Installation & Maintenance Manual

BBCS
Boiler Blowdown Control System
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**PLEASE NOTE** - Throughout this manual this cautionary symbol is used to describe a potential damage or injury that might occur if the safety considerations are overlooked. This symbol denotes CAUTION, WARNING or DANGER.
1. Preface:

This manual is intended for anyone using, commissioning, servicing, or disposing the below mentioned products safely and efficiently.

**BBCS – Boiler Blowdown Control System**

2. Important Safety Notes:

Read this section carefully before installing/operating/maintaining the product. The precautions listed in this manual are provided for personnel and equipment safety. Furthermore, Forbes Marshall accepts no responsibility for accidents or damage occurring as a result of failure to observe these precautions. Note that the product is designed to perform for non-contaminated fluids only. A contamination in the form of chemical, foreign particle etc. can lead to problem with product performance and life of the product.

If these products in compliance with the operating instructions are, properly installed, commissioned, maintained and installed by qualified personnel (refer Section 2.7) the safety operations of these products can be guaranteed. General instructions for proper use of tools and safety of equipments, pipeline and plant construction must also be complied with.

This product is designed and constructed to withstand the forces encountered during normal use. This product is not intended to withstand any other external stresses induced due to other connecting systems. User is advised to consider the same & do the needful to minimise these stresses.

Use of the product for any purpose other than as intended use could cause damage to the product and may cause injury or fatality to the personnel.

Before installation or maintenance, always ensure that all primary steam and condensate return lines and water lines are isolated. Ensure any residual internal pressure in the system on connecting pipe work is carefully relieved.

This system is designed and constructed to the specific parameters. To achieve the best results from this system ensure that the parameters are adhered to.

**WARNING:** Do not install the BBCS outdoors without additional weather protection

**Lifting:** During transportation, the BBCS system should be lifted using Bottom Blowdown Line with Manual Blowdown only and not using any other components or top piping of the system. The system must be placed in position and securely bolted to the mating flanges in blowdown line.

**Note:** Sufficient space should be provided around the system to have proper access for maintenance.

2.1 Intended use:

i. Check if the product is suitable for intended use/ application by referring to the installation and maintenance instructions, name plates and technical information sheets.

ii. The product is suitable for use as defined in the technical information sheet.

iii. Check for the suitability in conformance to the limiting conditions specified in technical information sheet of the product.

iv. The correct installation and direction of fluid flow has to be determined.

v. Forbes Marshall products are not intended to resist external stresses, hence necessary precautions to be taken to minimize the same.
2.2 Accessibility and Lighting:
Safe accessibility and working conditions are to be ensured prior to working on the product.

2.3 Hazardous environment and media:
The product has to be protected from hazardous environment and check to ensure that no hazardous liquids or gases pass through the product.

2.4 Depressurizing of systems and normalizing of temperature:
Ensure isolation and safety venting of any pressure to the atmospheric pressure. Even if the pressure gauge indicates zero, do not make an assumption that the system has been depressurized. To avoid danger of burns allow temperature to normalize after isolation.

2.5 Tools and consumables:
Ensure you have appropriate tools and / or consumables available before starting the work. Use of original Forbes Marshall replacement parts is recommended.

2.6 Protective clothing:
Consider for the requirement of any protective clothing for you/ or others in the vicinity for protection against hazards of temperature (high or low), chemicals, radiation, dangers to eyes and face, noise and falling objects.

2.7 Permits to work:
All work to be carried out under supervision of a competent person. Training should be imparted to operating personnel on correct usage of product as per Installation and Maintenance instruction. “Permit to work” to be complied with (wherever applicable), in case of absence of this system a responsible person should have complete information and knowledge on what work is going on and where required, arrange to have an assistant with his primary goal and responsibility being safety. “Warning Notices” should be posted wherever necessary.

2.8 Handling:
There is a risk of injury if heavy products are handled manually. Analyze the risk and use appropriate handling method by taking into consideration the task, individual, the working environment and the load.

2.9 Freezing:
Provision should be made to protect systems which are not self-draining, against frost damage (in environment where they may be exposed to temperatures below freezing point) to be made.

