ 1.45 psig	-	Warning displayed Emergency stop	Service sequence	
12	FEED_TEMP_HI	Feedwater temperature hot	Temperature exceeds 40□C / 104□F	-	Warning displayed Emergency stop	Service sequence	
13	LA11_ANLG_ ALA_OPEN	Level sensor analogue input alarm circuit open	Cables removed from sensor	Ceased production of clean steam	Emergency stop displayed on HMI/ Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
14	LA11_ANLG_ ALA_SHRT	Level sensor analogue input alarm short circuit	Pinched cable from sensor	Ceased production of clean steam	Emergency stop displayed on HMI/ Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	
16	PA01_ANLG_ ALA_OPEN	Pressure sensor analogue input alarm circuit open	Cables removed from sensor	Ceased production of clean steam	Emergency stop displayed on HMI/ Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
17	PA01_ANLG_ ALA_SHRT	Pressure sensor analogue input alarm short circuit	Pinched cable from sensor	Ceased production of clean steam	Emergencey stop displayed on HMI/ Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	TA41	Temperature sensor	Analogue input	4	1	Operator error			Close isolation valve VM51
	FA01	Flowmeter	Analogue input	0	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	FA01	Flowmeter	Analogue input	0	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	PA01	Pressure sensor	Analogue input	0	1	Insufficent isolation during servicing			Work and check isolation valves
	TA01	Temperature sensor	Analogue input	0	1	Insufficent isolation during servicing			Work and check isolation valves
	LA11	Level sensor	Analogue input	1	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	LA11	Level sensor	Analogue input	1	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	PA01	Pressure sensor	Analogue input	0	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	PA01	Pressure sensor	Analogue input	0	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller

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Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
18	PA21_ANLG_ ALA_OPEN	Pressure sensor analogue input alarm circuit open	Cables removed from sensor	Ceased production of clean steam	Emergency stop displayed on HMI/ Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
19	PA21_ANLG_ ALA_SHRT	Pressure sensor analogue input alarm short circuit	Pinched cable from sensor	Ceased production of clean steam	Emergency stop displayed on HMI/ Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	
20	PA31_ANLG_ ALA_OPEN	Supply steam in pressure Analog input alarm circuit open	Cables removed from sensor	-	Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
21	PA31_ANLG_ ALA_SHRT	Supply steam in pressure Analog input alarm short circuit	Pinched cable from sensor	-	Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	
22	PRI_BAND_HI_ ALARM	Primary band HIGH alarm	-	Emergencey stop sequence - Ceased production of clean steam	Emergency stop displayed on HMI	Reduced primary pressure	
23	PRI_BAND_ LOW_ALARM	Primary band LOW alarm	Control valve failed closed	Emergencey stop sequence - Ceased production of clean steam	Emergency stop displayed on HMI	Customer steam supply	
24	PRI_CAP_ ALARM	Primary control capacity alarm	Valve over 99% open	Target clean steam pressure not achieved	Alarm displayed on HMI	Steam demand exceeds CSG capacity.	
25	PRI_PRES_HI	Primary side pressurised	Pressure exceeds 0.1 bar g/ 1.45 psig		Emergency stop displayed on HMI	Service sequence	
26	PRI_PRES_LOW	Primary pressure low alarm	Valve 100% open	Emergencey stop sequence - Ceased production of clean steam	Emergency stop displayed on HMI	Primary pressure PA31 lower than setpoint for clean steam pressure	
27	PRI_TEMP_HI	Primary side temperature hot	Temperature exceeds 40□C / 104□F	-	-	-	
28	SEC_BAND_HI_ ALARM	Secondary band HIGH alarm	-	-	Alarm displayed on HMI	Leaking within valve PID Settings	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	PA21	Pressure sensor	Analogue input	2	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	PA21	Pressure sensor	Analogue input	2	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	PA31	Pressure sensor	Analogue input	3	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	PA31	Pressure sensor	Analogue input	3	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	-	-	-	-	-	Setpoint not achieved			Re-tune system
									Leaking control valve
	-	-	-	-	-	Codensate blockage			Tune PID
						Insuffiecnt customer steam supply/ Qaulity of inlet steam			Fix Inlet steam supply
	-	-	-	-	-	Insufficient capacity			Review IMI to check capacities
	PA31	Pressure sensor	Analogue input	3	1	Incorrectly isolated valves			Check isolation valves
	PA31	Pressure sensor	-	-	-	Insufficient customer steam suppy			Increase supply of inlet steam
	TA31	Temperature sensor	Analogue input	3	1	-			-
	VA01	Water control valve	Analogue input	0	1	Water control valve stuck open			Inspect water control valve to identify cause
						Poor PID Settings			Adjust PID settings

Troubleshooting continued on next page

Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
29	SEC_BAND_ LOW_ALARM	Secondary band LOW alarm	No noise/ pump not spinning	No feedwater pressure	Water pump failure alarm	Water supply not sufficent	
						Air lock in water pump	
						Power loss to pump	
						Pump mechanical/ electrical failure	
			Valve closed when not instruct ed	-	Water level low alarm Valve feedback alarm (OPT)	For more information see alarm 60	
			Reduced water level on visual boiler sight glass				
			Boiler water being dumped to drain, potential for flash steam		Water level low alarm Valve feedback alarm (OPT)	Valve failure	
			Excess Steam coming from drain Water level indicator low Sound from valve	Potential reduced CSG capacity More water consumption	-	Debris/ Wear	
						TDS settings too Low	
			Possible reduced pressure on pressure dial	-	-	Inlet water supply	
30	SEC_CAP_ ALARM	Secondary control capacity alarm	Valve over 99% open	Target clean steam pressure not achieved	Alarm on HMI	Steam demand exceeds CSG capacity	
31	SEC_LVL_LOW	Secondary side boiler water level low	Level indicator low	Emergencey stop sequence - Ceased production of clean steam	Low water level alarm displayed, Emergency stop displayed on HMI	Water level lower than setpoint	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	MB01 MD01	Pump	Analogue output Digital input	0	1	-			Check water supply (Pressure and ensure no debris - Check strainers/ Filters)
						-			Check air bleed
						-			Check power status
						Pump failure			Refer to pump IMI
	VB01	Supply water control valve	Analogue output	0	1	For more information see Alarm 60			For more Information see alarm 60
	VE11	Drain valve	Digital output	1	1	Visual inspection			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
	VE12	TDS control valve	Digital output	1	2	Wear of seat			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Debris in pipeline			Check strainer screen on water inlet. Check for debris origin.
						TDS valve stuck open			Visit TDS Blowdown section in IMI for details. Check input water conductivity.
	-	-	-	-	-	Inlet water supply failure			Check inlet water supply for any blockages
	-	-	-	-	-	Insufficient capacity			Review IMI to check capacities
	-	-	-	-	-				

Troubleshooting continued on next page

Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
32	SEC_PRES_HI	Secondary side pressurised	Pressure exceeds 0.1 bar g/ 1.45 psig	-	Emergency Stop displayed on HMI	Service sequence	
33	SEC_TEMP_HI	Clean steam temperature hot	Temperature exceeds 40°C / 104°F	-	-	Temperature exceeds 40°C / 104°F	
34	TA01_ANLG_ ALA_OPEN	Feedwater temperature Analog input alarm circuit open	Cables removed from sensor	-	Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
35	TA01_ANLG_ ALA_SHRT	Feedwater temperature Analog input alarm short circuit	Pinched cable from sensor	-	Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	
36	TA0X_ANLG_ ALA_OPEN	Panel temperature analogue input alarm circuit open	Cables removed from sensor	Emergencey stop sequence - Ceased production of clean steam	Emergency Stop displayed on HMI/ Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
37	TA0X_ANLG_ ALA_SHRT	Panel temperature analogue input alarm short circuit	Pinched cable from sensor	Emergencey stop sequence - Ceased production of clean steam	Emergencey Stop displayed on HMI/ Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	
38	TA0X_HIGH_ ALARM	Panel temperature limit alarm		Emergencey stop sequence - Ceased production of clean steam	Emergency stop displayed with high panel temperature alarm	High panel temperature	
39	TA11_ANLG_ ALA_OPEN	Water in temperature Analog input alarm circuit open	Cables removed from sensor	-	Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
40	TA11_ANLG_ ALA_SHRT	Water in temperature Analog input alarm short circuit	Pinched cable from sensor	-	Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	PA21	Pressure sensor	Analogue input	2	1	Isolation valves in service sequence			Check isolation valves
	TA21	Temperature sensor	Analogue input	2	1	-			-
	TA01	Temperature sensor	Analogue input	0	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	TA01	Temperature sensor	Analogue input	0	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	TAX1	Temperature of panel	Analogue input	0	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	TAX1	Temperature of panel	Analogue input	0	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	TAX1	Temperature of panel	Analogue Input	X	1	High ambient temperature			Reduce enviroment temperature
	TA11	Temperature sensor	Analogue input	1	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	TA11	Temperature sensor	Analogue input	1	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller

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Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
41	TA21_ANLG_ ALA_OPEN	Clean steam temperature Analog input alarm circuit open	Cables removed from sensor	Emergencey stop sequence - Ceased production of clean steam	Emergency Stop displayed on HMI/ Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
42	TA21_ANLG_ ALA_SHRT	Clean steam temperature Analog input alarm short circuit	Pinched cable from sensor	Emergencey stop sequence - Ceased production of clean steam	Emergency Stop displayed on HMI/ Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	
43	TA31_ANLG_ ALA_OPEN	Supply steam temperature Analog input alarm circuit open	Cables removed from sensor	-	Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
44	TA31_ANLG_ ALA_SHRT	Supply steam temperature Analog input alarm short circuit	Pinched cable from sensor	-	Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	
45	TA41_ANLG_ ALA_OPEN	Supply waste temperature Analog input alarm circuit open	Cables removed from sensor	-	Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
46	TA41_ANLG_ ALA_SHRT	Supply waste temperature Analog input alarm short circuit	Pinched cable from sensor	-	Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	
47	TA51_ANLG_ ALA_OPEN	Condensate out temperature Analog input alarm circuit open	Cables removed from sensor	-	Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
48	TA51_ANLG_ ALA_SHRT	Condensate out temperature Analog input alarm short circuit	Pinched cable from sensor	-	Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	TA21	Temperature sensor	Analogue input	2	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	TA21	Temperature sensor	Analogue input	2	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	TA31	Temperature sensor	Analogue input	3	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	TA31	Temperature sensor	Analogue input	3	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	TA41	Temperature sensor	Analogue input	4	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	TA41	Temperature sensor	Analogue input	4	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	TA51	Temperature sensor	Analogue input	5	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	TA51	Temperature sensor	Analogue input	5	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller

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Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
49	TA52_ANLG_ ALA_OPEN	Drain temperature analogue input alarm circuit open	Cables removed from sensor	-	Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	
50	TA52_ANLG_ ALA_SHRT	Drain temperature analogue input alarm short circuit	Pinched cable from sensor	-	Flashing conductivity readings	Wire pinched or kinked Sensor failure BC3250 controller failure	
51	TDS_HI	TDS failure	- -	High levels of conductivity	TDS alarm displayed	TDS set point exceeded Invalid time duration entry	
52	TDS_HYS_FAIL	TDS hysteresis fault	Continous Blowdown	-	TDS hystersis alarm displayed	TDS hystersis setpoint not achieved	
54	TRAP_FAIL_ CLOSE	Trap failure close	Cold before trap, steam collapse/ waterhammer on start up (noise at primary inlet) -	Startup not acievced Rapid loss of clean steam pressure	No alarm Trap Failed Closed Alarm on HMI	No steam in heat excahnger to heat water Rapid build-up of condensate	
55	TRAP_FAIL_ OPEN	Trap Failure Open	High temperature / WaterHammer/ Pressurised Condensate return system Increase in steam consumption	Increase in Supply water temperature and pressure Pressurised condensate return system	Trap Fail open alarm displayed on HMI	Condensate travelling uncontrolled through trap	
56	VA01_ANLG_ ALA_OPEN	Water level control valve feedback Analog input alarm circuit open	Cables removed from sensor	-	Flashing conductivity readings	Wire removed from sensor Sensor failure BC3250 controller failure	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	TA52	Temperature sensor	Analogue input	5	2	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	TA52	Temperature sensor	Analogue input	5	2	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	VE12	TDS valve	Digital output	1	2	TDS set point exceeded			Take action to reduce TDS, if necesssary adjust setpoint Visit TDS blowdown section in IMI for details
						Input error on HMI			
	VE12	TDS valve	Digital output	1	2	Input error on HMI			Adjust setpoint whilst refering to IMI
						Partially blocked valve			Inspect blocked valve
						Restrictions in blowdown			Inspect any blockages in blowdown
	QU51	Steam trap	Uncontrolled	5	1	Blockage in condensate line during start-up			Identify blockages
						Blockage in condensate line during operation			
	QU51	Steam trap	Uncontrolled	5	1	Wear of seat Debris in pipeline			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
	VA01	Feedwater control valve	Analogue input	0	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller

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Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
57	VA01_ANLG_ ALA_SHRT	Water level control valve feedback Analog input alarm short circuit	Pinched cable from sensor	-	Flashing conductivity readings	Wire pinched or kinked	
						Sensor failure	
						BC3250 controller failure	
58	VA31_ANLG_ ALA_OPEN	Supply steam in control valve feedback Analog input alarm circuit open	Cables removed from sensor	-	Flashing conductivity readings	Wire removed from sensor	
						Sensor failure	
						BC3250 controller failure	
59	VA31_ANLG_ ALA_SHRT	Supply steam in control valve feedback Analog input alarm short circuit	Pinched cable from sensor	-	Flashing conductivity readings	Wire pinched or kinked	
						Sensor failure	
						BC3250 controller failure	
60	VB01_FBK	Feedwater control feedback error	Valve not open when instructed.	-	Valve feedback alarm (OPT), Water level failure ala rm, Water level high alarm	Leaking seat/ plug	
						Positioner failure	
						Positioner calibration faulty	
						Actuator failure	
			Valve closed when ot instructed.	Potential reduced CSG capacity. More water consumption	Water Level Low alarm, Valve feedback alarm (OPT)	Mechanically failed shut	
						Positioner failure	
						Actuator failure	
			Gauling Valve		Valve feedback alarm (OPT), Water level failure ala rm, Water level high alarm	Valve failure	
						Positioner failure	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	VA01	Feedwater control valve	Analogue input	0	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	VA31	Plant steam control valve	Analogue input	3	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	VA31	Plant steam control valve	Analogue input	3	1	Operator error			Replace cable
						Refer to technical documentation			Replace sensor
						Refer to technical documentation			Replace controller
	VA01	Feedwater control valve	Analogue input	0	1	Wear of seat			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Debris in pipeline			Check strainer screen on water inlet. Check for debris origin.
						Mismatch between positioner and PLC			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Mismatch between positioner and actual stem indicator position and PLC			
						Mismatch between positioner and actual stem indicator position and PLC			
						Gailing of stem			
						Mismatch between positioner and PLC			
						Mismatch between positioner and actual stem indicator position and PLC			
						Gailing/ Wear of stem			
						Mismatch between positioner and PLC			

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Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
61	VB31_FBK	Steam in control feedback error	Valve not open when instructed.	-	Valve feedback alarm (OPT), Water level failure ala rm, Water level high alarm	Leaking seat/ plug	
						Positioner failure	
						Positioner calibration faulty	
						Actuator failure	
			Valve closed when not instructed	Potential reduced CSG capacity. More water consumption	Water Level Low alarm. Valve feedback alarm (OPT)	Mechanically failed shut	
						Positioner failure	
						Actuator failure	
			Gauling valve		Valve feedback alarm (OPT), Water level failure ala rm, Water level high alarm	Valve failure	
						Positioner failure	
62	WASTE_TEMP_ HI	Waste steam temperature hot	Temperature exceeds 40□C / 104□F	Service sequence halted	-	Service sequence	
63	WATER_PUMP_ FAIL	Water pump failure	No Sound from water pump	Reduced output of clean steam	Alarm displayed on HMI	Power loss to pump	
						Water supply not suffiecnt	
						Air lock in water pump	
						Pump mechanical/ electrical failure	
64	WATER_TEMP_ HI	Water in temperature hot	Temperature exceeds 40□C / 104□F	Service sequence halted	Alarm displayed on HMI	Service sequence	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	VA01	Feedwater control valve	Analogue input	0	1	Wear of seat			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Debris in pipeline			Check strainer screen on water inlet. Check for debris origin.
						Mismatch between positioner and PLC			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Mismatch between positioner and actual stem indicator position and PLC			
						mismatch between positioner and actual stem indicator position and PLC			
						Gailing of stem			
						Mismatch between positioner and PLC			
						Mismatch between positioner and actual stem indicator position and PLC			
						Gailing/ Wear of stem			
	TA41	Temperature sensor	Analogue input	4	1	Insufficent isolation during servicing			Work and check isolation valves
	MB01 MD01	Pump	Analogue output Digital input	0	1	-			Check power status
						Insufficent water head pressure			Check water supply (Ensure no debris, checking strainers and filters along with the pressure)
						Insufficent bleeding			Check air bleed
						-			Refer to pump IMI - Suspect pump internal failure
	TA01	Temperature sensor	Analogue input	0	1	Insufficent isolation during servicing			Work and check isolation valves

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Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
66	VALVE_CAP_ FAIL	Electric valve fault	-	Emergency Stop Sequence- Ceased production of clean steam	Emergency stop displayed on HMI	Internal fault with electric actuator	
67	INITIALISE	PLC Start-up from power cycle	-	No Clean Steam Produced / CSG not operational	No display on HMI or partial display	Faulty PLC	
68	WATER_LVL_HI	Water level high alarm	Water Level exceeds 90%	Inaccurte control of water control valve	Alarm displayed on HMI	Water level exceeds 90%	
				Water control valve failed open			
69	WATER_LVL_ ALARM	Water level failure	TDS Valve opening outside of TDS control	-	Alarm displayed on HMI	Repeated high water level alarm on HMI	
70	AIR_PRESS_ FAIL	Air supply pressure fail	No valve movement	-	Alarm displayed on HMI	Insufficent Compressed Air	
71	VE31_FAIL_ OPEN	Plant isolation valve fail open	-	Start-up/ Shutdown sequence would halt	Alarm displayed on HMI	Leaking seat	
			Actuator Indicator in incorrect Position			Actuator failure	
72	VE31_FAIL_ CLOSE	Plant isolation valve fail closed	Indicator displays closed when instructed to open	CSG does not start/ Loss of clean steam supply	Alarm displayed on HMI	Valve does not leave closed position when instructed	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	VA11 VA31	Electric Actuator	Digital input	1 3	1	Component fault			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
	-	-	-	-	-	PLC failure			Contact SXS engineer
	VA01	Feedwater control valve	Analogue input	0	1	65	WATER_VLV_ FAIL	Water control valve failure	Inaccurte control of water control valve
						65	WATER_VLV_ FAIL	Water control valve failure	Water control valve failed open
	-	-	-	-	-	See Alarm 68 for more information			See Alarm 65 for more Information
	PDX1	Air supply	Digital input	0	1	-			Restore air supply
	VE31	Steam isolation valve	Digital output	3	1	Wear of seat			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Debris in pipeline			Check strainer screen on water inlet. Check for debris origin.
	VE31	Steam isolation valve	Digital output	3	1	Insufficent customer air supply			Check customers air supply line
	VE31	Steam isolation valve	Digital output	3	1	Mismatch between positioner and actual stem indicator position and PLC			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.

Troubleshooting continued on next page

Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
73	VE31_FAIL_ STICK	Plant isolation valve fail stuck	Actuator indicator shows neither on/ off	Start-up/ Shutdown sequence would halt	Alarm displayed on HMI	Leaking seat	
						Actuator failure	
74	VE31_FAIL_ SPEED	Inlet Plant valve fail opening speed	Possible waterhammer in primary side	-	Alarm displayed on HMI	Unrestricted exhaust flow from actuator	
75	VE21_FAIL_ OPEN	Outlet isolation valve fail open	-	Start-up/ Shutdown sequence would halt	Alarm displayed on HMI	Leaking seat	
			Actuator Indicator in incorrect position			Actuator failure	
76	VE21_FAIL_ CLOSE	Outlet isolation valve fail closed	Indicator displays closed when instructed to open	CSG does not start/ Loss of clean steam supply	Alarm displayed on HMI	Valve does not leave closed position when instructed	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	VE31	Steam isolation valve	Digital output	3	1	Wear of seat			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Debris in pipeline			Check strainer screen on water inlet. Check for debris origin.
						Insufficent customer air supply			Check customers air supply line
	VE31	Steam isolation valve	Digital output	3	1	Exhaust restrictor set incorrectly			Reset/ Replace exhaust restrictor
	VE21	Steam isolation valve	Digital output	2	1	Wear of seat			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Debris in pipeline			Check strainer screen on water inlet. Check for debris origin.
						Insufficent customer air supply			Check customers air supply line
	VE21	Isolation valve	Digital output	2	1	Mismatch between positioner and actual stem indicator position and PLC			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.

