System Description and Operation Overview

TAB 4A

SGA

HEAT RECOVERY STEAM GENERATOR

April 2003

Contents

System Description for Heat Recovery Steam Generator

1.0 System Description

1.1 System Identification

System Name	Heat Recovery Steam Generator
System Code	SGA

1.2 Function

The function of the Heat Recovery Steam Generator System is to transfer heat from the combustion turbine exhaust gases over the heat recovery steam generator (HRSG) heating surfaces to the water or steam piped through those surfaces to produce superheated steam. This heat transfer process produces the main steam, intermediate-pressure steam, reheat steam, and low-pressure steam at the pressures and temperatures required by the steam turbine.

1.3 General Description

Two HRSGs are provided; one each dedicated per combustion turbine. For a description of the HRSGs, refer to the HRSG MANUFACTURER'S technical description included in Appendix A.

Equipment locations are shown on the Arrangement Drawings. Schematic representations of the system are shown on the Piping and Instrument Diagrams.

The system parameters for the Heat Recovery Steam Generator System are summarized in the HRSG MANUFACTURER'S technical description included in Appendix A.

2.0 Component Description

2.1 HRSGs

2.1.1 Component Designations

The HRSGs have the following component designations:

1SGA-HRSG-101 Heat Recovery Steam Generator 1.

1SGA-HRSG-201 Heat Recovery Steam Generator 2.

2.1.2 Description

For a description of the HRSGs, refer to the HRSG MANUFACTURER'S technical description included in Appendix A.

2.1.3 Design

Refer to the HRSG MANUFACTURER'S technical description included in Appendix A for HRSG design parameters.

2.2 SCR System Equipment

2.4.1 Component Designation

The SCR system equipment has the following component designations:

1SGA-SKD-101--Ammonia Vaporization Skid 101.

1SGA-SKD-201--Ammonia Vaporization Skid 201.

2.4.2 Description

For a description of the SCR system equipment, refer to the HRSG MANUFACTURER'S Instruction Manual.

2.4.3 Design

Refer to the technical description included in the HRSG MANUFACTURER'S Instruction Manual for the SCR system equipment design parameters.

3.0 Controls and Instrumentation

3.1 Major Equipment Controls and Power Supplies

Control of the Heat Recovery Steam Generator System is provided by the Distributed Control System (DCS) through the graphic operator interface stations located in the control room. Control is normally automatic, but manual control of several system components can be accomplished from the operator interface stations.

The electrical one-line diagrams referenced in Section 6.0 show the electrical power supplies for the system equipment.

3.2 Alarms and Instrumentation

1) Alarms generated by the Heat Recovery Steam Generator System are annunciated in the control room and displayed on the DCS graphic operator interface stations.

2) IP steam flow is measured by a flow element and flow transmitter (FT-103/203) and is displayed on the DCS graphic operator interface stations.

3) Reheat steam desuperheater spray flow is measured by a flow element (FE-102/202) and flow transmitter (FT-102/202) and is displayed on the DCS graphic operator interface stations.

4) HP steam desuperheater spray flow is measured by a flow element (FE-101/201) and flow transmitter (FT-101/201) and is displayed on the DCS graphic operator interface stations.

5) Each drum level transmitter is pressure compensated by individual pressure transmitters. The median IP drum level is selected to provide control signals to other control loops (feedwater supply, blowdown, etc.). Deviation alarms are developed should any of the three compensated levels signals vary significantly from the selected value. When any of the level signals is shown to be bade quality (from either the level transmitter or the pressure transmitter) and the median is selected, the control system shall automatically transfer control to the average of the remaining two good signals. If two level signals are bad quality, the control system shall automatically transfer control to the remaining good signal. Any of the three level signals, if good quality, may be selected for control instead of the median value; transfer of control from one signal to another shall be rate limited to avoid process upsets. Indication and alarming of bad quality shall be provided for each transmitter.