2.10 Product Disposal:
It is necessary to dispose this product only in accordance with local regulations at the authorized, qualified collecting point specified for equipment’s and its parts—Please refer the part details mentioned in the material table of this manual. Please follow all waste disposal guidelines (Management & Handling) as published by local governing authorities in India & abroad

2.11 Returning products:
Customers and Stockiest are reminded that, when returning products to Forbes Marshall they must provide information on any hazards and the precautions to be taken due to contamination residues or mechanical damage which may present a health, safety or environmental risk. This information must be provided in writing including Health and Safety data sheets relating to any substances identified as hazardous or potentially hazardous.

3. Brief Product Information

3.1 General Information
The feed water used in the boilers contains varying levels of impurities that must be removed to protect the boiler and associated equipments. Various pretreatment processes such as reverse osmosis, ion exchange, filtration, softening and demineralization may be used to reduce the level of impurities, but even the best pretreatment processes will not remove them all and will continuously carry some dissolved mineral impurities into the boiler.

As steam generates, it leaves behind impurities in the boiler water, which will concentrate unless we remove them. The increasing concentration of dissolved solids leads to carryover of boiler water into the steam, damaging piping, steam traps and other process equipment. This boiler problem can be avoided by periodically discharging or “blowing down” water from the boiler to reduce the concentrations of suspended and total dissolved solids. While control of suspended and dissolved solids in the boiler is critical, care must be taken to avoid excessive blowdown, as this would increase the demand for make-up (feed) water, treatment chemicals and fuel.

Forbes Marshall Boiler Blowdown Control System (BBCS) is designed to maintain the boiler water TDS within the limits specified by the boiler manufacturer.
Features and Benefits:
- Reduced operating costs (less feed water consumption; chemical treatment and higher heating efficiency)
- Reduced maintenance and repair costs (minimized carryover and deposits)
- Cleaner and more efficient steam
- Minimize energy loss from boiler blowdown
- Compact and complete boiler blowdown control solution
- High quality components requiring low maintenance

3.2 Core components of BBCS
- High Temperature Conductivity Sensor (HTCS) with built-in Temperature Sensor. (Cell Constant K=1)
- Sensor Chamber
- 4-Core Shielded Cable for BBCS Sensor
- BBCS 485 Controller
- Boiler Blowdown Control Piping System comprises of following –
  1. Isolation Valves,
  2. “Y” Strainer,
  3. Sample Collection Point,
  4. Sensor Chamber,
  5. Pneumatically Operated On-off Blowdown Valve
  6. Manual Blowdown Valve
  7. Forbes Marshall everSENSE (optional extra)

Note: For additional information about any particular components used in this system, refer the relevant product specific technical information sheet (TIS).

3.3 Pressure and Temperature Limits:
Mechanical:
- Maximum Operating Pressure: 31 Kg/cm²(g)
- Maximum Operating Temperature: 238 °C
- Cold Hydraulic Test Pressure: 47 Kg/cm²(g)
- Minimum Operating Temperature: 0 °C
- Instrument Air Supply: 4 to 6 Kg/cm²(g)

Electrical:
- Power Supply: 110 or 230 VAC (+10%, -15%) 50/60 Hz (Factory set)

Measurement:
- TDS Range: 700 to 7000 ppm, Resolution: 10 ppm
- Temperature Range: 0 to 250 °C, Resolution: 0.1 °C

3.4 Materials:

<table>
<thead>
<tr>
<th>Item</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Temperature Conductivity Sensor (HTCS K=1)</td>
<td>SS316L</td>
</tr>
<tr>
<td>Sensor Chamber</td>
<td>ASTM A182 Gr. F304</td>
</tr>
<tr>
<td>BBCS 485 Controller</td>
<td>Die-cast Aluminum with powder coating</td>
</tr>
</tbody>
</table>
| Sensor Cable | 4-Core PTFE Isolated/SPC Shielded/PTFE Jacketed Cable [Length: 5 meter (default) / 10 meter (optional extra)]
| | [30 meter (optional extra for Effimax)]
| | Specify cable length in Order |
| “Y” Strainer with 0.8mm SS perforation screen | ASTM A216 Gr. WCB |
| Isolation Valves | Ball Valve: ASTM A105 (Non-Gujarat Area) Piston Valve: ASTM A105 (For Gujarat Area) |
| Pneumatically Actuated On-Off Valve with 230VAC/50Hz Solenoid Valve & AFR | Ball Valve: ASTM A105 (Non-Gujarat Area) FM Globe Valve: ASTM A216 Gr. WCB (For Gujarat Area) |
| Manual Blowdown Valve | ASTM A216 Gr. WCB |
### 3.5 BBCS Sizes:
BBCS piping set with BBCS 485 Controller, Sensor HTCS K=1, Sensor Cable & Manual Blowdown Valve:

<table>
<thead>
<tr>
<th>Size</th>
<th>Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN25</td>
<td>DN25 Boiler Bottom Blowdown piping with Manual Blowdown Valve &amp; DN15 Top Piping with On-Off Ball Valve</td>
<td>Non-Gujarat Area</td>
</tr>
<tr>
<td>DN40</td>
<td>DN40 Boiler Bottom Blowdown piping with Manual Blowdown Valve &amp; DN15 Top Piping with On-Off Ball Valve</td>
<td>Gujarat Area</td>
</tr>
<tr>
<td>DN50</td>
<td>DN50 Boiler Bottom Blowdown piping with Manual Blowdown Valve &amp; DN15 Top Piping with On-Off Ball Valve</td>
<td></td>
</tr>
<tr>
<td>DN25</td>
<td>DN25 Boiler Bottom Blowdown piping with Manual Blowdown Valve &amp; DN15 Top Piping with On-Off Globe Valve</td>
<td></td>
</tr>
<tr>
<td>DN40</td>
<td>DN40 Boiler Bottom Blowdown piping with Manual Blowdown Valve &amp; DN15 Top Piping with On-Off Globe Valve</td>
<td></td>
</tr>
<tr>
<td>DN50</td>
<td>DN50 Boiler Bottom Blowdown piping with Manual Blowdown Valve &amp; DN15 Top Piping with On-Off Globe Valve</td>
<td></td>
</tr>
</tbody>
</table>

### 3.6 Battery Limit End Connections:

| BBCS Bottom Blowdown Piping Inlet & Outlet - DN25, DN40, DN50 | Flanged end as per ASME B16.5, #300, SWRF | Flange Material - ASTM A105 |

### 3.7 Overall Dimensions & Weight:

<table>
<thead>
<tr>
<th>BBCS Size</th>
<th>Overall Dimensions, mm (Approx)</th>
<th>Weight (Approx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBCS with On-off Ball Valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN25</td>
<td>650 L x 700 W x 700 H</td>
<td>45 kg</td>
</tr>
<tr>
<td>DN40</td>
<td>750 L x 700 W x 700 H</td>
<td>60 kg</td>
</tr>
<tr>
<td>DN50</td>
<td>750 L x 800 W x 700 H</td>
<td>65 kg</td>
</tr>
<tr>
<td>BBCS with On-off Globe Valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN25</td>
<td>885 L x 700 W x 1300 H</td>
<td>70 kg</td>
</tr>
<tr>
<td>DN40</td>
<td>935 L x 700 W x 1300 H</td>
<td>85 kg</td>
</tr>
<tr>
<td>DN50</td>
<td>935 L x 800 W x 1300 H</td>
<td>90 kg</td>
</tr>
</tbody>
</table>
4. **Product Working Principle**

The BBCS Sensor measures the electrical conductivity of the boiler water which is directly related to the level of total dissolved solids (TDS). The conductivity of the boiler water is compared with the Set Point in the BBCS 485 controller. If it is lower than the Set Point, the On-off blowdown valve in BBCS top piping closes at the end of the purge time and remains closed till next purge. If the conductivity is higher than the Set Point, the On-off blowdown valve will open for preset blowdown time & closes at the end of blowdown time. This Purging, Measurement & blowdown cycle is repeated until the conductivity level drops below the Set Point.

5. **Installation Guidelines**

*Note*: Before starting any installations observe the “Important Safety notes” in section 2. Referring to the Installation and Maintenance Instructions, name-plate and Technical Information Sheet, check that the product is suitable for the intended installation.

**WARNING**: Boiler must be depressurized and vented to atmosphere before installation of the BBCS.

5.1 **Boiler Bottom Blowdown Line Connections**

All connecting pipe work should always be free from external stresses & adequately supported.