Troubleshooting continued on next page

Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
77	VE21_FAIL_ STICK	Outlet isolation valve fail stuck	Actuator indicator shows neither on/ off	Start-up/ Shutdown sequence would halt	Alarm displayed on HMI	Leaking seat	
						Actuator failure	
78	VE21_FAIL_ SPEED	Outlet isolation valve fail opening speed	Waterhammer	Sudden/ rapid pressure loss Risk of carryover	Alarm displayed on HMI	Unrestricted exhaust flow from actuator	
79	WATER_ SUPPLY_FAIL	Customer water supply failure	Lack of supply water pressure	Emergency Stop Sequence- Ceased production of clean steam	Emergency stop displayed on HMI	Water supply pressure does not meet requirements for clean steam generator	
80	VE32_FAIL_ OPEN	Test air isolation fail open	-	Start-up/ Shutdown sequence would halt	Alarm displayed on HMI	Leaking seat	
			Actuator Indicator in incorrect Position			Actuator failure	
81	VE32_FAIL_ CLOSE	Test air isolation fail close	Indicator displays closed when instructed to open	CSG does not start/ Loss of clean steam supply	Alarm displayed on HMI	Valve does not leave closed position when instructed	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	VE21	isolation valve	Digital output	2	1	Wear of seat			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Debris in pipeline			Check strainer screen on water inlet. Check for debris origin.
						Insufficent customer air supply			Check customers air supply line
	VE21	isolation valve	Digital output	2	1	Exhaust restrictor set incorrectly			Reset/ Replace exhaust restrictor
	PA01	Pressure sensor	Analogue input	0	1	Customer water supply pressure < setpoint for water pressure			Check customer water supply
	VE32	Steam isolation valve	Digital output	3	1	Wear of seat			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Debris in pipeline			Check strainer screen on water inlet. Check for debris origin.
	VE32	Steam isolation valve	Digital output	3	1	Insufficent customer air supply			Check customers air supply line
	VE32	Steam isolation valve	Digital output	3	1	Mismatch between positioner and actual stem indicator position and PLC			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.

Troubleshooting continued on next page

Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
82	VE32_FAIL_ STICK	Test air isolation fail stuck	Actuator indicator shows neither on/ off	Start-up/ Shutdown sequence would halt	Alarm displayed on HMI	Leaking seat	
						Actuator failure	
83	VE32_FAIL_ SPEED	Test air isolation fail opening speed	Possible waterhammer in primary side	-	Alarm displayed on HMI	Unrestricted exhaust flow from actuator	
84	VE51_FAIL_ OPEN	Condensate isolation valve fail open	-	Start-up/ Shutdown sequence would halt	Alarm displayed on HMI	Leaking seat	
			Actuator Indicator in incorrect position			Actuator failure	
85	VE51_FAIL_ CLOSE	Condensate isolation valve fail close	Indicator displays closed when instructed to open	CSG does not start/ Loss of clean steam supply	Alarm displayed on HMI	Valve does not leave closed position when instructed	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	VE32	Steam isolation valve	Digital output	3	1	Wear of seat			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Debris in pipeline			Check strainer screen on water inlet. Check for debris origin.
						Insufficent customer air supply			Check customers air supply line
	VE51	Steam isolation valve	Digital output	3	1	Exhaust restrictor set incorrectly			Reset/ Replace exhaust restrictor
	VE51	Steam isolation valve	Digital output	2	1	Wear of seat			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Debris in pipeline			Check strainer screen on water inlet. Check for debris origin.
						Insufficent customer air supply			Check customers air supply line
	VE51	Isolation valve	Digital output	2	1	Mismatch between positioner and actual stem indicator position and PLC			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.

Troubleshooting continued on next page

Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
86	VE51_FAIL_ STICK	Condensate isolation valve fail stuck	Actuator indicator shows neither on/ off	Start-up/ Shutdown sequence would halt	Alarm displayed on HMI	Leaking seat	
						Actuator failure	
87	VE51_FAIL_ SPEED	Condensate isolation valve fail opening speed	Waterhammer	Sudden/ rapid pressure loss Risk of carryover	Alarm displayed on HMI	Unrestricted exhaust flow from actuator	
88	TEMP_LIM	Saturated pressure temperature limit	-	Emergency Stop Sequence- Ceased production of clean steam	Emergency stop displayed on HMI	Clean steam thermistat tripped	
						Low water level limit exceeded	
89	HMI_SYNC_ ALARM	HMI Communications Fault	HMI Unresponsive	Optional: Emergency Stop Sequence- Ceased production of clean steam	HMI connection banner	Communication between PLC and HMI has been lost	
90	ALA_TEST_ LEAK_NEG	Integrity test leak alarm	Leak pipe joints	Ceased production of clean steam	Alarm displayed on HMI	Leak in pipe joints	
			Leak in steam control valve			Leak in steam control valve	
			Leaks in Integrity test valves			Leak in isolation valves	
91	ALA_TEST_ POS_MAX	Integrity test count alarm	-	Ceased production of clean steam	Alarm displayed on HMI	Maximum number of integrity tests reached	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	VE51	isolation valve	Digital output	2	1	Wear of seat			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Debris in pipeline			Check strainer screen on water inlet. Check for debris origin.
						Insufficent customer air supply			Check customers air supply line
	VE51	isolation valve	Digital output	2	1	Exhaust restrictor set incorrectly			Reset/ Replace exhaust restrictor
	TD21	Temperature switch	Digital input	2	1	Clean steam temperature exceeds set limit			Investigate clean steam temperture source
						Clean steam temperature switch failure			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
	LD11	Level switch	Digital input	1	1	Water level below allowanle limit			
						Water low level switch failure			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
	-	HMI screeen	-	-	-	HMI Failure			Replace HMI
						Connection fault with ethernet cable			Check ethernet ports for connection and communication lights
	-	-	-	-	-	-			Inspect pipe joints
	VA31	Steam control valve	Anaolgue input	3	1	-			Inspect steam control valve
	-	-	-	-	-	-			Inspect isolation valves
	-	-	-	-	-	Air pressure rises during integrity test requires customer decision before clean steam production can begin			Use on-screen pop-up screen

Troubleshooting continued on next page

Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
92	DRAIN_TEMP_HI	Drain temperature hot	Temperature exceeds 40°C / 104°F	Service sequence halted	Alarm displayed on HMI	Service sequence	
93	ESTOP_PB	Emergency stop button pressed	E-stop button locked in	Ceased production of clean steam	Emergency stop displayed on HMI	-	
94	PRE_CYCLE_ LIMIT	Pre-heater thermal cycles limit	-	Possible stress cracks in pre-heater	Alarm displayed on HMI	-	
95	PRE_HP_TA11_ LOW	Preheater temperature low	Temperature falls below TA21 - 2.5°	Ceased production of clean steam	Alarm displayed on HMI	Preheater pressure too low	
96	PRE_HP_TA11_HI	Preheater temperature high	Temperature raises above TA21 + 2.5°	Ceased production of clean steam	Alarm displayed on HMI	Overpressure in the preheater	
97	PRI_BAND_HI_ ALERT	Prirmary band high alert	-	High clean stem pressure	Alert displayed on HMI	Failed open control valve	
						Leaking control valve	
						Leak in heat exchanger	
						PID settings	
98	PRI_BAND_ LOW_ALERT	Prirmary band low alert	Control valve closed for a given amount of time	Low clean steam pressure	Alert displayed on HMI	Valve positioning incorrect	
						PID settings	
						Customer supply steam	
						Restricted condensate flow	
99	PRI_CAP_ALERT	Primary control capacity alert	Valve over 99% open for a given amount of time	-	Alert displayed on HMI	Plant steam	
						Capacity incorrect	
						Restricted condensate flow	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	TA52	Temperature sensor	Anaolgue input	5	2	Insufficent isolation during servicing			Work and check isolation valves
	-	-	-	-	-	User operated			Release e-stop button and press reset button
	-	-	-	-	-	Total number of allowable thermal spikes for the preheater has been exceeded			Replace Pre-heater
	TA11 and TA21	Temperature Sensor	Analogue input	1 and 2		Check preheater HE02 for scale and re-set VU33. Alarm could also be triggered due to poor PID tuning.			Reset VU33 and retune PID settings
	TA11 and TA21	Temperature Sensor	Analogue input	1 and 2		Mal-adjusted VU33 or primary side overpressure or poor PID tuning			Perform inspection on VU33 and primary steam control valve
						See alarm 71 for more information			See Alarm 71 for more Information
						-			Identify leak in control valve
						-			Identify leak in heat exchanger
						Incorrect PID settings			Adjust PID setting if necessary
	VA31	Steam control valve	Analogue input	3	1	-			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
	-	-	-	-	-	Incorrect PID settings			Adjust PID setting if necessary
						-			Fix inlet steam supply
						Debris in pipeline			Remove debris from pipeline
	VA31	Plant steam control valve	Analogue input	3	1	Plant steam Insufficent			Fix Plant steam
	-	-	-	-	-	Capacity incorrect			See IMI for corrcet capacities.
						Debris in pipeline			Inspect pipeline and remove any debris

Troubleshooting continued on next page

Alarm number	Alarm PLC tag	Alarm description	Identfier			Fault	
			Physical	Process	System		
100	SEC_BAND_HI_ ALERT	Secondary band high alert	-	Possible carryover	Alert displayed on HMI	PID settings	
						Leaking valve	
101	SEC_BAND_ LOW_ALERT	Secondary band low alert	-	-	Alert displyayed on HMI	Positioner failure	
						PID settings	
102	SEC_CAP_ ALERT	Secondary control capacity alert	-	-	Alert displayed on HMI	Insuffiecnt water supply	

	Component					Cause			Action
	TAG number	Item description	Control type	Zone	Instance	Alarm No	ALARM PLC TAG	ALARM DESCRIPTION	
	-	-	-	-	-	Inspect PID settings			Adjust PID settings if necessary
						-			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
	-	-	-	-	-	-			Identify failed part with tag and schematic in IMI. Consult individual product IMI. Replace or repair failed part.
						Inspect PID settings			Adjust PID settings if necessary
	-	-	-	-	-	Debris in pipeline			Remove any debris from pipeline.

8. Maintenance

Before starting any maintenance operation, carefully read the general safety information in Section 1 of this document.

Before starting any installation or maintenance operation, make sure that power has been shut-off.

To carry out many maintenance procedures, the unit shall be isolated from the system. The unit can be re-inserted in the system only after completing all the procedures.
It is recommended that maintenance personnel carry out the shut-down and start-up procedures described in this manual.

After the maintenance activities is required a washing cycle with a CIP (cleaning in place), or other procedure required by the process/plant directives.

8.1 General information

The maintenance of single system components must be carried out as indicated in the individual installation and maintenance manuals (IM).

8.2 Inspection/Replacement of the pressure safety switch

The safety pressure switch acts as a fail-safe for Spirax Sarco Clean Steam Generators. The alarm and shut down for high pressure is set at a value lower than the set of the safety valve. If the pressure safety switch mounted on the tank is not functioning correctly and must be replaced, follow the procedures outlined below.

8.2.1 Disassembly of the pressure switch:

- Follow the shutdown procedure to take the unit off-line before attempting to replace the safety pressure switch.
- Turn off/disconnect all electric power before attempting any maintenance procedures.
- Check that primary steam, condensate return line, feedwater inlet, NCG vent and clean steam outlet are isolated; that both circuits (primary and secondary) are not pressurized; that the generator has been completely drained and all components and surfaces are cold.
- Carefully disconnect the wires leading from/to the control cabinet.
- Loosen the connections until the pressure probe can be removed.

8.2.2 Inspection of the pressure switch:

- Examine the probes for damage or incorrect positioning. For the exact procedure for examination, refer to the Spirax Sarco manual information included with the unit.

8.2.3 Re-assembly of the pressure switch:

- To install a new unit, follow recommendations contained in the manufacturer's documentation.
- After ensuring that the unit is correctly installed, tighten the fittings.
- Follow the start-up procedures to put the unit back on-line. Carefully check all connections for any sign of leakage.

8.3 Replacement of the Pressure Safety Valve (Generator)

The pressure safety valve acts as a fail-safe for Spirax Sarco Compact Steam Generators. The valve will open for high pressure to protect the system from explosion. If the pressure safety valve mounted on the pressure vessel is not functioning correctly and must be replaced, follow the procedures outlined below.

8.3.1 Disassembly of the safety valve:

- Follow the shutdown procedure to take the unit off-line before attempting to replace the safety pressure switch.
- Turn off/disconnect all electric power before attempting any maintenance procedures.
- Check that primary steam, condensate return line, feedwater inlet, NCG vent and clean steam outlet are isolated; that both circuits (primary and secondary) are not pressurized; that the generator has been completely drained and all components and surfaces are cold.
- After assuring that the pressure has been relieved from the tank, disconnect the vent line leading from the pressure relief valve to atmosphere (usually through the roof), and via a drip elbow, to drain.
- Carefully disconnect the pressure relief valve from between the generator vessel and feed tank.

8.3.2 Re-assembly of the pressure switch:

- Install the new valve. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use of joint compound or sealer at the connections.
- Reconnect the vent line leading from the pressure safety valve to atmosphere and, via drip elbow, to drain.
- Follow the start-up procedures to put the unit back on-line. Carefully check all connections for any sign of leakage.

8.4 Preheater replacement

The preheater will need replacing once it has met it's thermal cycling capacity. To replace the preheater:

8.4.1 Disassembly of the preheater heat exchanger

- Check that all inlets and outlets to the system (primary steam, condensate return, feedwater inlet and clean steam outlet) are isolated, that both circuits (primary and secondary) are not pressurised; that the process heat exchanger has been completely drained and all components and surfaces are cold
- Carefully disconnect the piping the preheater heat exchanger and inspect the gaskets for wear
- Once the connections have been disconnected, the heat exchanger can be removed

8.4.2 Re-assembly of the preheater heat exchanger

- Secure the new preheater heat exchanger in place, take care the ensure the orientation matches that as heat exchanger that was removed
- Fix the heat exchanger in place by connecting the pipework connections
- Thoroughly clean the mating surfaces
- Replace any worn gaskets and seals and reattach the piping to the preheater heat exchanger
- Carefully check all connections to detect any leaks during start-up

8.5 Spare parts

For recommended spare parts for commissioning or maintenance, please contact our Service Department.

8.6 Recommend inspection

The following table indicate the suggested interval times for the inspection on the clean steam generator and of all the other components installed on the package.

Inspection	Refer to product IMI	Daily	Weekly	Quarter	
Blowdown		•			
Control valve	•				
Water level**		•			
Pressure level**				•	
Level control	•				** To verify the difference between the measure of the transmittal against the indicator
Inlet and outlet line				•	
Pneumatic connections				•	
Electrical connection				•	
Primary and secondary side pressure		•			
Safety Valves	•				
Manual isolation valve			•		
Strainers				•	
Preheater pressure reducing valve	•			•	

8.7 Spirax Sarco Service maintenance

Spirax Sarco can provide on request of routine scheduled maintenance contract with the following steps. The maintenance contract usually includes two visits per year.

Maintenance Test	6 month visit	12 month visit	18 month visit	24 month visit
Visual inspection of control valves and actuators	•	•	•	•
Dismantle control valves, clean and visually inspect valve internals, replace valve stem seals		•		•
Check valve/actuator/positioners, zero and stroke, adjust if necessary	•		•	
Visual inspection of all wiring and terminations	•	•	•	•
Check all electrical connections for tightness	•	•	•	•
Ensure correct operation of pump (if present)		•		•
Pressure, temperature and level transmittal control		•		•
Functional inspection of safety components and PLC			•	•
Visual inspection of heat exchanger for external leakage	•	•	•	•
Preheater heat exchanger inspection				•
Check and clean all strainer screens, re-fit using new cap gaskets	•		•	
TDS test and probe check	•	•	•	•
TDS re-calibration		•		•
Fully functional test of the unit	•	•	•	•

9. Component map

The Components detailed below may not be fitted to all versions of the CSG-FBHP. Refer to section 9.2 for Component configuration lists. Optional items are designated with *.

9.1 System PandID

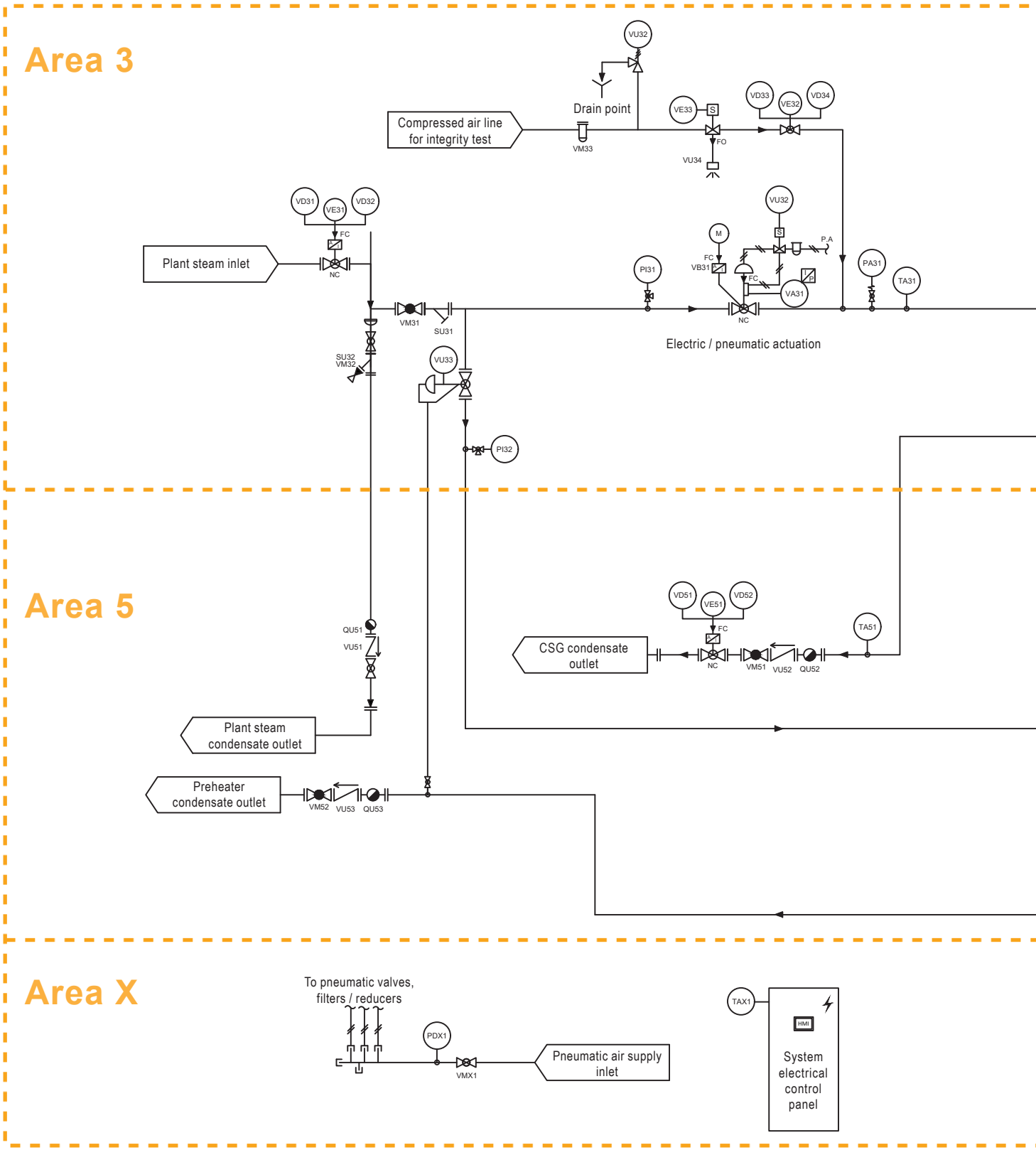
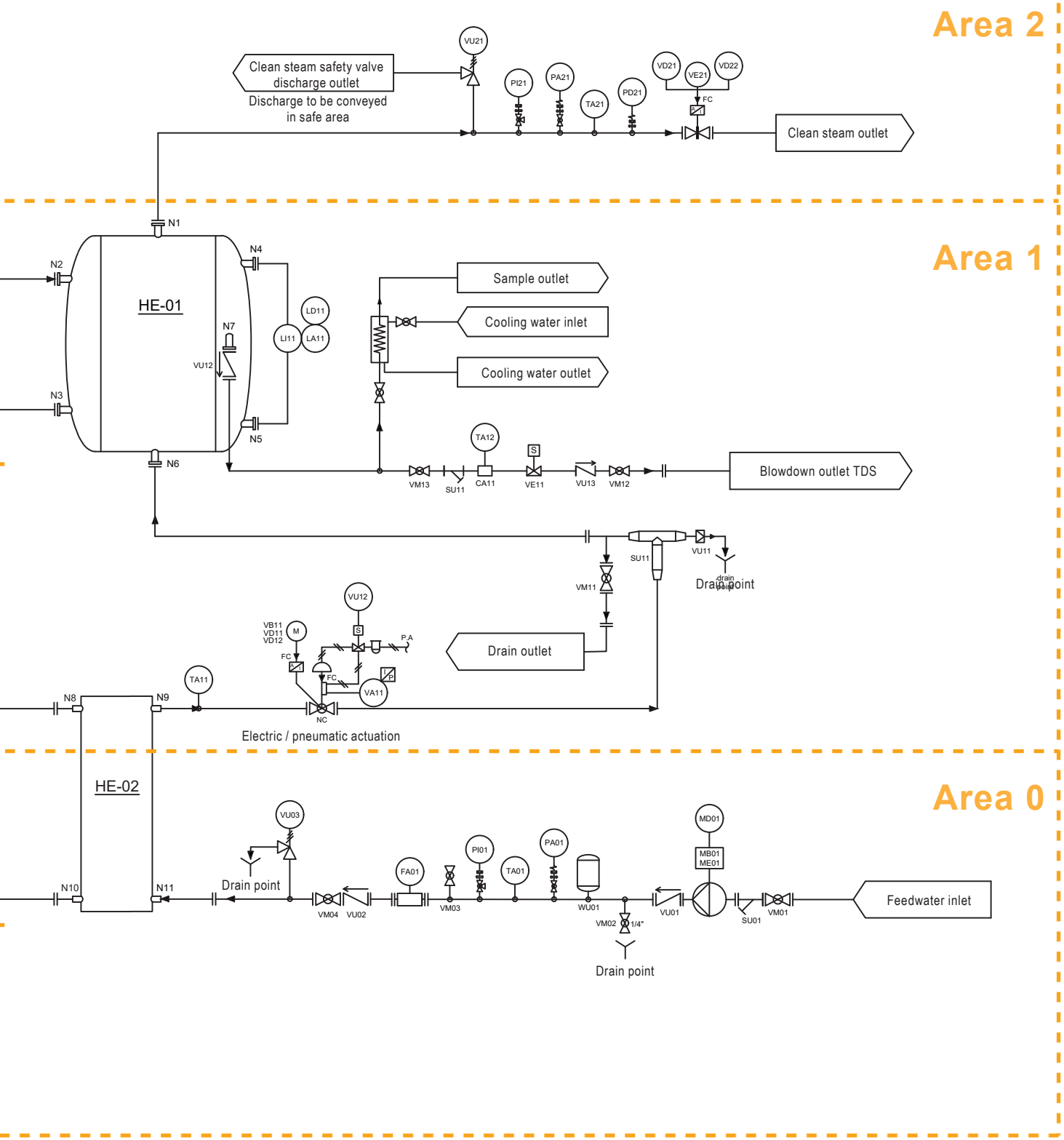