Forbes Marshall BBCS unit must not be operated above the maximum pressure & temperature of boiler blowdown water indicated on system general arrangement drawing / product nameplate.

Connect the Inlet & Outlet boiler blowdown line as indicated in respective general arrangement drawing for to BBCS unit.

5.2 **BBCS Sensor Installation**

Fit the sensor chamber in a horizontal pipeline with suitable isolation valves to facilitate inspection/cleaning of the sensors. Process flow must be in the direction of arrow marked on sensor chamber. **The sensor must be fitted in vertical direction with sensor head upwards.** The sensor is supplied with a gasket for sealing between sensor & sensor chamber

- Do not install the sensor outdoors without additional weather protection
- Do not install the sensor in inverted/horizontal position
- Fit the sensor to the sensor chamber by gripping it across flat provided on sensor for spanner only. Do not apply torque to sensor aluminium head or extension piece with cooling fins to fit sensor to sensor chamber
- Ensure that sensor cable is not exposed to a temperature greater than 120°C

5.3 **Air Supply**

Connect instrument air supply at 4 to 6 kg/cm²(g) to Air Filter Regulator mounted on On-off blowdown valve.

5.4 **Electrical Connections**

a) **Connecting the signal and power cables :**

**DANGER!** Cables may only be connected when the power is switched off.

**WARNING!** Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

b) **Power supply**

Power supply given to BBCS 485 controller should be strictly as indicated on wiring diagram provided in BBCS 485 Controllers.

Check for the correct supply voltage printed on the label fitted on side of BBCS 485 Controller.

All electrical wiring and connections should be carried out in accordance with National regulations and Standards.

**CAUTION!**

- Ensure that firm Earth is provided to BBCS 485 controller
- While replacing the fuse, switch off the mains power supply.
c) Signal Cable
It is mandatory to use Forbes Marshall BBCS Sensor Cable only, supplied along with BBCS unit to connect the BBCS Sensor to BBCS 485 controller.

Length of BBCS Sensor cable is limited to 5 meters. In special case it can be 10 meters max. Maintain distance between the BBCS sensor & BBCS 485 controller accordingly. Forbes Marshall BBCS sensor cable available in Length 5 meter as Standard & 10 meter as optional. Sensor cable length must be specified in Purchase order.

Refer detailed instructions for all power & signal cabling, provided in the separate documentation - BBCS 485 Controller User Manual

INFORMATION! The power supply cable & cable for connecting solenoid valve on On-off blowdown valve to BBCS 485 controller are not part of the scope of delivery.

6. Startup and Commissioning

6.1 Precautions

Ensure that all connections are properly made and that all valves are closed.

Use gasket in between all flange joints and tighten all the Nut / Bolts with Spanner to ensure the leak proof flange joint.

Being steam systems it is very important that the pressure is built up slowly to avoid possible damage to any sensitive equipment

6.2 Flushing of lines:

As part of pre-installation all fluid handling equipment particularly piping should be thoroughly cleaned of scale and the internal debris which accumulates during fabrication.

This is accomplished by blowing or flushing with air, steam, water and other suitable medium.

Note: For a detailed procedure on flushing of lines, please visit Forbes Marshall website.

6.3 Commissioning procedure:

Set the air supply to On-off blowdown valve at 4 kg/cm² (g) by using AFR.

Ensure that all power supply & signal connections are secure and as per installation drawing.

To ensure free movement of the On-off blowdown valve stem, an initial valve stroke check should be carried out by using manual override on solenoid valve fitted to actuator.

Open the Manual blowdown valve in boiler bottom blowdown line for 10-15 seconds to flush the boiler bottom blowdown line & close it.

Ensure that isolating valve in sample collection line is closed.

Open the isolating valve on the downstream of On-off blowdown valve in BBCS Top piping & then gradually open the upstream isolating valve.

Open the On-off blowdown valve by using manual override on solenoid valve fitted to actuator & ensure that blowdown water flows thru Top piping of BBCS unit.

Check for any leakage in BBCS piping.

If blowdown water circulation is okay, switch on the power supply to the BBCS 485 Controller.

When BBCS 485 Controller is powered on, the FM logo is displayed for few seconds. The Unit then enters the RUN mode.

Refer detailed instructions for Controller configuration, settings, Sensor calibration, etc provided in the separate documentation - BBCS 485 Controller User Manual
Forbes Marshall would strongly recommend that only a suitably trained controls engineer should perform controller settings & Sensor calibrations.

On completion of BBCS Controller settings & Sensor calibrations, check that purge cycle, measurement cycle, blowdown cycle happens correctly as per the parameters set in the BBCS 485 controller.

Sample collection from sampling line in BBCS Top piping to be done by well trained boiler operator only. Isolation valve should be opened very slowly & carefully.

Use personal safety devices suitable for high temperature & high pressure, since there is danger of burns that could be caused by hot blowdown water at boiler pressure.

7. Maintenance Guidelines

Warning: Read Section 2 - Important Safety information, before proceeding for any maintenance work

Note: For a detailed maintenance procedure for each product of the BBCS, please refer to the user manuals of the respective product.

7.1 Precautions

Before undertaking any maintenance on the BBCS, it must be isolated and any pressure should be allowed to safely normalize to atmosphere. The unit should then be allowed to cool. With suitable isolation, repairs can be carried out with the BBCS in the line.

When re-assembling, make sure that all joint faces are clean. Once completed open isolation valves slowly and check for leaks.

7.2 BBCS Sensor Maintenance

We recommend that the sensor is removed for cleaning & inspection at least once in three months, though the actual frequency of maintenance will depend on the quality of boiler water.

Ensure that strainer fitted before sensor chamber in blowdown controller system is cleaned at least once in a week

- Isolate & depressurize the system, ensure that blowdown water is cooled before sensor is removed
- Inspect male & female threads for signs of damage, which may have occurred due to over tightening, leading to torn threads or even localized cold welding (galling). If damage is seen, replace the sensor.
- If there is no damage to the threads is seen, proceed to clean the sensor tip with fine wet-or-dry emery paper.
- Inspect the sensor tip, sensor body & insulator for erosion, damage or pitting and refit or replace it.
- Retighten the Sensor to Sensor Chamber. Always fit with new gasket

7.3 Routine and Preventive Maintenance:

Note: Frequency of cleaning & inspection will depend on the quality of blowdown water, which varies from area to area. Below mentioned frequency for checking various parameters are just for guidelines.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>PARAMETERS TO BE CHECKED</th>
<th>FREQUENCY FOR CHECKING VARIOUS PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Daily</td>
</tr>
<tr>
<td>1</td>
<td>Visual inspection for leakages</td>
<td>Y</td>
</tr>
<tr>
<td>2</td>
<td>Cleaning of Strainer in BBCS top piping</td>
<td>Y</td>
</tr>
<tr>
<td>3</td>
<td>BBCS sensor in-line calibration</td>
<td>Y</td>
</tr>
<tr>
<td>6</td>
<td>Manually Operate the Piston Valves/Ball Valves</td>
<td>Y</td>
</tr>
<tr>
<td>7</td>
<td>Lubrication of piston valves</td>
<td>Y</td>
</tr>
<tr>
<td>8</td>
<td>Visual inspection &amp; cleaning of threads on piston valve stem</td>
<td>Y</td>
</tr>
<tr>
<td>9</td>
<td>Clean BBCS Sensor</td>
<td>Y</td>
</tr>
<tr>
<td>10</td>
<td>Clean BBCS Sensor Chamber</td>
<td>Y</td>
</tr>
</tbody>
</table>
7.4 Tool Kit:

<table>
<thead>
<tr>
<th>Component</th>
<th>Tool</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBCS Sensor</td>
<td>Open ended spanner</td>
<td>27 mm A/F</td>
</tr>
<tr>
<td>Strainer Cap</td>
<td>Open ended spanner</td>
<td>25 mm A/F</td>
</tr>
</tbody>
</table>

7.5 In addition to the preventive maintenance, follow the points below to keep the system in best working condition:

a. Strainer must be cleaned from time to time.
b. Correct material handling and lifting equipment's should be used.
c. Handling and warning must be carried out by expert personnel or all activities must be supervised and checked.
d. Remove flanges cover if present.
e. The interior of valve and piping line must be free from foreign particles.
f. Note installation position with reference to flow, see mark on each item.
g. Lay pipelines such that damaging transverse, bending and torsion forces are avoided.
h. Protect system components from dirt during construction work
i. Connection flanges must mate exactly.
j. Connecting bolts for pipe flanges should be mounted preferably from the counter flange side (Hexagon nuts from the component side)

8. Troubleshooting

If the expected performance is unachievable after installation of the Strainer, check the following points for appropriate corrective measures.