Fig. 9


Area 2
Clean steam safety valve discharge outlet
Discharge to be conveyed in safe area
VU21
PI21
PA21
TA21
PD21
VD21
VE21
VD22
FC
Clean steam outlet
Area 1
N1
N2
N3
N4
N5
N6
N7
HE-01
LD11
LI11
LA11
VU12
Sample outlet
Cooling water inlet
Cooling water outlet
TA12
VM13
SU11
CA11
VE11
VU13
VM12
Blowdown outlet TDS
SU11
VU11
drain point
VM11
VU12
VB11
VD11
VD12
M
FC
P,A
VA11
NC
Drain outlet
TA11
N8
N9
Electric / pneumatic actuation
Area 0
HE-02
VU03
Drain point
N10
N11
VM04
VU02
FA01
VM03
PI01
TA01
PA01
WU01
VM02
1/4"
Drain point
MD01
MB01
ME01
VU01
SU01
VM01
Feedwater inlet

9.2 Component Configuration

The options available for the CSG-FBHP are listed in section 2.3. Many of the available options will utilise additional equipment fitted the system. The components specifically required for each option are listed below.
Default items fitted as standard are identified with*

Plant steam inlet isolation valve

- Manual valve*: VM31
- Automated valve: VM31 replaced by VE31, VD31, and VD32

TDS control system

- Timer control*: VE11
- Pulsed and continuous hysteresis control: VE12 and CA11

Feedwater pressurisation system

- None*
- Integrated pump: MA01, MD01

Independent downstream plant protection

- None*
- Low level limit switch: LD11
- Saturated temperature limit switch: TD21

Intelligent Diagnostics

- None*
- Integrity test: VM51 replace by VE51, VM11 replace by VE11, PA31, TA31, VE32, VE33
- Performance monitoring: TA01. TA21, TA31, TA51, TA52, FA01, PA31, PA01 and TA11
- System diagnostics: VB01, VB31, PA31, TA51 and TA52
  - With pneumatic control or Integrity test: PDX1
  - Without integrated pump: PA01

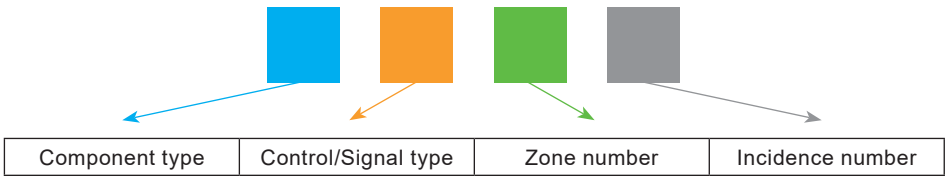
Clean steam outlet isolation valve

- None*
- Manual Valve: VM21
- Automated valve: VE21, VD21 and VD22

9.3 Component naming convention

The naming convention for the system map do not correlate to the specific parts and part numbers. The tag names are specific to the CSG-FBHP system and are not tied to specific component models. To identify a particular component, reference the component tag number to the Bill Of Materials for the specific model of CSG-FBHP.

The tag numbers can be deciphered to aid identification and location of the component on the CSG-FBHP.



9.3.1 Component types

Opposite is a table of currently identified component types.

Letter	Component type
C	Conductivity
F	Flow sensor
H	Heat exchanger (preheater, sample cooler, etc)
L	Level sensor
P	Pressure sensor
Q	Trap (steam, air eliminator, etc)
S	Separator
T	Temperature sensor
V	Valve (globe, ball, check, vacuum breaker, butterfly, etc)
W	Water vessel (pressure buffer, storage, etc)
Y	Strainer

9.3.2 Control/signal type

Opposite is a table of currently identified Control and Signal types. The direction of signals is always reference in relation to the PLC or process controller.

Letter	Control/Signal type
A	Analogue input (signal)
B	Analogue output (control)
D	Digital input
E	Digital output
I	Indicator (non-electrical, dial, etc)
M	Manual control
U	Un-controlled (check valve, strainer, separator, etc)

9.3.3 Zone allocation

Zones are used to segregate areas of the package into sub-areas based around state changes of the process of the package.

Numbering of the Zones begins with the inlet flow of the process fluid at Zone 0. When the process fluid undergoes a change or state change, the Zone number increases until it leaves the CSG-FBHP.

The inlet of the control fluid begins with the next available Zone number. At each state change of the control fluid, increase the Zone number until the control fluid leaves the package.

Components located externally to the steam system are always labelled as Zone X.

9.3.4 Incidence number

Where multiples of similar devices and parts occur in the same zone, incidence numbers are used to distinguish between them.

Starting points for incidence numbers always start from the component closest the entry of the Zone area.
e.g. On a condensate line, 2 manual valves are identified in Zone 5. The first of the manual valves to come into contact with the condensate as it passes through zone 5 will be given the Incidence number 1.

10. HMI map

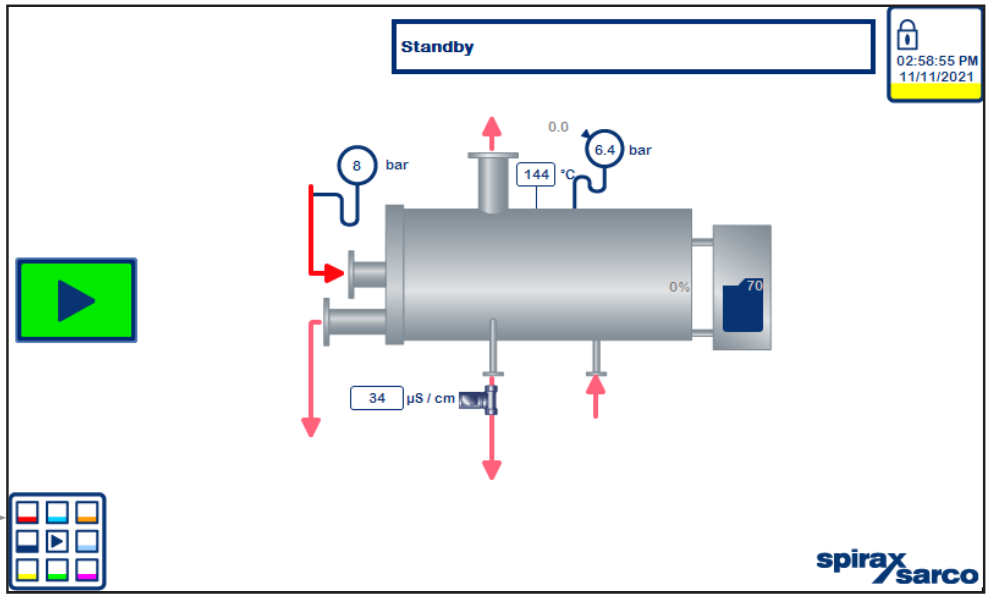
The following map shows the screens available to all users. Some screens will require a security password to access. The minimum required level is highlighted with the Key shown opposite.

Service Sequence resume

Home

Commission

Home



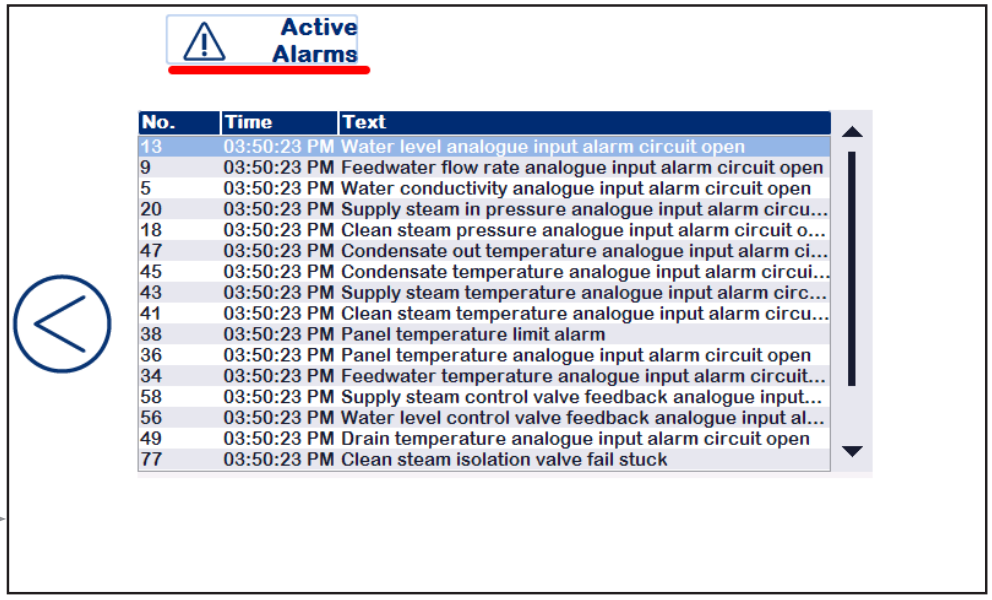
Level key

1 Level 1: Customer User

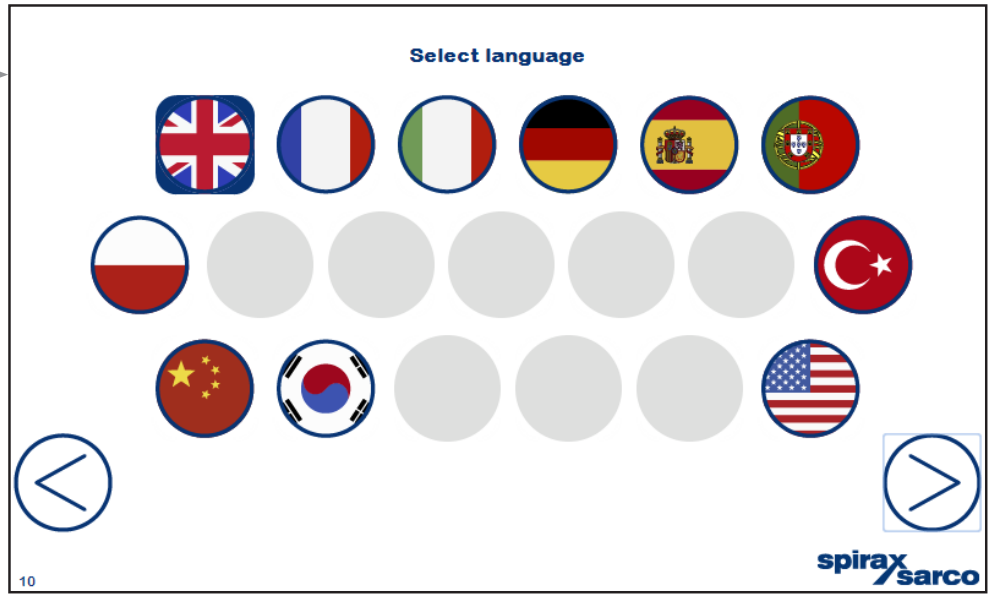
2 Level 2: Customer engineer

3 Level 3: Spirax Sarco engineer

Pre-commission alarm

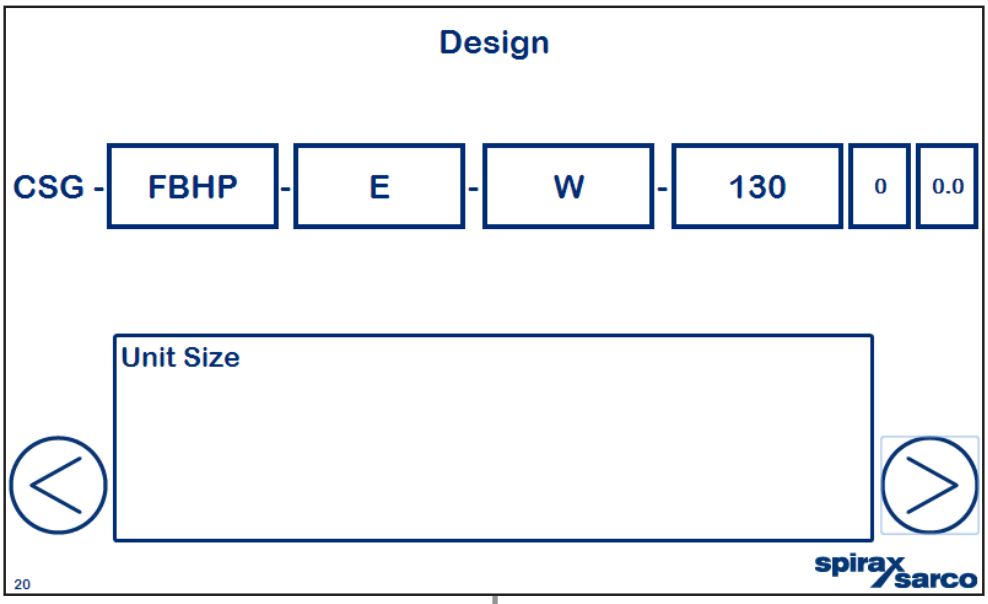


Commission

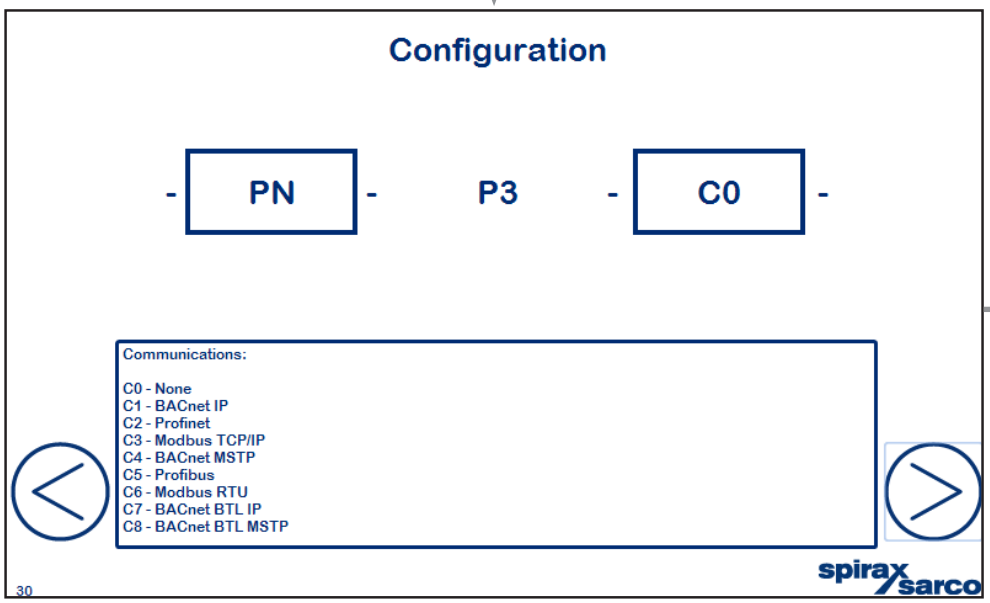


10.1 Commissioning screens

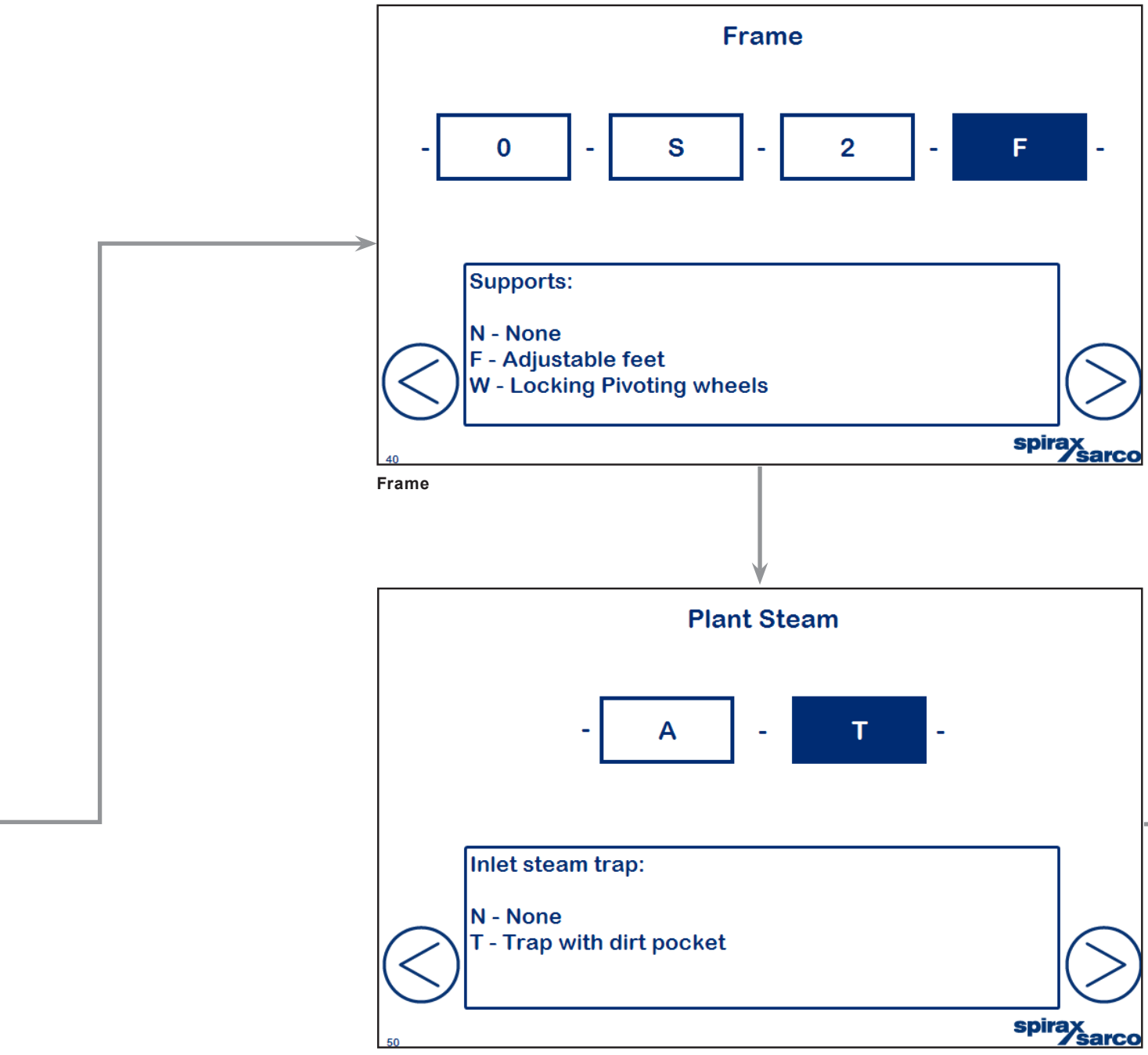
The commissioning screens allow users to input the configuration of the CSG-FBHP into the control system using the model specific nomenclature. These are generated at the point of ordering and must be referenced to ensure correct operation of the CSG-FBHP.