<table>
<thead>
<tr>
<th>Failure Mode</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>No flow through BBCS Top piping</td>
<td>Top piping inlet/outlet manual ball valves/piston valves are closed.</td>
<td>Open the outlet Ball valve/piston valve &amp; then gradually open the inlet Ball valve/piston valve</td>
</tr>
<tr>
<td>Blowdown water leakage from strainer cap</td>
<td>Strainer cap gasket deterioration or damage.</td>
<td>Replace with new gasket and tighten the cap to the recommended torque</td>
</tr>
<tr>
<td>Blowdown water leakage from flanged Joints</td>
<td>Flange Joint gasket deterioration or damage or loose flange bolting.</td>
<td>Replace with new gasket and tighten the flange end connections with proper torque</td>
</tr>
<tr>
<td>Blowdown water leakage from end connections of threaded end items</td>
<td>End connection is not tight.</td>
<td>Tighten the threaded end of items with proper torque</td>
</tr>
<tr>
<td>Blowdown water leakage from BBCS sensor &amp; Sensor chamber threaded Joint.</td>
<td>BBCS Sensor connection is not tight.</td>
<td>Tighten the BBCS Sensor to Sensor chamber by gripping it across flat provided sensor for spanners only.</td>
</tr>
<tr>
<td>On-off blowdown valve in top piping is not operating</td>
<td>No air supply or air supply pressure is less than 4 kg/cm²(g) for Solenoid valve on actuator of On-off blowdown valve</td>
<td>Ensure that Air supply is available in range of 4 to 6 kg/cm²(g)</td>
</tr>
<tr>
<td></td>
<td>No power signal from BBCS Controller to Solenoid valve on actuator of On-off blowdown valve</td>
<td>Check if valve fuse link in BBCS controller is intact.</td>
</tr>
</tbody>
</table>

Notes:

- For detailed troubleshooting of each product of the BBCS, please refer to the installation & maintenance manual of the respective product.
- Never attempt to modify the product. When replacing old part with new part, use the spare parts listed in section 9.
9. **Available Spares**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Spares Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SPARE-BBCS-CTR</td>
<td>BBCS 485 CONTROLLER</td>
</tr>
<tr>
<td>2</td>
<td>SPARE-BBCS-C5M</td>
<td>BBCS SENSOR CABLE - 5 MTR</td>
</tr>
<tr>
<td>3</td>
<td>SPARE-BBCS-C10M</td>
<td>BBCS SENSOR CABLE - 10 MTR</td>
</tr>
<tr>
<td>4</td>
<td>SPARE-BBCS-C30M</td>
<td>BBCS SENSOR CABLE - 30 MTR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(For use with Effimax only)</td>
</tr>
<tr>
<td>5</td>
<td>SPARE-BBCS-SENCH</td>
<td>BBCS SENSOR CHAMBER</td>
</tr>
<tr>
<td>6</td>
<td>SPARE-BBCS-SENSR</td>
<td>BBCS HIGH TEMPERATURE CONDUCTIVITY SENSOR (HTCS K=1)</td>
</tr>
<tr>
<td>7</td>
<td>SPARE-BBCS-BV</td>
<td>DN15 BALL VALVE</td>
</tr>
<tr>
<td>8</td>
<td>SPARE-BBCS-ACT</td>
<td>ACTUATOR FOR DN15 BALL VALVE</td>
</tr>
<tr>
<td>9</td>
<td>SPARE-BBCS-BVACT</td>
<td>DN15 BALL VALVE WITH ACTUATOR ASSLY</td>
</tr>
<tr>
<td>10</td>
<td>SPARE-BBCS-ARCA</td>
<td>DN15 FM GLOBE VALVE WITH ACTUATOR (Gujarat Area)</td>
</tr>
<tr>
<td>11</td>
<td>SPARE-BBCSSENSR-GKIT</td>
<td>BBCS SENSOR GASKET PACK OF 3</td>
</tr>
</tbody>
</table>

10. **Warranty Period**

As per ordering information and agreements in the contract.