Design

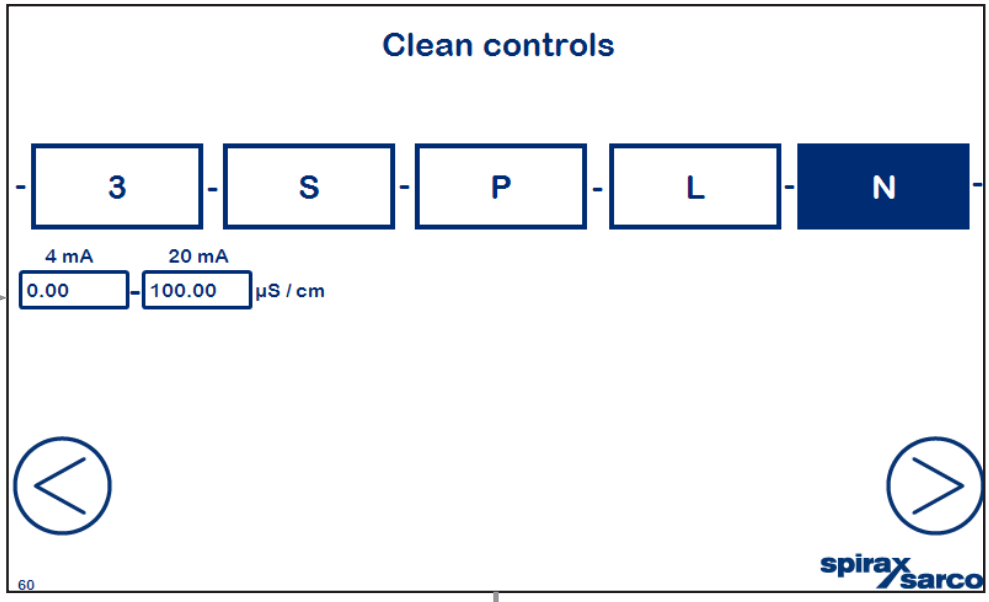


Configuration

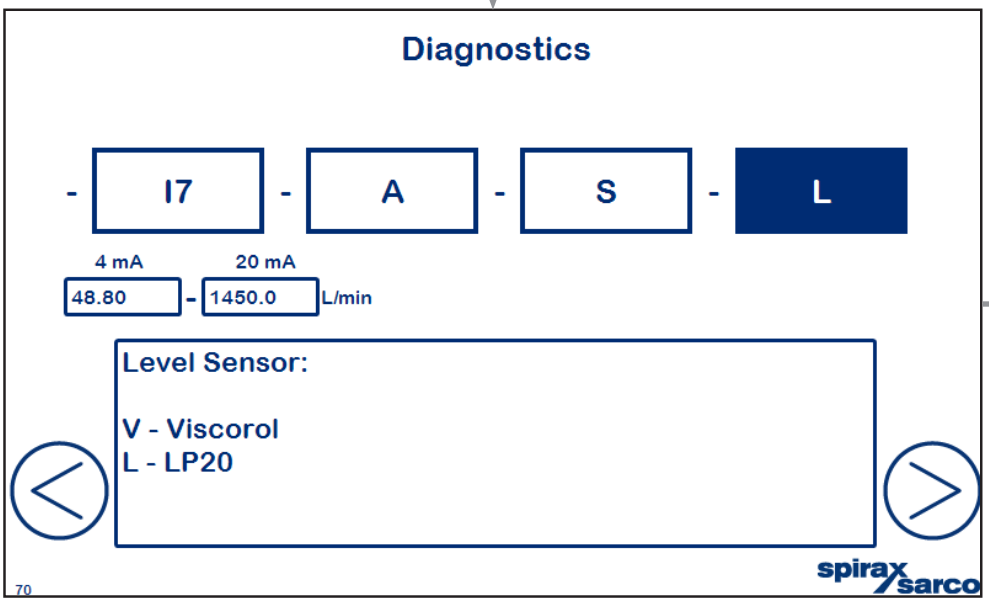


Frame

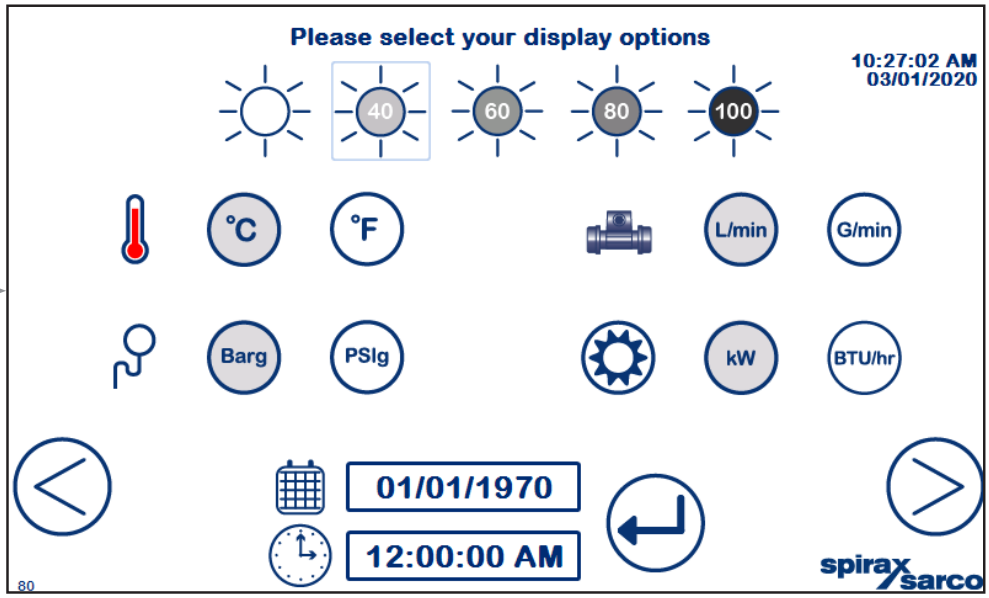
Plant steam



Clean controls



Diagnostics



Display settings

10.2 Home screen

The home screen (110) gives the user the ability to quickly view the essential parameters and run status of the CSG-FBHP. Additionally, more detailed parameters and process values are quickly and easily accessible.

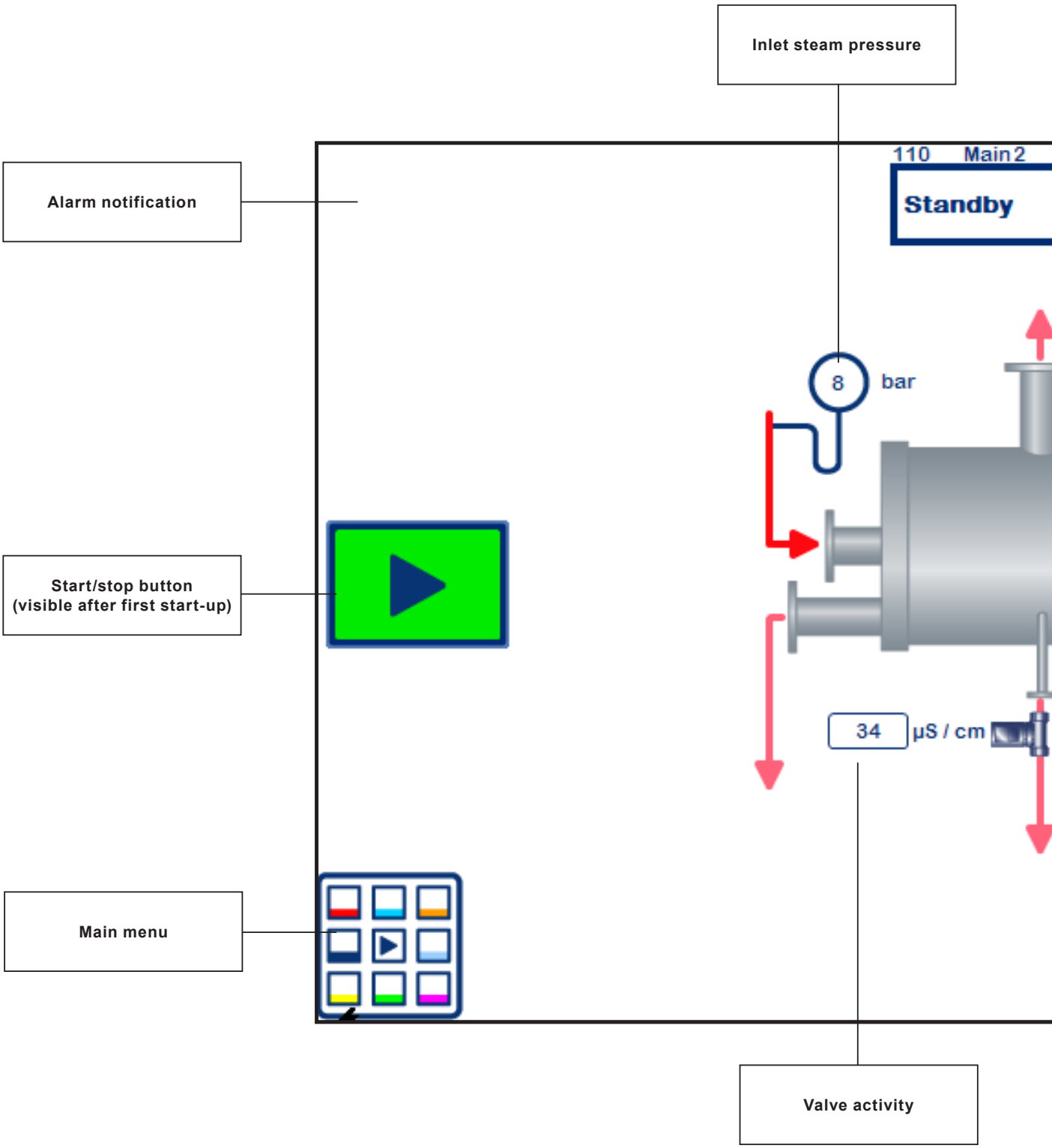
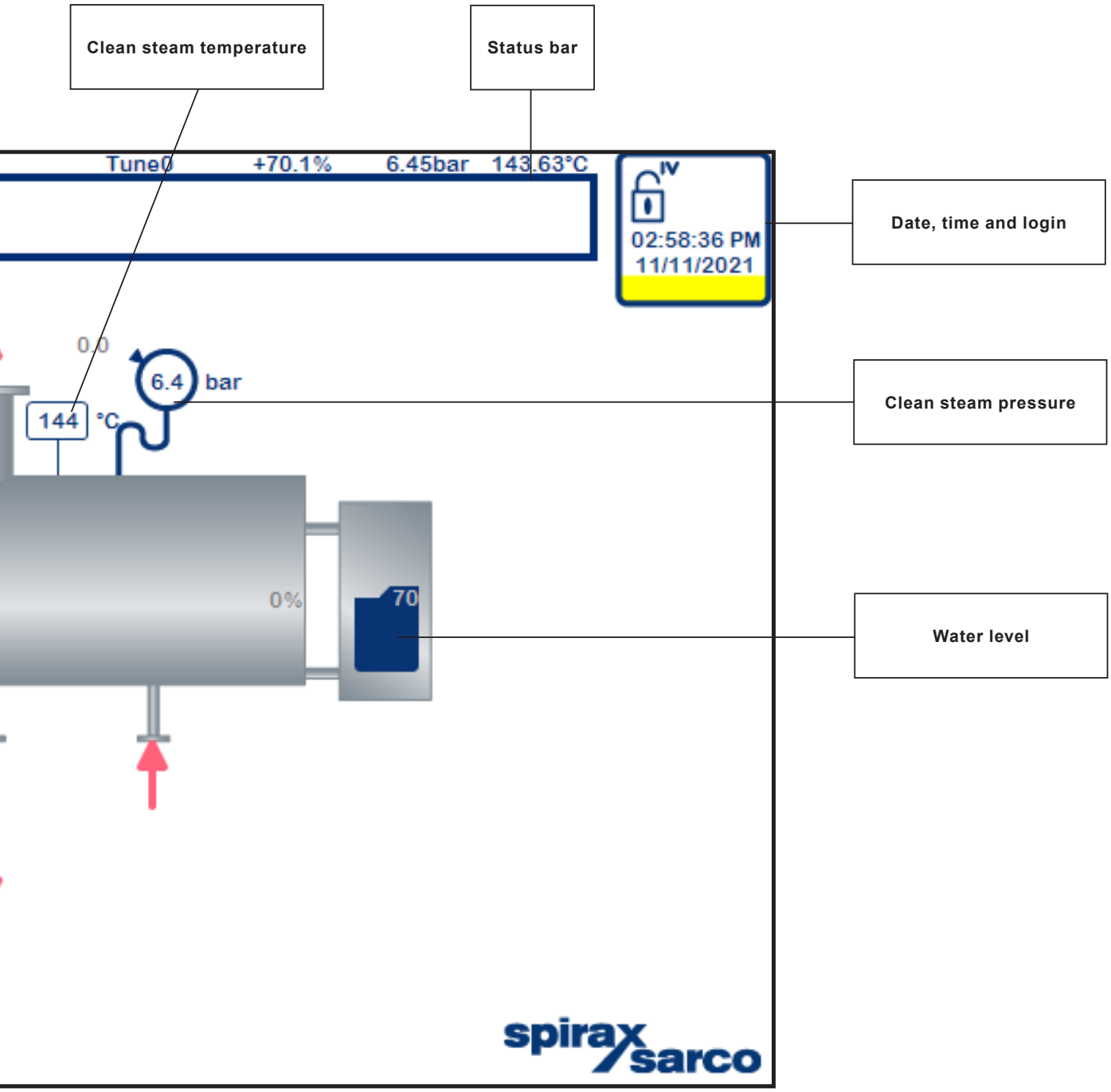
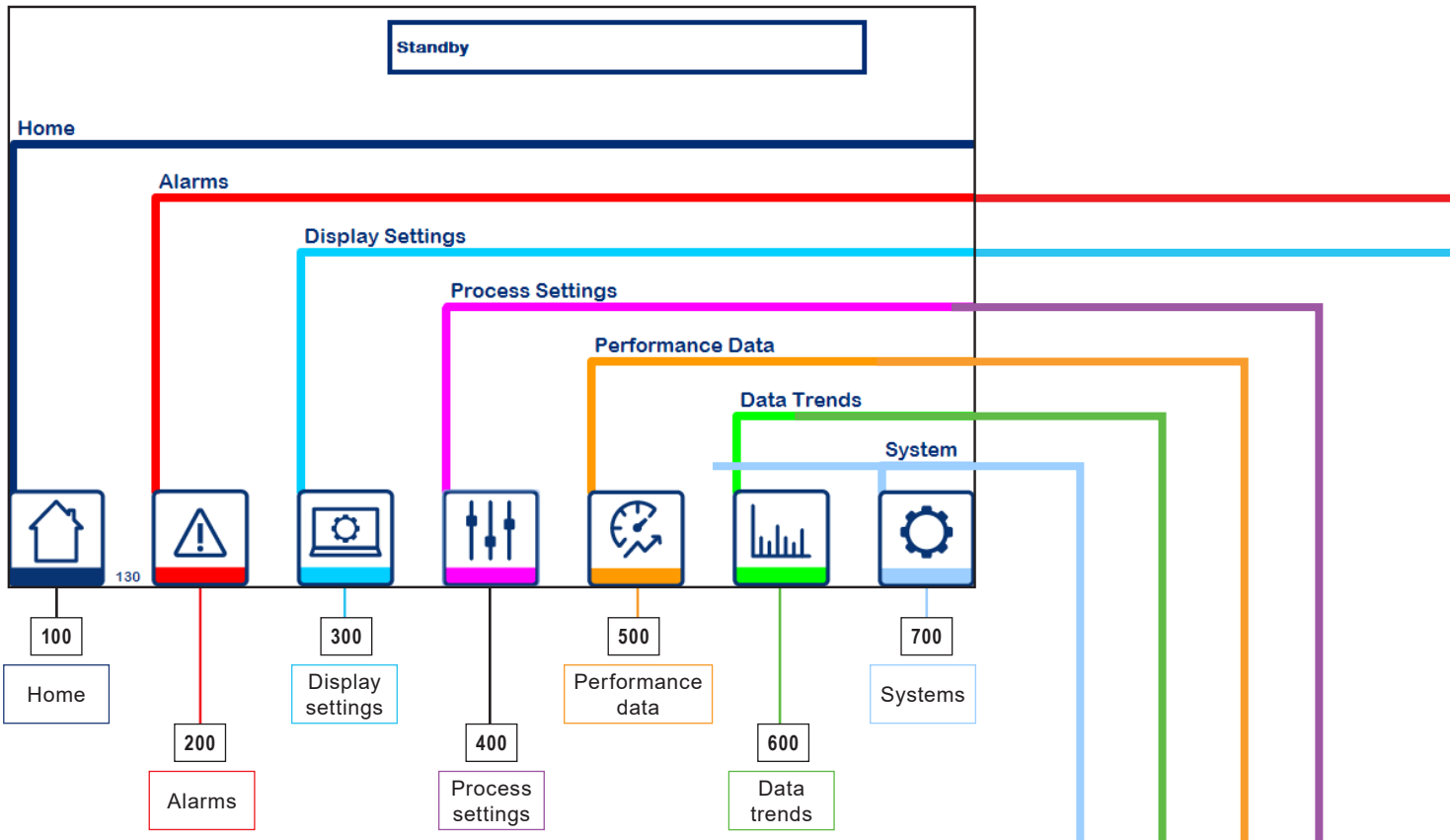


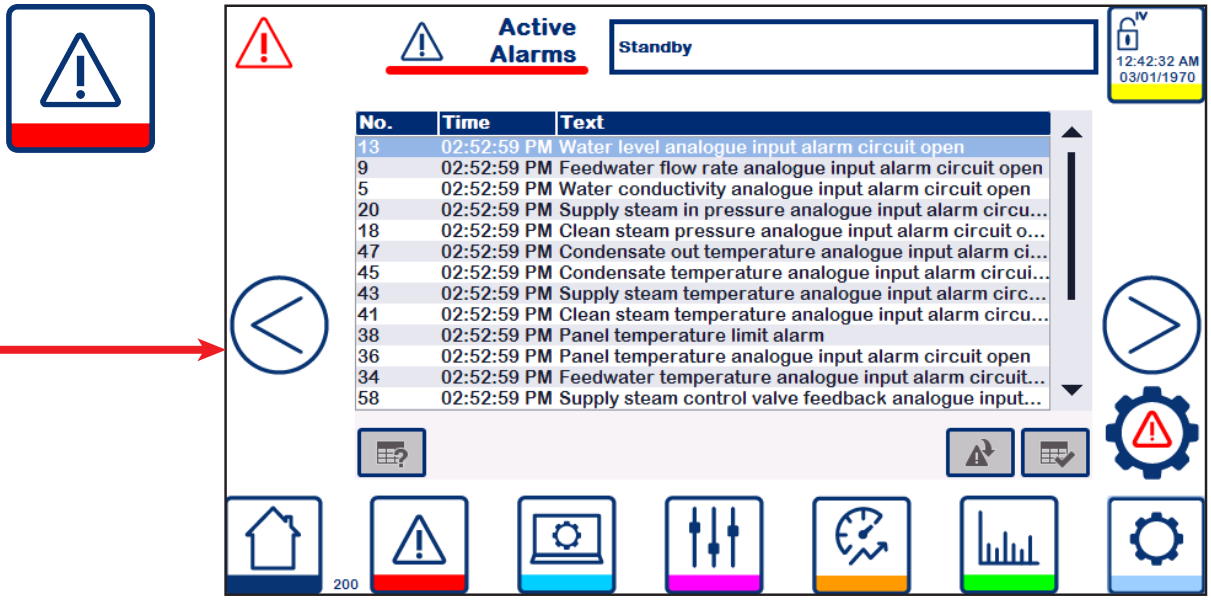
Fig. 10

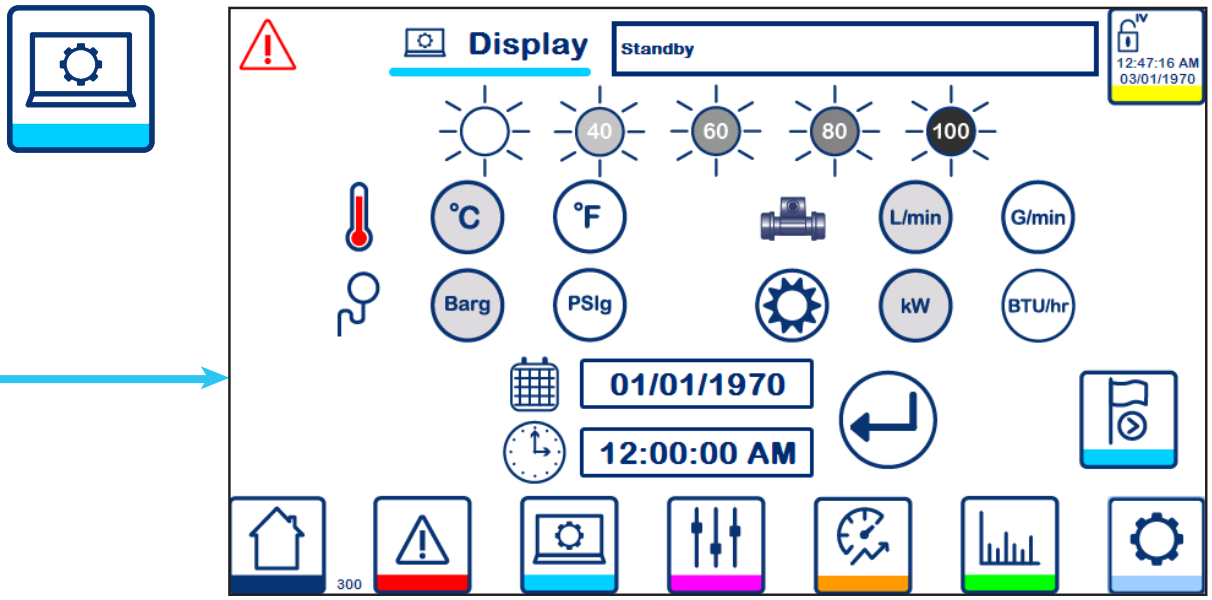

Clean steam temperature
Status bar
Tune0
+70.1%
6.45bar
143.63°C
IV
02:58:36 PM
11/11/2021
Date, time and login
0.0
6.4
bar
144
°C
Clean steam pressure
0%
70
Water level
spirax sarco

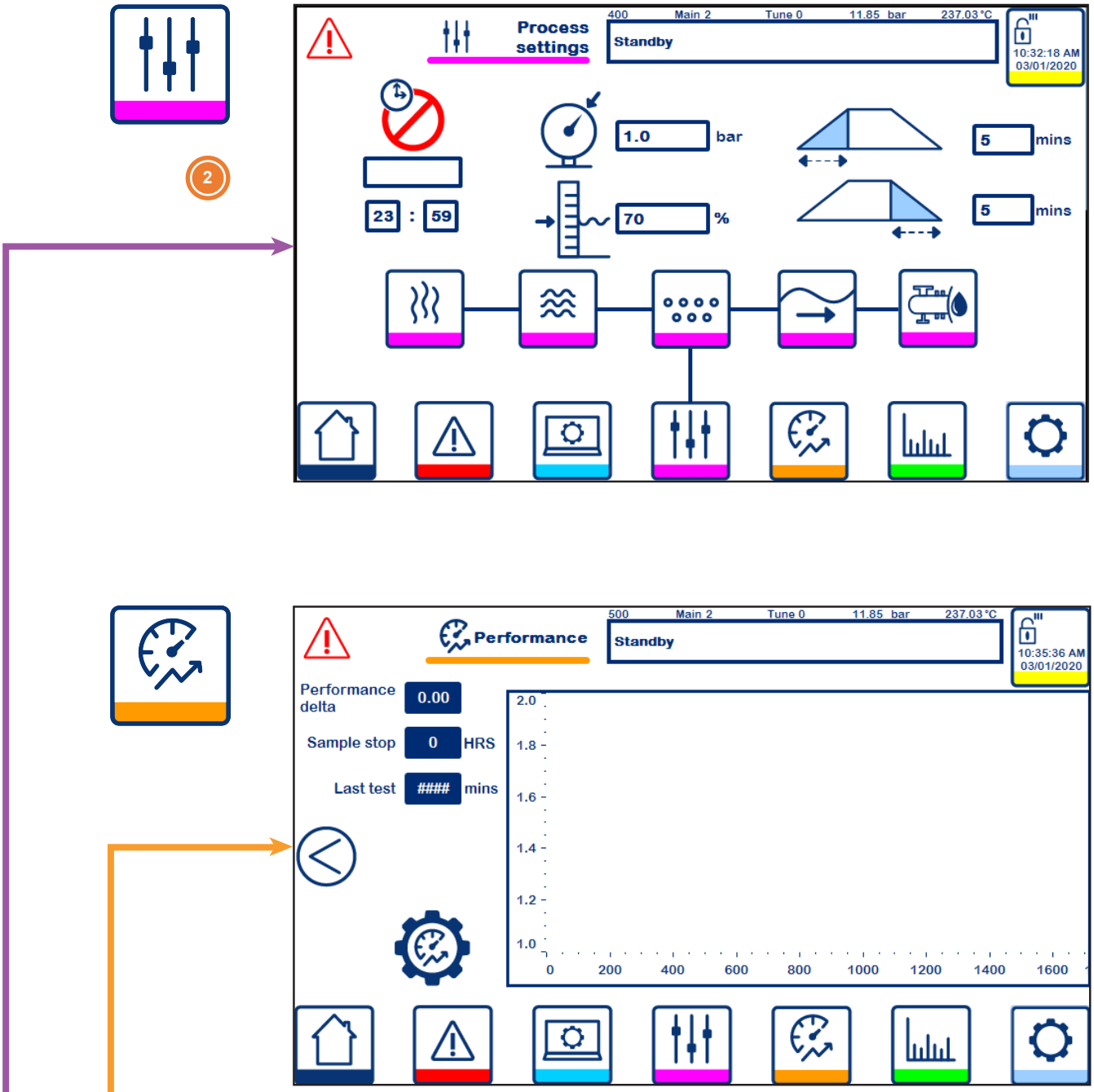
10.3 Main menu

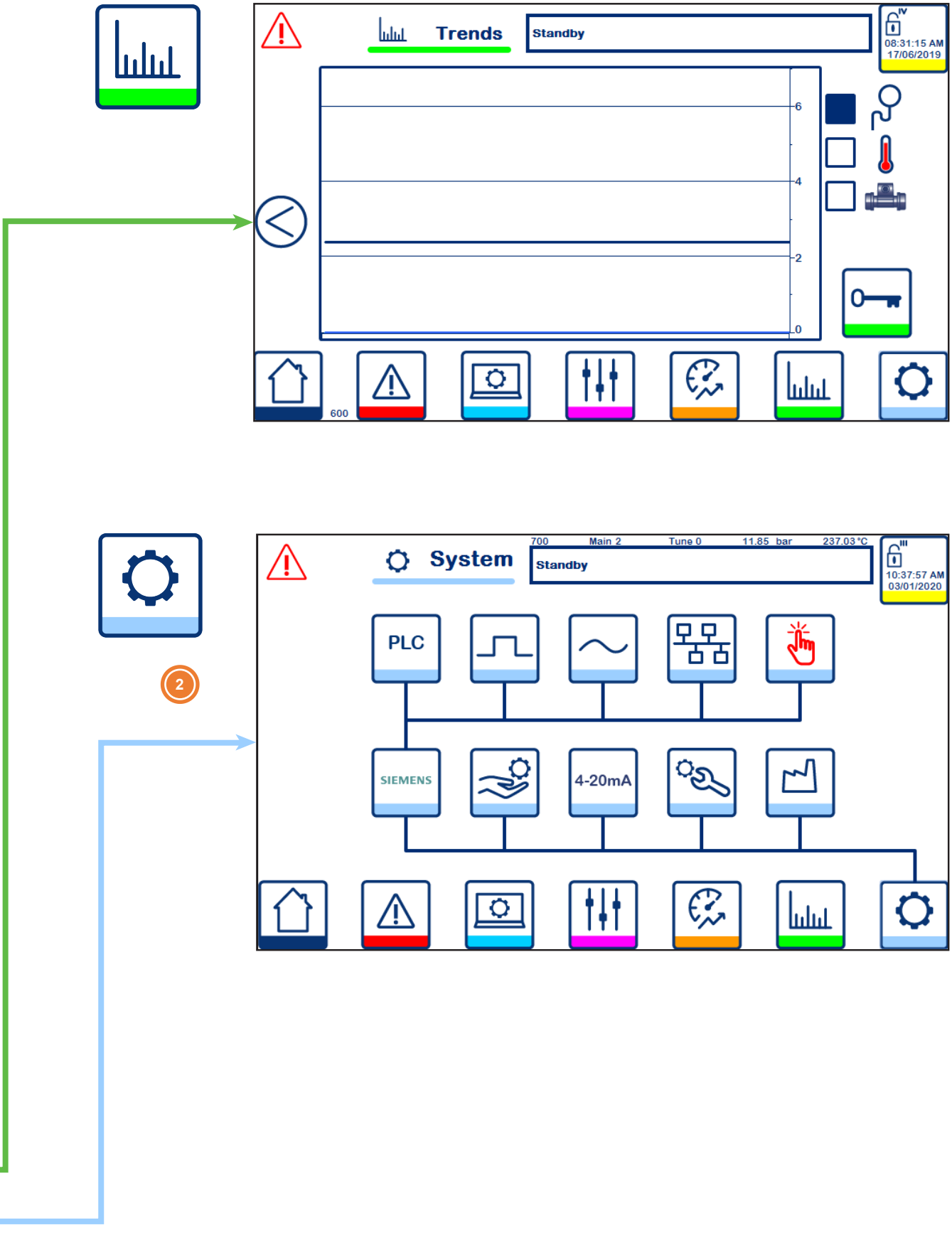
By selecting the Main Menu button from the Home screen, the user has access to settings, alarms and diagnostics screens. These are split in to 6 sub-menus as described below.




Active Alarms
Standby
12:42:32 AM
03/01/1970
No. Time Text
13 02:52:59 PM Water level analogue input alarm circuit open
9 02:52:59 PM Feedwater flow rate analogue input alarm circuit open
5 02:52:59 PM Water conductivity analogue input alarm circuit open
20 02:52:59 PM Supply steam in pressure analogue input alarm circu...
18 02:52:59 PM Clean steam pressure analogue input alarm circuit o...
47 02:52:59 PM Condensate out temperature analogue input alarm ci...
45 02:52:59 PM Condensate temperature analogue input alarm circui...
43 02:52:59 PM Supply steam temperature analogue input alarm circ...
41 02:52:59 PM Clean steam temperature analogue input alarm circu...
38 02:52:59 PM Panel temperature limit alarm
36 02:52:59 PM Panel temperature analogue input alarm circuit open
34 02:52:59 PM Feedwater temperature analogue input alarm circuit...
58 02:52:59 PM Supply steam control valve feedback analogue input...
200

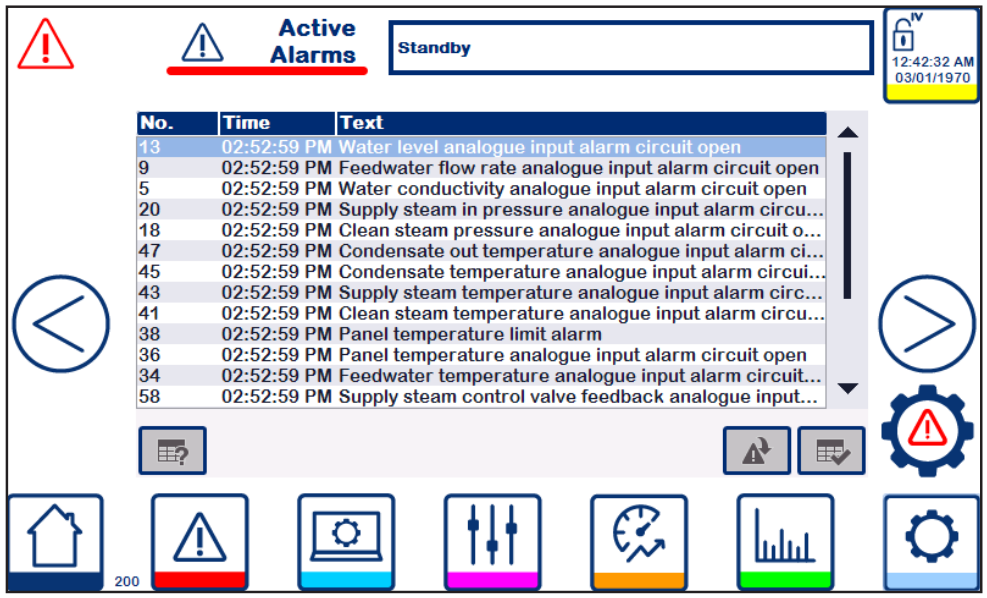

Display
Standby
12:47:16 AM
03/01/1970
40
60
80
100
°C
°F
L/min
G/min
Barg
PSIg
kW
BTU/hr
01/01/1970
12:00:00 AM
300


2
Process settings
400 Main 2 Tune 0 11.85 bar 237.03 °C
Standby
10:32:18 AM
03/01/2020
1.0 bar
5 mins
23 : 59
70 %
5 mins
Performance
500 Main 2 Tune 0 11.85 bar 237.03 °C
Standby
10:35:36 AM
03/01/2020
Performance delta
0.00
Sample stop
0 HRS
Last test
mins
2.0
1.8
1.6
1.4
1.2
1.0
0
200
400
600
800
1000
1200
1400
1600

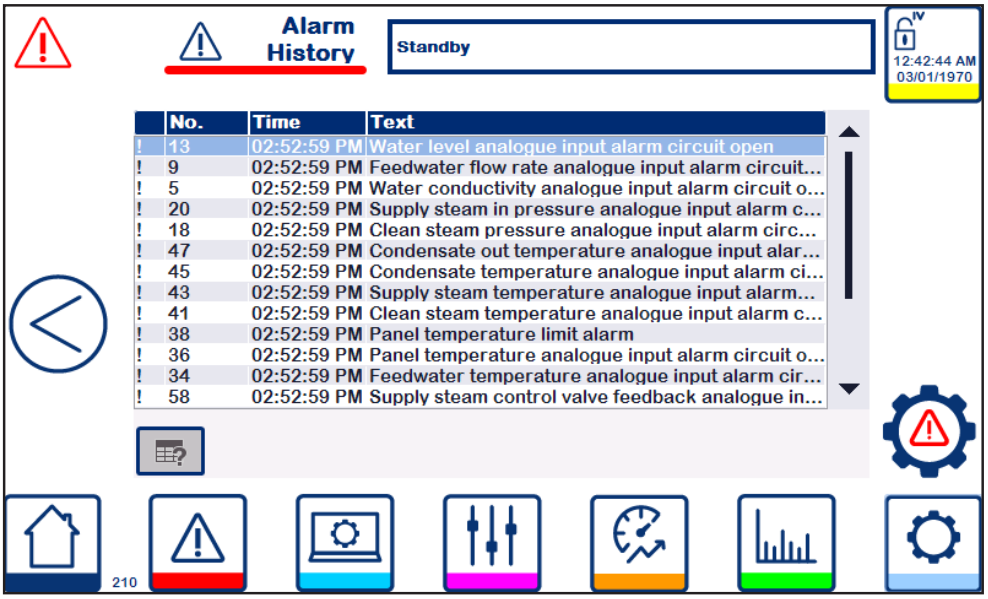

Trends
Standby
08:31:15 AM
17/06/2019
6
4
2
0
600
System
700
Main 2
Tune 0
11.85 bar
237.03 °C
Standby
10:37:57 AM
03/01/2020
PLC
SIEMENS
4-20mA
2

10.4 Alarms

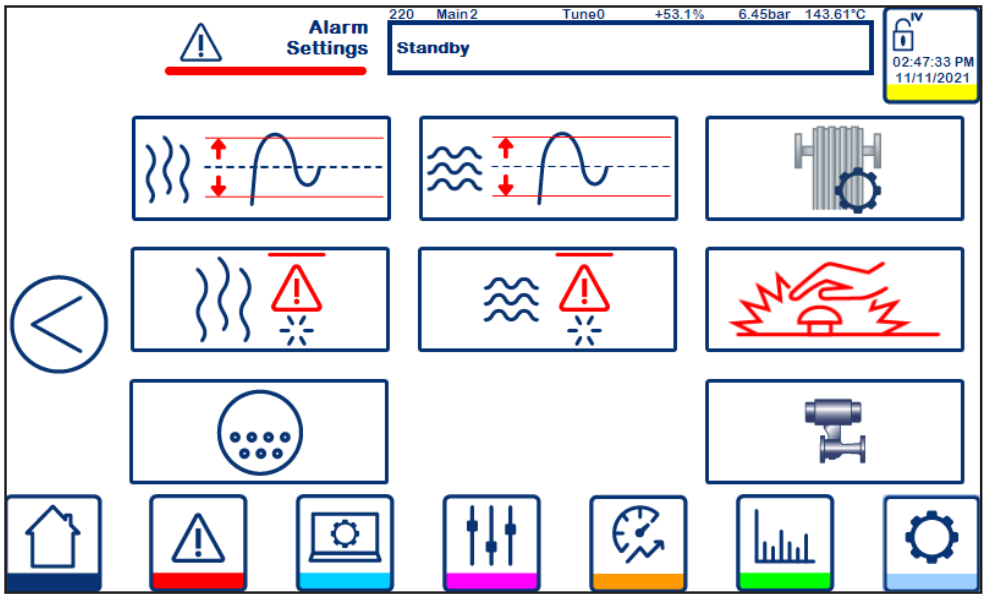
The alarm screens display active and historic alarms as well as all the settings for the diagnostics alarms.



Active alarms (200) remains on screen until they are acknowledged by the user.



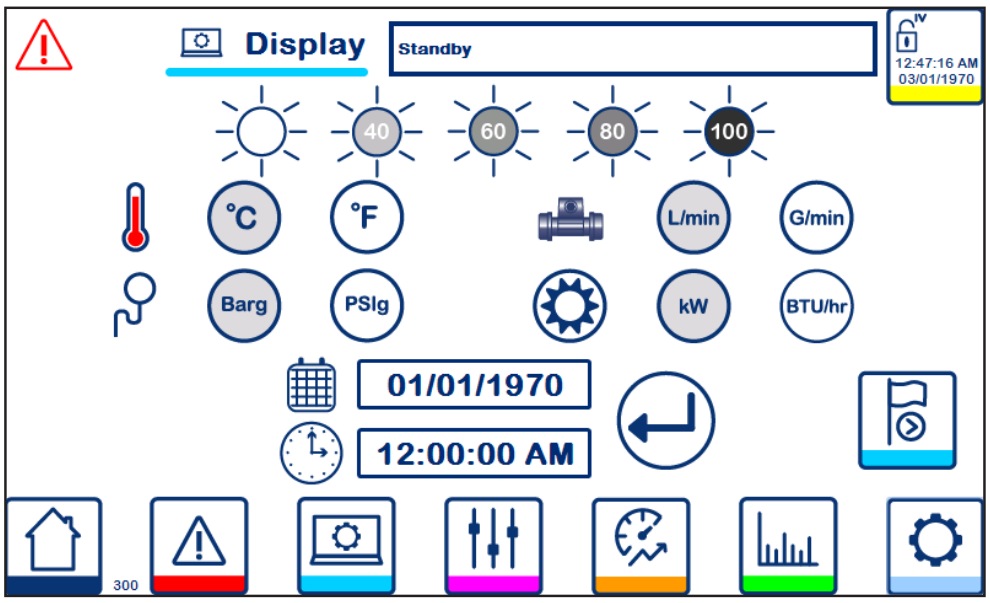
Alarms history (210) provides an historic log of previous alarms including time and date stamp for clarification and diagnosis. A rolling total of 1024 alarms are retained until a power cycle of the CSG-FBHP.



Alarm settings (220)

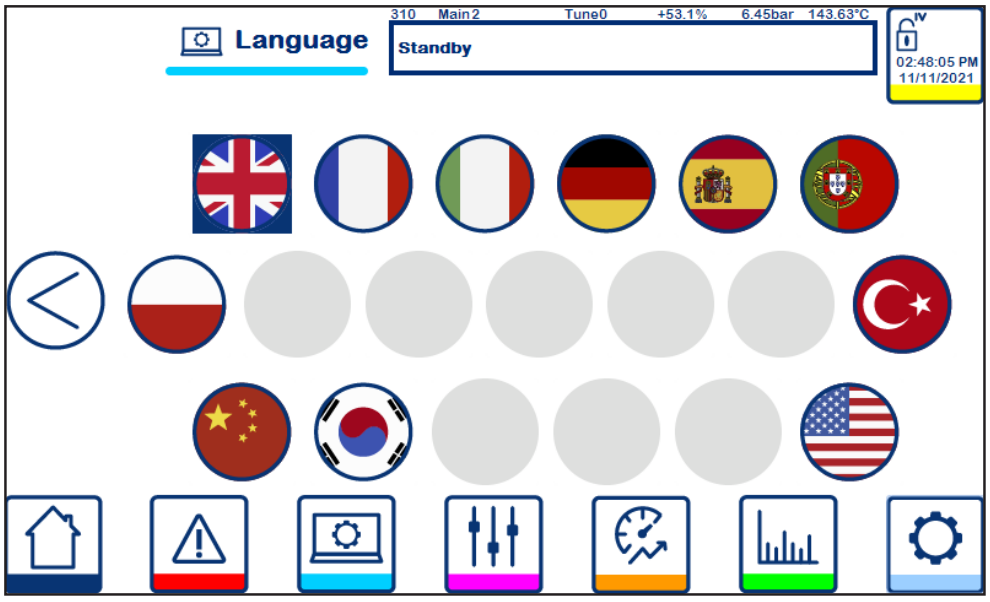
10.5 Display settings

The display settings screen, as well as altering the display units for the HMI, the user can also alter the time, date and language.



Display settings (300)

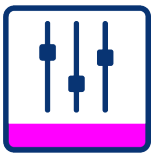
1



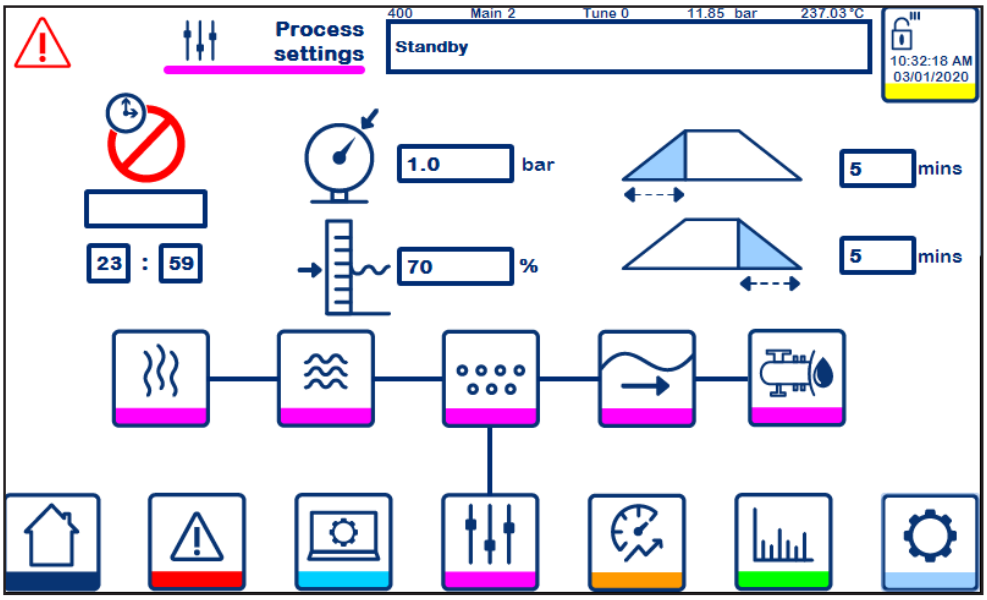
Language (310)

10.6 Process settings

The settings available across the process settings screens directly affect the running of the CSG-FBHP and the effective output of clean steam.

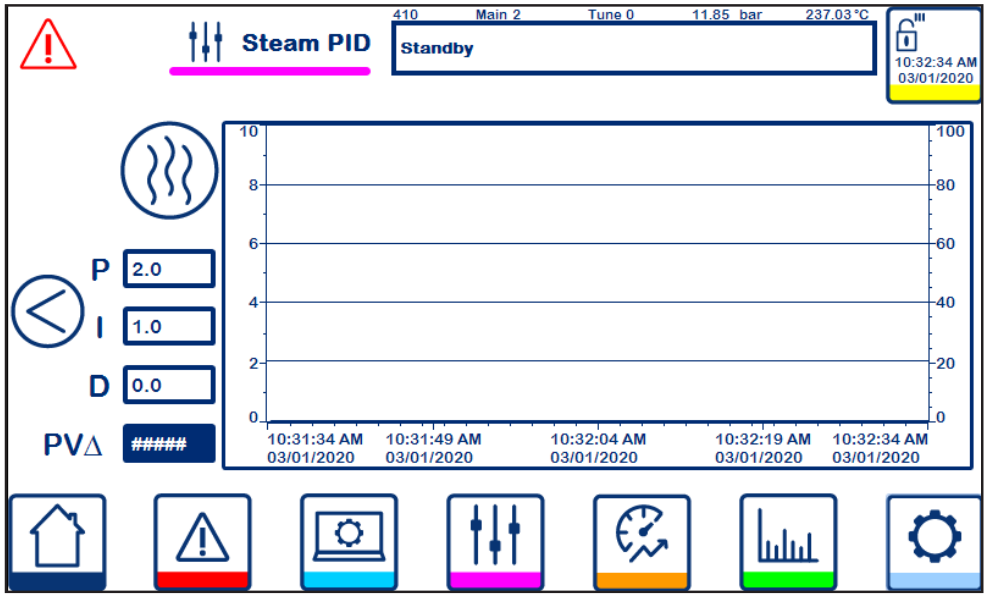


2

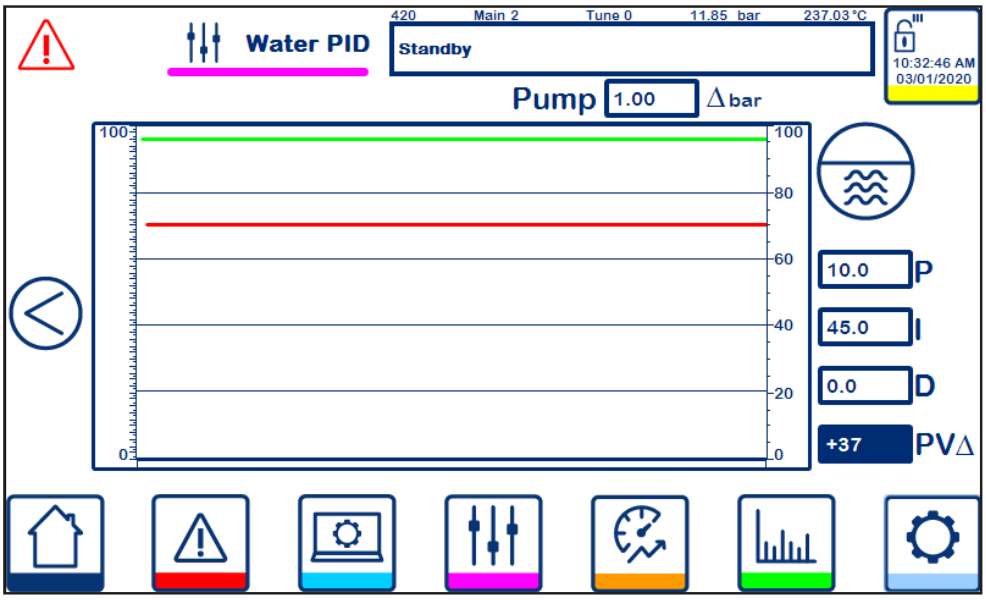


Main process set-points (400). Including clean steam pressure, water level, ramp up time and ramp down time.

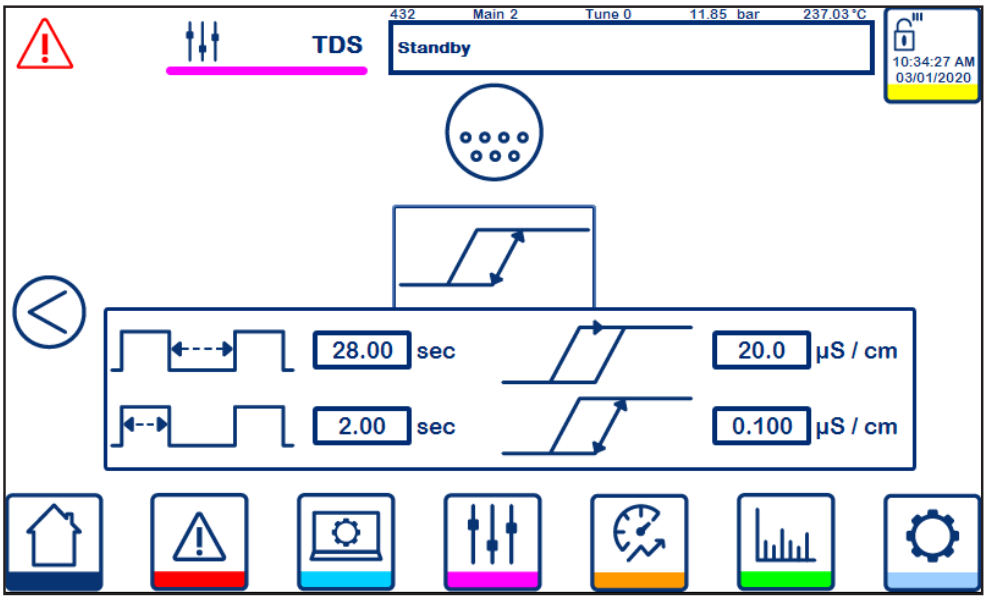
2



Steam PID settings (410) also includes a live PID graph showing the process and control values, and the process set-point.

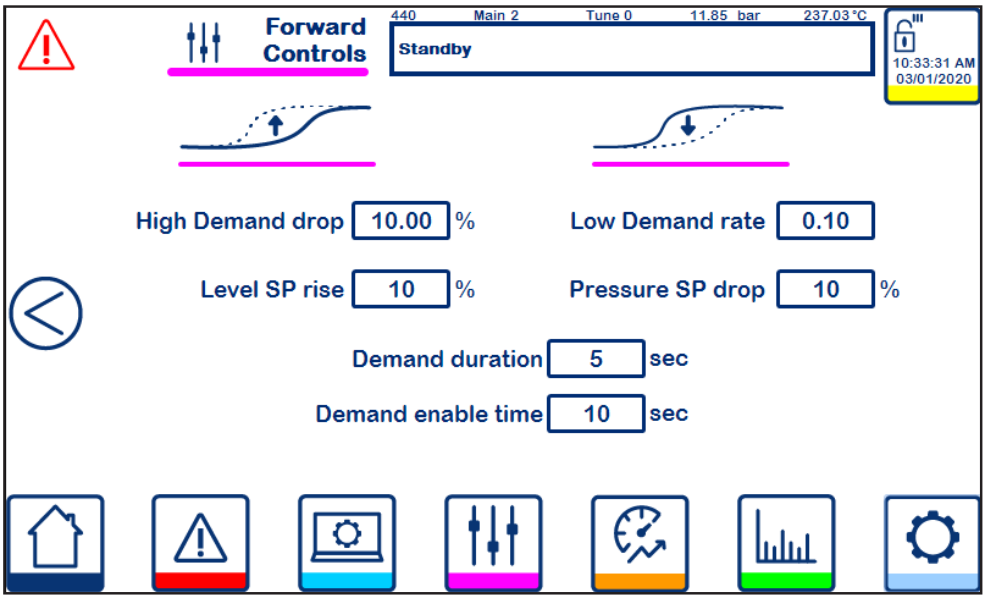


Water PID settings (420) also includes the pump offset value and a live PID graph showing the process and control values, and the process set-point.

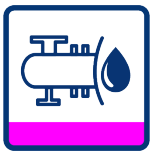


TDS settings (430-432) allows the user to set and select the TDS control they require.

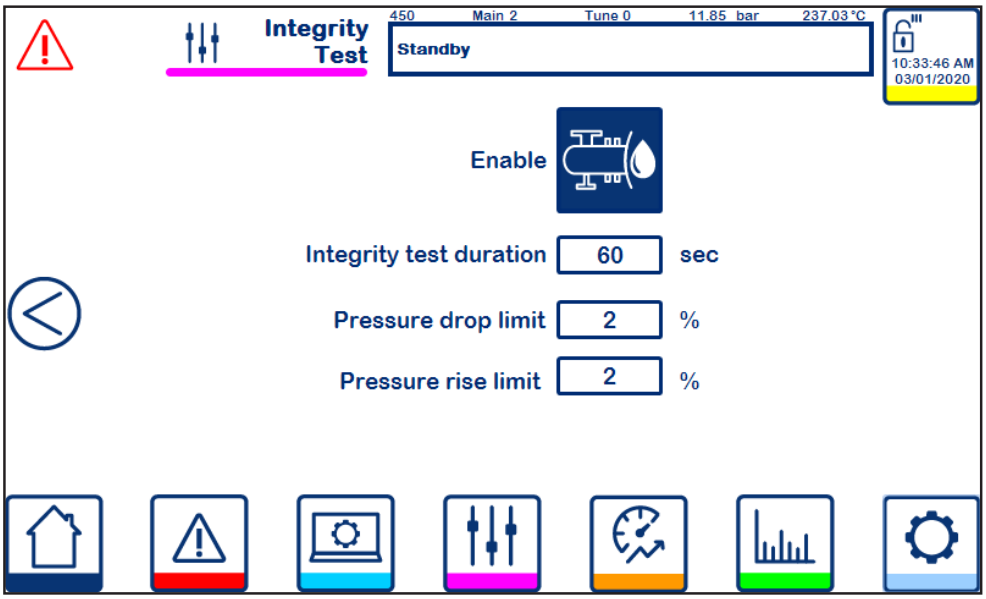
2



Forward controls (440)



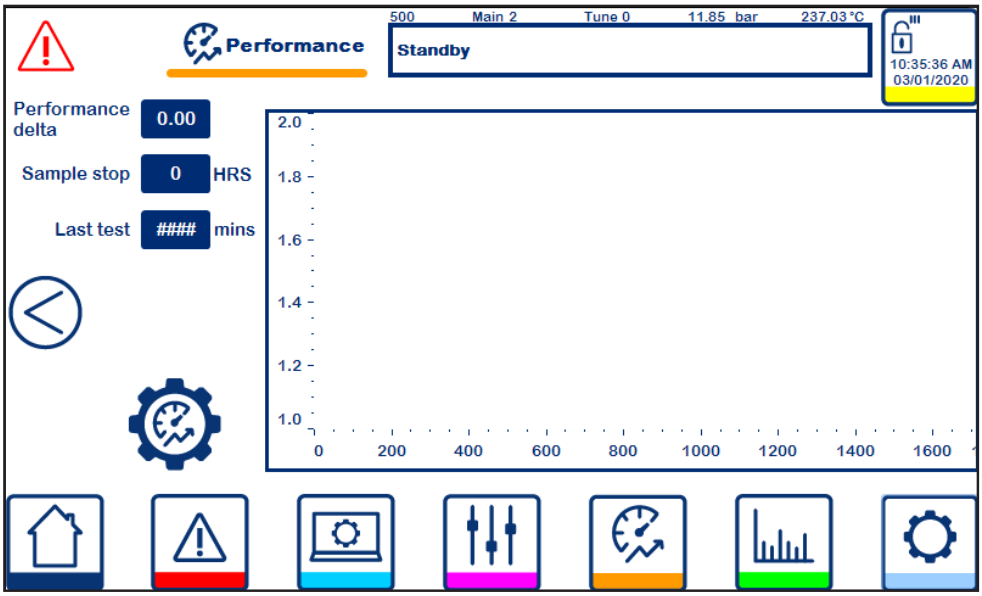
2



Integrity test (450)

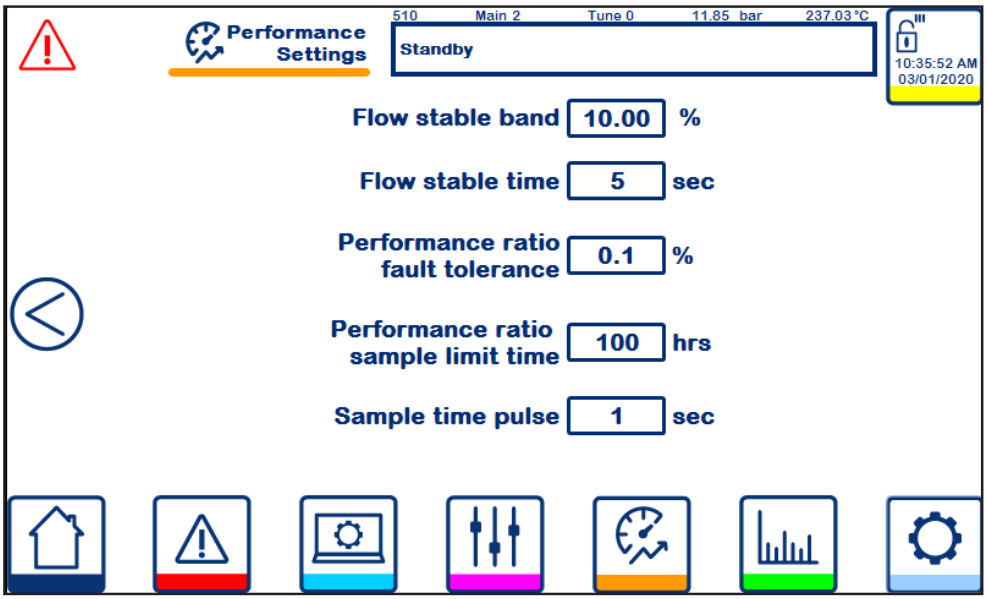
10.7 Performance data

The performance data screen will only display the performance profile of the CSG-FBHP whist in Running mode and once sufficient data has been collected. If the Performance Monitoring options pack has not been installed, no information will be available.



Performance data (500), as well as showing the current performance profile of the CSG-FBHP also shows the current data sample and data times.

2

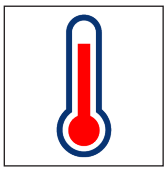


Performance data settings (510) allows users to alter the sampling process and performance tolerance.

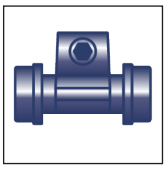
10.8 Data trends

The live data displayed on the Trends screen is grouped in to similar process values.

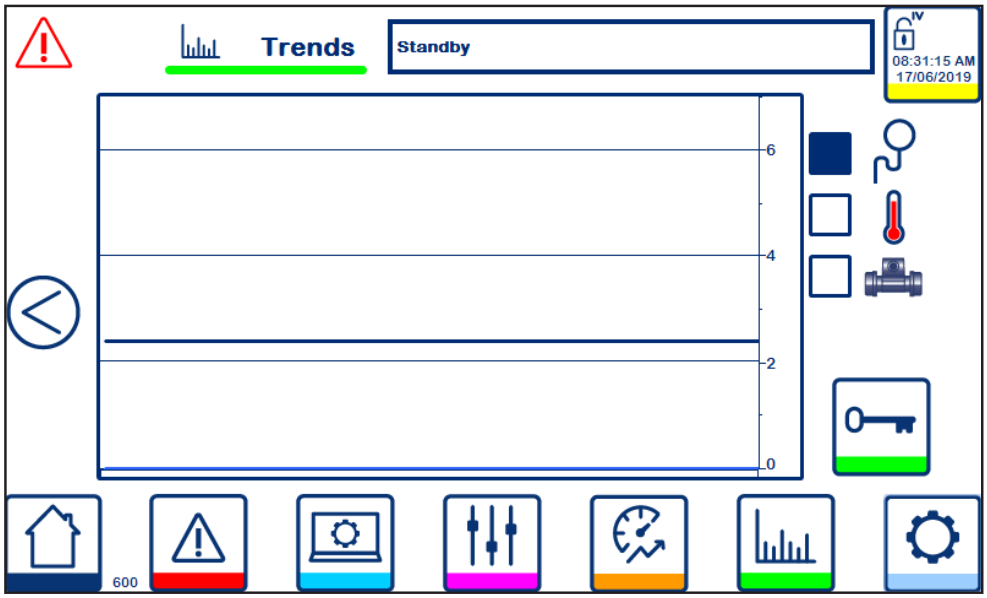
Pressure variables. All currently installed pressure sensors.



Temperature variables. All currently installed temperature sensors.



Flow variable from FA01 if installed.

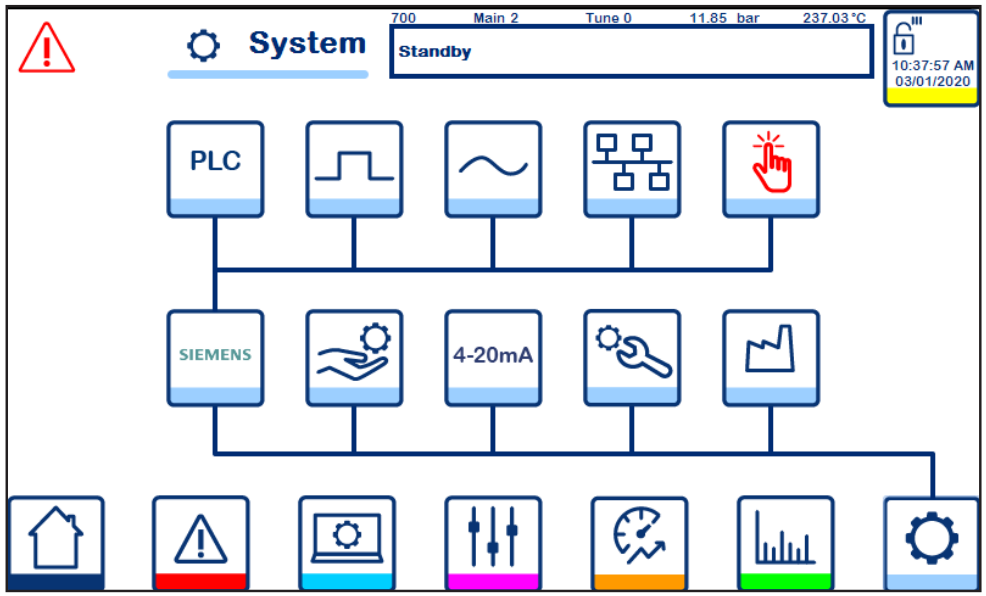


Trends (600) provided a live feed of the selected process variables.

10.9 System

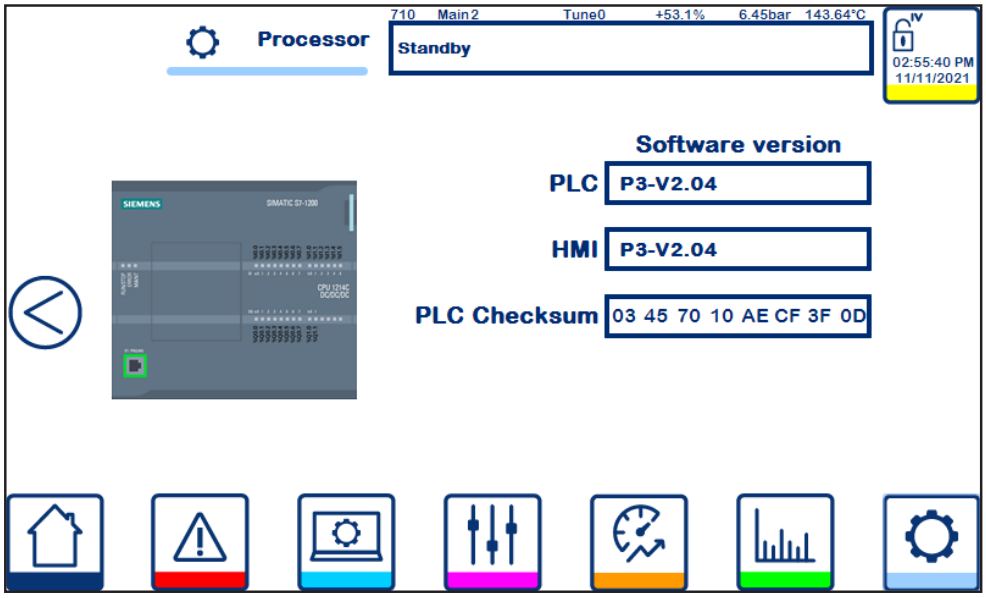
System related controls and settings are available for the advanced user to alter the CSG-FBHP away from a pre-configured settings.

2

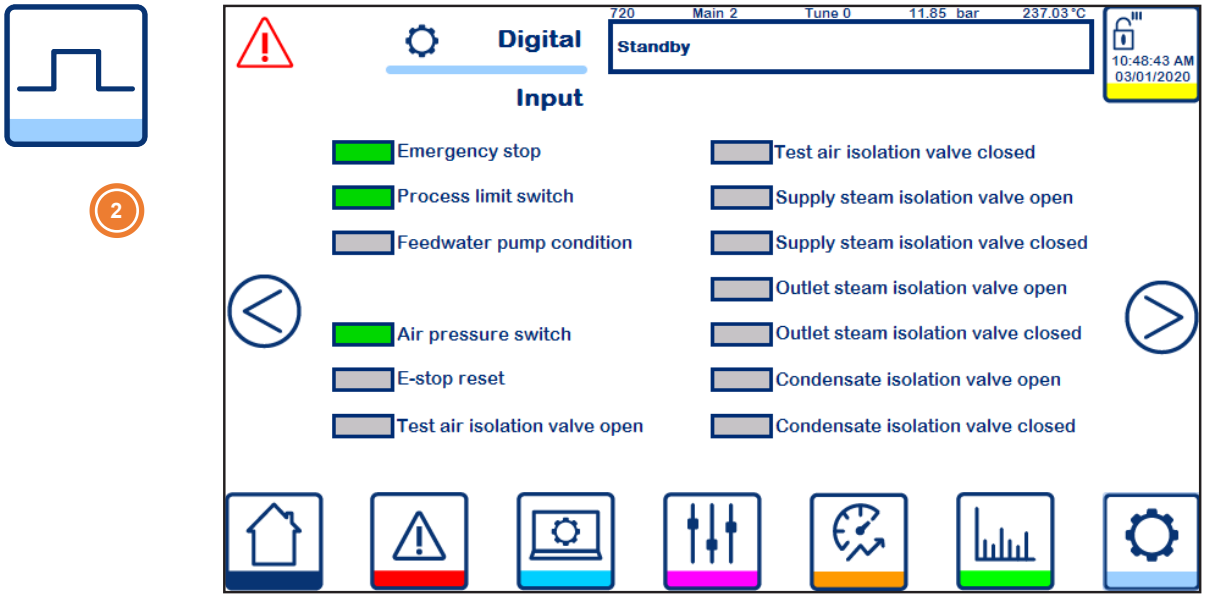


System sub menu (700)

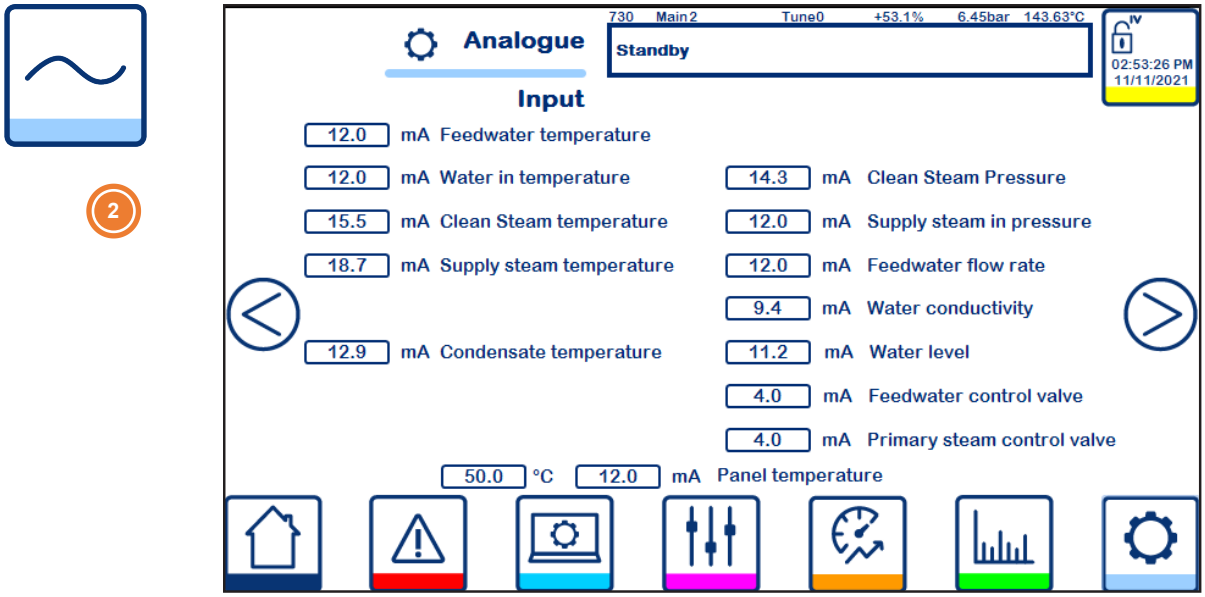
2



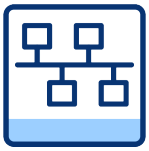
PLC status (710) displays any PLC error codes and the stored PLC date and time.



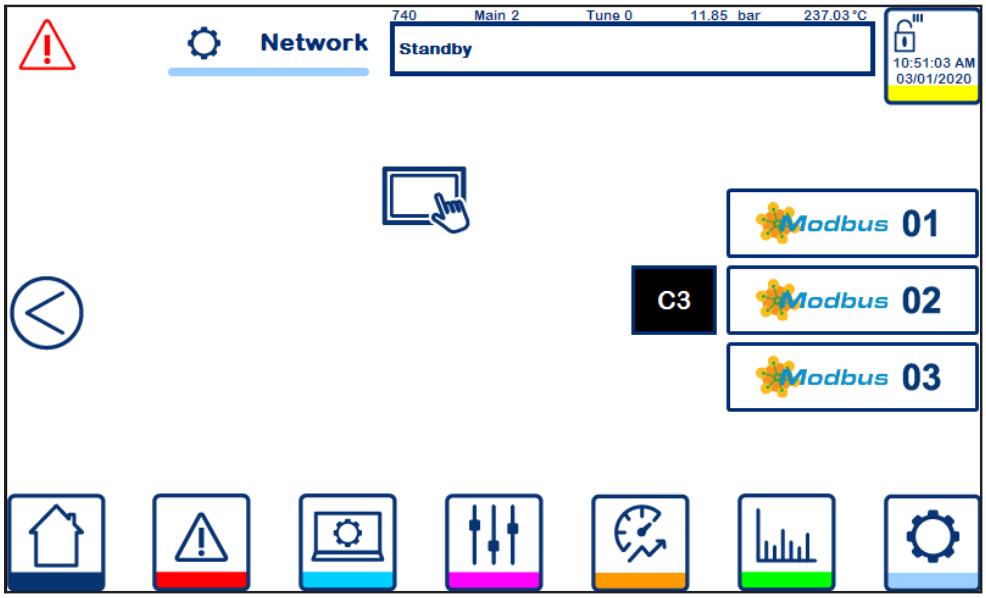
Digital Input status (720) and digital output status (721)



Analogue input status (730) and analogue output status (731)

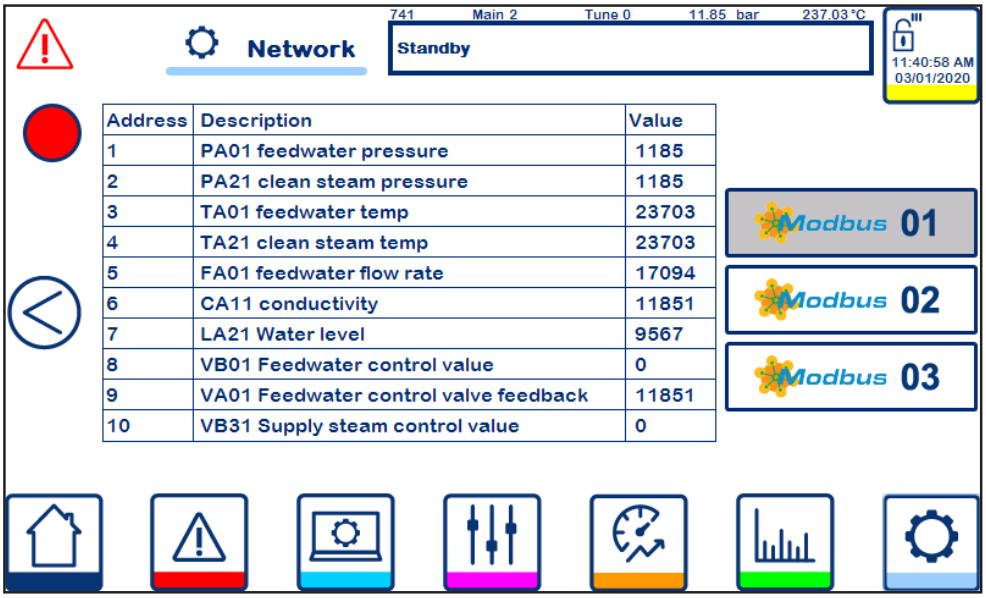


2



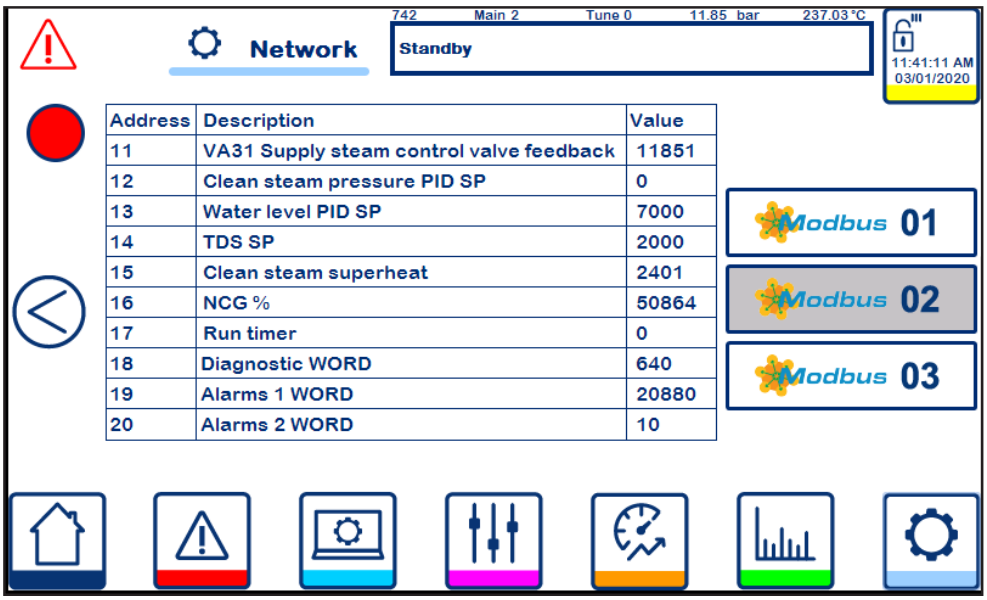
Network status (740)

2

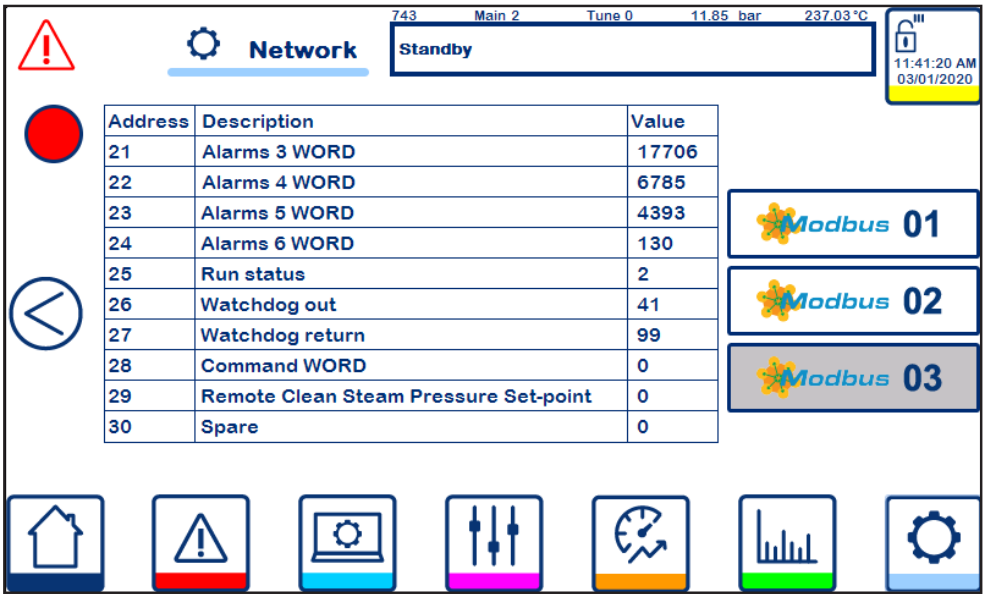


Communications tables and status (741-745)

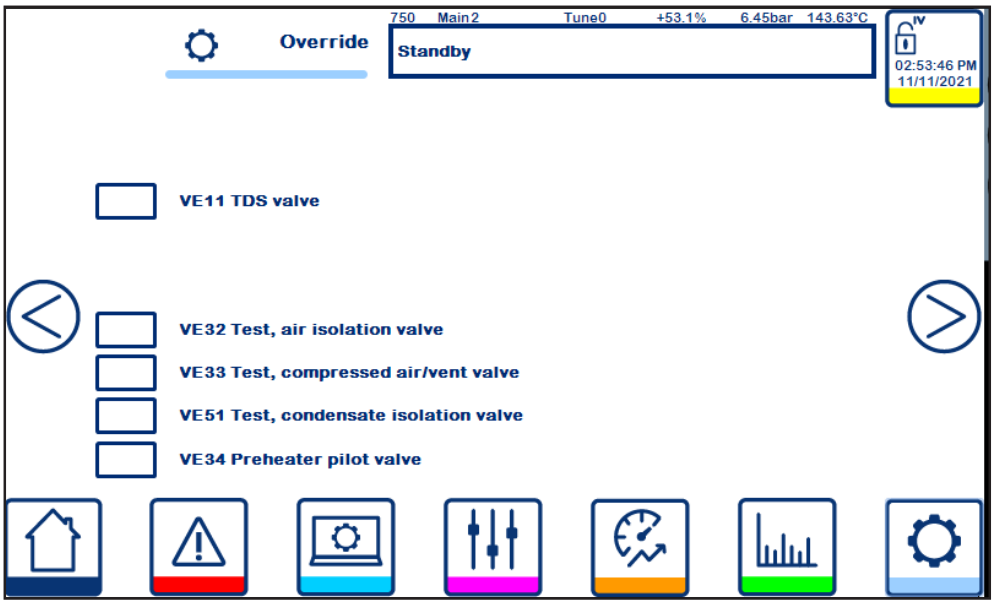
2


742 Main 2 Tune 0 11.85 bar 237.03 °C
Network
Standby
11:41:11 AM
03/01/2020
Address | Description | Value
11 | VA31 Supply steam control valve feedback | 11851
12 | Clean steam pressure PID SP | 0
13 | Water level PID SP | 7000
14 | TDS SP | 2000
15 | Clean steam superheat | 2401
16 | NCG % | 50864
17 | Run timer | 0
18 | Diagnostic WORD | 640
19 | Alarms 1 WORD | 20880
20 | Alarms 2 WORD | 10
Modbus 01
Modbus 02
Modbus 03

2

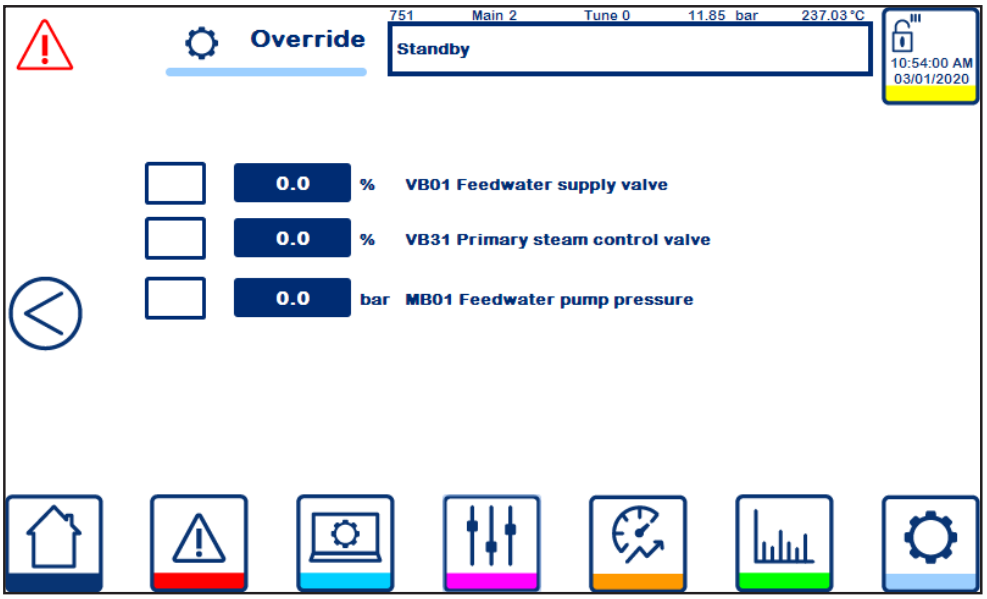

743 Main 2 Tune 0 11.85 bar 237.03 °C
Network
Standby
11:41:20 AM
03/01/2020
Address | Description | Value
21 | Alarms 3 WORD | 17706
22 | Alarms 4 WORD | 6785
23 | Alarms 5 WORD | 4393
24 | Alarms 6 WORD | 130
25 | Run status | 2
26 | Watchdog out | 41
27 | Watchdog return | 99
28 | Command WORD | 0
29 | Remote Clean Steam Pressure Set-point | 0
30 | Spare | 0
Modbus 01
Modbus 02
Modbus 03

2



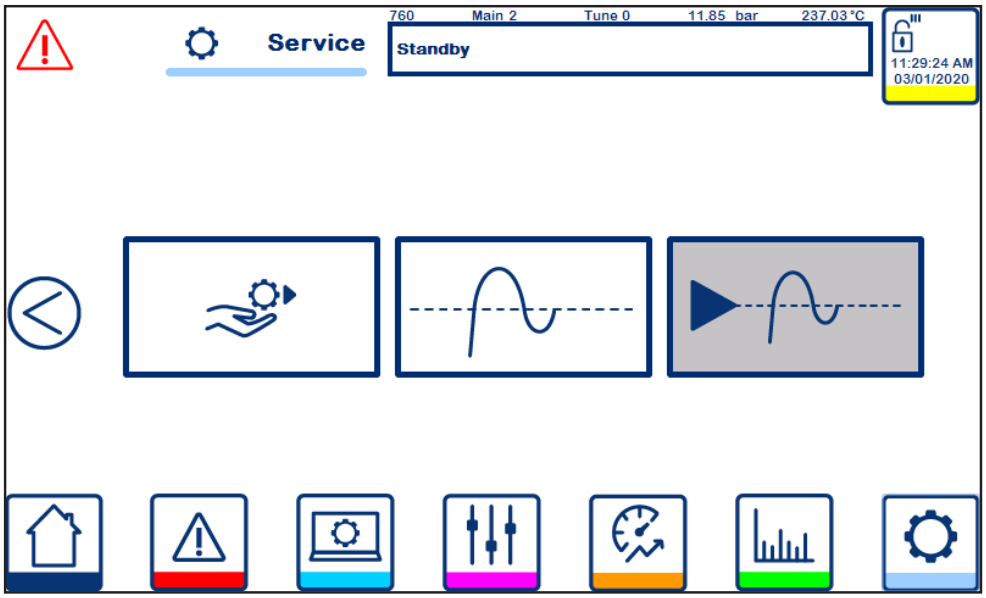
Digital override (750) open and close fitted and available isolation valves (only available in standby mode)

2

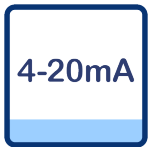


Analogue override (751) enable and move control valves to specific position. (only available in standby mode)

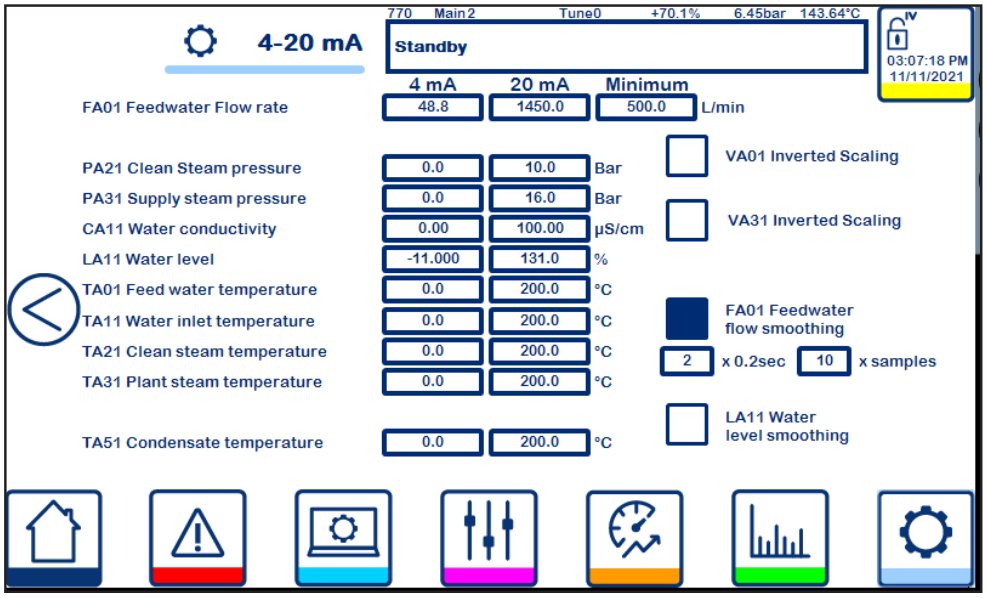
2



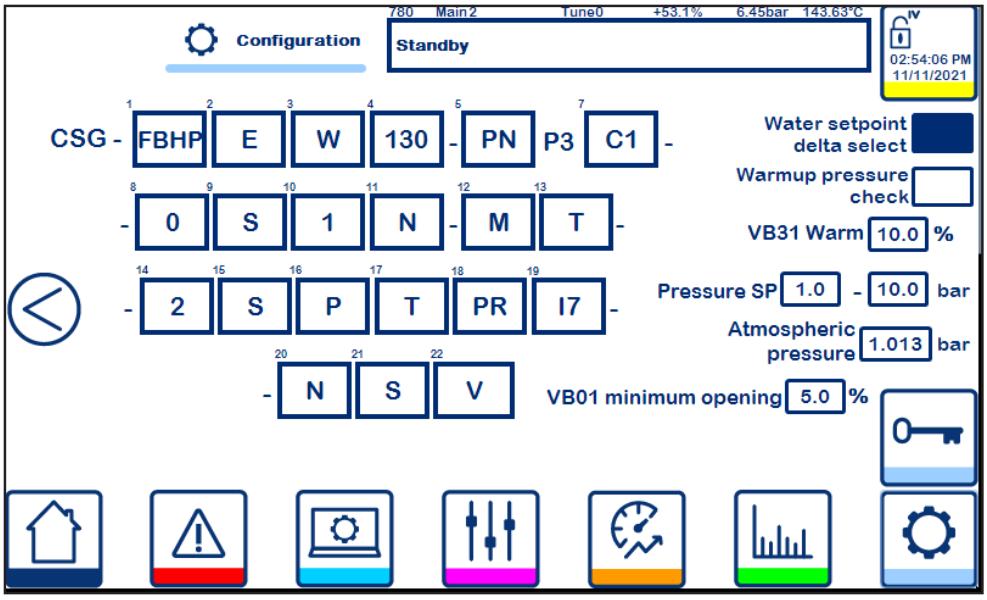
Service (760) allows users to begin service sequence‡, enter PID Tuning mode (only available in standby mode) or Running Tuning mode (only available when in Run mode).



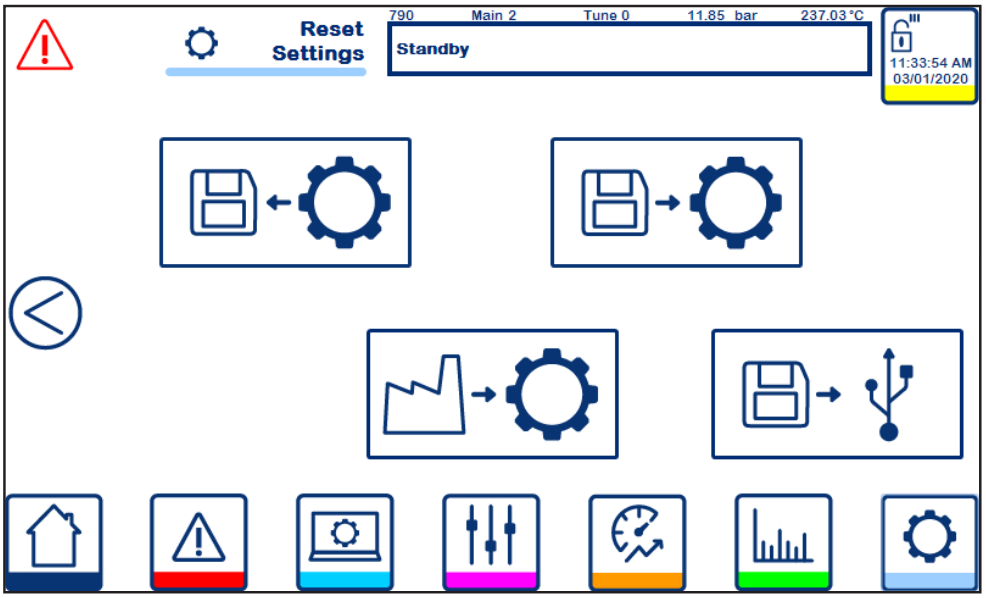
2



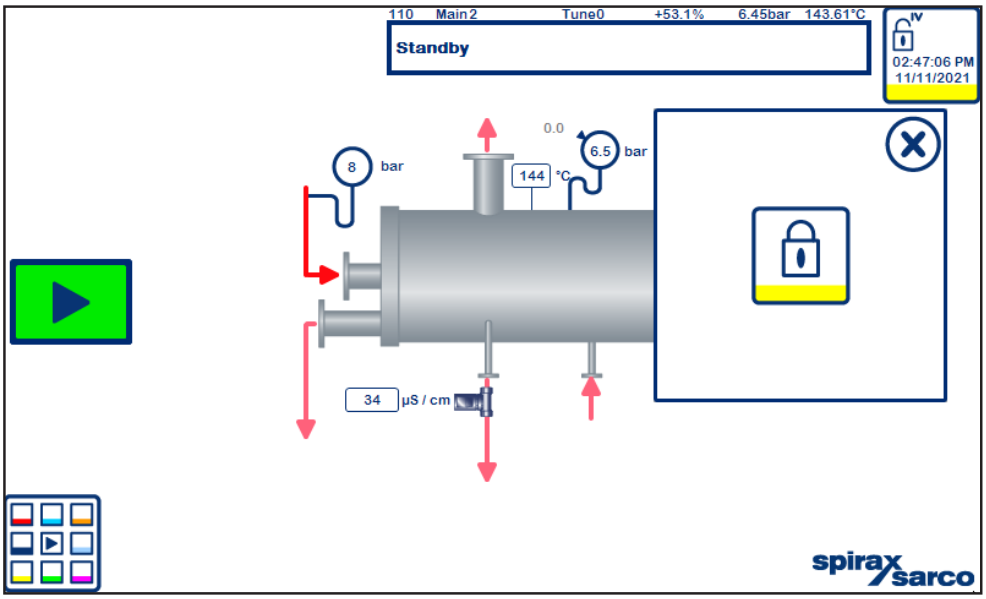
Scaling (770) allows alteration of the 4-20 mA input scaling and the input smoothing of FA01 and LA11 (only available in standby mode).



System configuration (780)



Factory reset (790) allows users to save, load and reset the current settings and configuration of the CSG-FBHP. (only available in standby mode)



Security screen (800), allows users to logoff from the current user.

11. Appendix

The torquing procedure should follow the steps detailed in this Appendix.

There are two types of gaskets used on the CSG-FBHP.

PTFE gaskets are used on feedwater and clean steam circuits.

Graphite gaskets are used on plant steam and condensate return lines.

11.1 Torquing procedure:

- If fitting a graphite gasket, lubricate the bolt threads and the nut faces with a suitable lubricant
- If fitting a PTFE gasket, apply a suitable high temperature thread-locking compound (above 200 °C) to the bolt threads
- Insert the bolts through the flanges
- Finger tighten the nuts
- Number all the bolts so that torquing requirements can be followed

11.1.1 For graphite gaskets:

- Apply torque in 20%, 1/5 steps of required final torque, loading all bolts at each step before proceeding to the next step
- Use rotational tightening until all bolts are stable at final torque level

	ANSI 150		ANSI 300		PN16		PN40	
	Bolt Size	Graphite	Bolt Size	Graphite	Bolt Size	Graphite	Bolt Size	Graphite
½" (DN15)	½"	64	½"	64	M12	53	M12	53
¾" (DN20)	½"	81	5/8"	85	M12	53	M12	53
1" (DN25)	½"	81	5/8"	122	M12	53	M12	53
1¼" (DN32)	½"	81	5/8"	142	M16	131	M16	131
1 ½" (DN40)	½"	81	¾"	230	M16	131	M16	131
2" (DN50)	⅝"	81	5/8"	153	M16	131	M16	131
2½" (DN65)	⅝"	163	¾"	198	M16	131	M16	131
3" (DN80)	⅝"	163	¾"	271	M16	131	M16	131
4" (DN100)	⅝"	163	¾"	271	M16	131	M20	255
5" (DN125)	¾"	217	¾"	271	M16	131	M24	441
6" (DN150)	¾"	271	¾"	271	M20	255	M24	441
8" (DN200)	¾"	271	⅞"	434	M20	255	M27	647

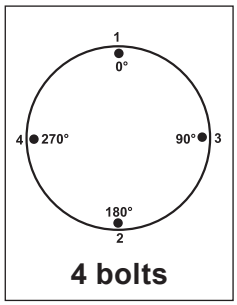
Torque values in Nm for Graphite gaskets.
Note – gaskets as per original spare parts.

11.1.2 For PTFE gaskets:

- Use the same rotational tightening technique as per the graphite gaskets
- Due to the nature of PTFE gaskets, torquing is not possible. Instead, the PTFE gasket will start to compress as the nut is tightened.
- Tighten each nut so that a degree of compression on the gasket has been observed
- Do not continue to overtighten the nuts as this will over-compress the gasket

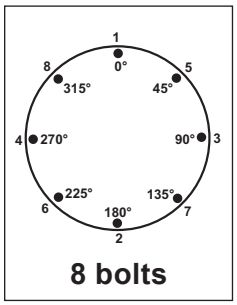
During operation of the CSG-FBHP, thermal expansion in the flanges may cause the nuts to loosen. It is good practice to regularly check the nuts and retighten as required.

Note – PTFE gaskets should not be reused if the flange has been disassembled. PTFE can never be disposed of in incinerators. See section 1.16 Disposal for correct disposal of PTFE gaskets.



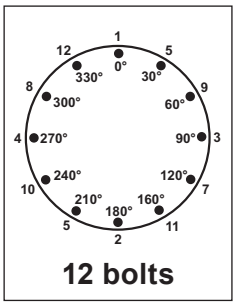
4 bolts

Sequential Order	Rotational Order
1-2	1
3-4	3
	2
	4



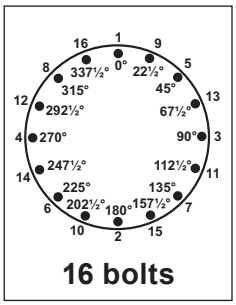
8 bolts

Sequential Order	Rotational Order
1-2	1
3-4	5
5-6	3
7-8	7
	2
	6
	4
	8



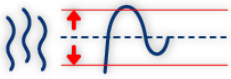
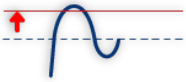
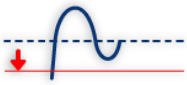
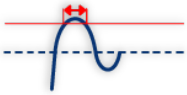
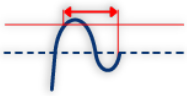
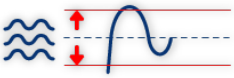
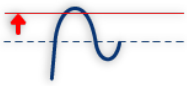
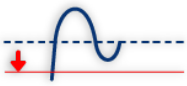
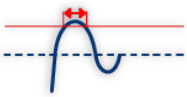
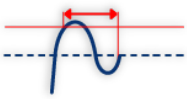
12 bolts

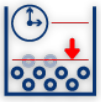
Sequential Order	Rotational Order
1-2	1
3-4	5
5-6	9
7-8	3
9-10	7
11-12	11
	2
	6
	10
	4
	8
	12



16 bolts

Sequential Order	Rotational Order
1-2	1
3-4	9
5-6	5
7-8	13
9-10	3
11-12	11
13-14	7
15-16	15
	2
	10
	6
	14
	4
	12
	8
	16

	Setting	Units	Lower limit	Upper limit	Default	Setting
	**Alarm settings**					
	**Clean steam pressure band alarm**					
	**High band**	%	1.0	10.0	10.0	
	**Low band**	%	1.0	10.0	10.0	
	**Alert time**	sec	1	30	10	
	**Alarm time**	sec	30	180	30	
	**Water level band alarm**					
	**High band**	%	1.0	10.0	10.0	
	**Low band**	%	1.0	10.0	10.0	
	**Alert time**	sec	1	30	10	
	**Alarm time**	sec	30	180	30	

	Setting	Units	Lower limit	Upper limit	Default	Setting
	**Clean steam control capacity alarm**					
	**Alert time**	sec	1	60	30	
	**Alarm time**	sec	1	60	60	
	**Water level control capacity alarm**					
	**Alert time**	sec	1	60	30	
	**Alarm time**	sec	1	60	60	
	**TDS alarm**					
	**TDS high time**	sec	0	600	600	
	**Hysteresis time**	sec	0	600	600	

	Setting	Units	Lower limit	Upper limit	Default	Setting
	**Trap Diagnostics**					
	**Trap fail open temperature difference**	°C			15.0	
	**Trap fail closed temperature**	°C			15.0	
	**Maximum water level valve opening**	sec	0.0	20.0	5.0	
	**Maximum clean steam valve opening**	sec	0.0	20.0	10.0	

	Setting	Units	Lower limit	Upper limit	Default	Setting
	**Process settings**					
	Main process (FB-S and FB-F)					
	**Clean steam pressure**	bar	1.0	6.0	1.0	
	**Water level**	%	60	80	70	
	**Ramp up time**	min	2	10	5	
	**Ramp down time**	min	2	10	5	
	**Timed shut-down**	time	00:00	23:59	disabled	
	Main process (FB-O and FB-W)					
	**Clean steam pressure**	bar	1.0	10.0	1.0	
	**Water level**	%	56	80	68	
	**Ramp up time**	min	2	10	5	
	**Ramp down time**	min	2	10	5	
	**Timed shut-down**	time	00:00	23:59	disabled	

	Setting	Units	Lower limit	Upper limit	Default	Setting
	**Clean Steam PID**					
	Proportional gain	-	1.0		2.0	
	Integral gain	-	0.0		1.0	
	Derivative gain	-	0.0		0.0	
	**Water level PID**					
	Proportional gain	-	1.0		10.0	
	Integral gain	-	0.0		45.0	
	Derivative gain	-	0.0		0.0	
	Pump pressure	∆bar	0.5	2.0	1.0	
	**TDS (Interval only)**					
	**Interval time**	sec	5.00		28.00	
	**Duration time**	sec	0.00		2.00	
	(FB-S minimum 5% of interval time)					
	**TDS (CP10)**					
	**Interval time**	sec	5.00		28.00	
	**Duration time**	sec	0.00		2.00	
	(FB-S minimum 5% of interval time)					
	**TDS setpoint**	µS	10.0		35.0	
	**Hysteresis band**	µS	0.001	20.000	0.100	

	Setting	Units	Lower limit	Upper limit	Default	Setting
	**TDS (CP32)**					
	**Interval time**	sec	5.00		28.00	
	**Duration time**	sec	0.00		2.00	
	**TDS setpoint**	µS	10.0		35.0	
	**Hysteresis band**	µS	0.001	20.000	0.100	
	**Forward Controls**					
	High Demand drop	%	5.00	20.00	10.00	
	Level SP rise	%			10	
	Low Demand rate		0.00	1.00	0.10	
	Pressure SP drop	%			10	
	Demand duration	sec	1	10	5	
	Demand enable time	sec	1	60	10	
	**Integrity test**				**Enable**	
	Integrity test duration	sec			60	
	Pressure drop limit	%	-100	-1	-2	
	Pressure rise limit	%	100	1	2	

	Setting	Units	Lower limit	Upper limit	Default	Setting
	Performance Monitoring Settings					
	Flow stable band	%			10.00	
	Flow stable time	sec			5	
	Performance ratio fault tolerance	%			0.1	
	Performance ratio sample limit time	hrs			100	
	Sample time pulse	sec			1	
4-20mA	**4-20mA (FB-S and FB-F)**					
	FA01 4mA	L/min			48.80	
	FA01 20mA	L/min			1450.0	
	PA01 4mA	bar			0.00	
	PA01 20mA	bar			10.0	
	PA21 4mA	bar			0.00	
	PA21 20mA	bar			10.0	
	PA31 4mA	bar			0.00	
	PA31 20mA	bar			10.0	
	CA11 4mA	µS			0.0	
	CA11 20mA	µS			100.0	
	LA11 4mA (Viscorol)	%			0.0	
	LA11 20mA (Viscorol)	%			100.0	
	LA11 4mA (LP20)	%			16.7	
	LA11 20mA (LP20)	%			83.3	
	FA01 Feedwater flow smoothing				Enable	
	FA01 smothing interval	0.2sec			2	
	FA01 smothing samples				10	
	LA11 Water level smoothing				Disable	
	LA11 smothing interval	0.2sec			1	
	LA11 smothing samples				2	

	Setting	Units	Lower limit	Upper limit	Default	Setting
	**4-20mA (FB-O and FB-W)**					
	FA01 4mA	L/min			48.80	
	FA01 20mA	L/min			1450.0	
	PA01 4mA	bar			0.00	
	PA01 20mA	bar			16.0	
	PA21 4mA	bar			0.00	
	PA21 20mA	bar			16.0	
	PA31 4mA	bar			0.00	
	PA31 20mA	bar			16.0	
	CA11 4mA	µS			0.0	
	CA11 20mA	µS			100.0	
	LA11 4mA	%			43.0	
	LA11 20mA	%			100.0	
	FA01 Feedwater flow smoothing				Enable	
	FA01 smothing interval	0.2sec			2	
	FA01 smothing samples				10	
	LA11 Water level smoothing				Disable	
	LA11 smothing interval	0.2sec			1	
	LA11 smothing samples				2	
	**Configuration**					
	Water setpoint delta select				Enable	
	Warmup pressure check				Enable	
	(Disable for FB-O and FB-W)					
	VB31 warm	%			10.0	
	Pressure SP minimum	bar	0.0	10.0	1.0	
	Pressure SP maximum	bar	0.0	10.0	6.0	
	(10.0 for FB-O and FB-W)					
	Atmospheric Pressure	barA			1.013	
	VB01 minimum opening	%			5	

Service

For technical assistance contact our nearest Office or Agency or contact directly:

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Warranty

Ascertained partial or complete non-compliance with these regulations will result in forfeiture of the related warranty.