6) HP drum level is measured by level transmitters (LT-101A/201A, LT-101B/201B, and LT-101C/201C) and is displayed on the DCS graphic operator interface stations. Alarms and control signals are provided for various specific levels within the HRSG LP drums. Alarms and control points (referenced to normal level of 90 mm above the drum centerline) are:

High level (HHH)	>6.9 IN	Close HP Feedwater shutoff valve Trip steam turbine
High level (HH)	>4.9 IN	Pre alarm
High level (H)	>3 IN	Open HP drum intermittent blowdown Alarm
Low level (L)	<-3 IN	Close HP drum intermittent blowdown Alarm
Low level (LL)	<29.7 IN	Startup level
Low level (LLL)	<31.7 IN	Trip combustion turbine

7) IP drum level is measured by level transmitters (LT-111A/211A, LT-111B/211B, and LT-111C/211C) and is displayed on the DCS graphic operator interface stations. Alarms and control signals are provided for various specified levels within the HRSG LP drums. Alarms and control points (referenced to normal level of 13.2 IN above the drum centerline) are:

High level (HHH)	>6.9 IN	Close condensate shutoff valve Trip steam turbine
High level (HH)	>4.9 IN	Pre alarm
High level (H)	>3 IN	Open LP drum intermittent blowdown Alarm
Low level (L)	<-3 IN	Close LP drum intermittent blowdown Alarm
Low level (LL)	<-33.2 IN	Startup level
Low level (LLL)	<41.1 IN	Trip feedwater pump turbine Trip combustion turbine

8) LP drum level is measured by level transmitters (LT-121A/221A, LT-121B/221B, and LT-121C/221C) and is displayed on the DCS graphic operator interface stations. Alarms and control signals are provided for various specific levels within the HRSG LP drums. Alarms and control points (referenced to normal level of 90 mm below the drum centerline) are:

High level (HHH)	>6.9 IN	Close IP feedwater shutoff valve Trip steam turbine
High level (HH)	>4.9 IN	Pre alarm
High level (H)	>3 IN	Open IP drum intermittent blowdown Alarm
Low level (L)	<-3 IN	Close IP drum intermittent blowdown Alarm
Low level	<-28.7 IN	pre-alarm
Low level (LL)	<-29.7 IN	Startup level
Low level (LLL)	<-31.7 IN	Trip feedwater pump Trip combustion turbine

9) HRSG duct gas pressure drop across the catalyst is measured by pressure transmitters (PT-131/231) and is displayed on the DCS graphic operator interface stations. The pressure drop is alarmed in the DCS when it exceeds 2 inches of water.

10) HRSG inlet duct gas pressure is measured by pressure transmitters (PT-131/231) and is displayed on the DCS graphic operator interface stations. The outlet pressure is alarmed in the DCS when it exceeds the set point, and the combustion turbine is tripped when it exceeds the set point.

11) HP drum pressure is measured by pressure transmitters (PT-101A/201A, PT-101B/201B, and PT-101C/201C) and is displayed on the DCS graphic operator interface stations. High pressure is alarmed in the DCS when the pressure rises above 1,972 psig.

12) HP superheater outlet pressure is measured by pressure transmitters (PT-106/206) and is displayed on the DCS graphic operator interface stations.

13) HP feedwater pressure is measured by pressure transmitters (PT-102/202) and is displayed on the DCS graphic operator interface stations.

14) IP drum pressure is measured by pressure transmitters (PT-111A/211A, PT-111B/211B, and PT-111C/211C) and is displayed on the DCS graphic operator interface stations. High pressure is alarmed in the DCS when the pressure rises above 464 psig.

15) Reheater outlet pressure is measured by pressure transmitters (PT-110/210) and is displayed on the DCS graphic operator interface stations. High pressure is alarmed in the DCS when the pressure rises above 390 psig.

16) IP steam pressure is measured by pressure transmitters (PT-115/215) and is displayed on the DCS graphic operator interface stations. High pressure is alarmed in the DCS when the pressure rises above 435 psig.

17) IP feedwater pressure is measured by pressure transmitters (PT-112/212) and is displayed on the DCS graphic operator interface stations.

18) LP drum pressure is measured by pressure transmitters (PT-121A/221A, PT-121A/221B, and PT-121C/221C) and is displayed on the DCS graphic operator interface stations. High pressure is alarmed in the DCS when the pressure rises above 116 psig.

19) LP superheater outlet pressure is measured by pressure transmitters (PT-125/225) and is displayed on the DCS graphic operator interface stations. High pressure is alarmed in the DCS when the pressure rises above 109 psig.

20) Condensate pressure is measured by pressure transmitters (PT-122/222) and is displayed on the DCS graphic operator interface stations.

21) HRSG duct gas temperature is measured by thermocouples (TE-130A/230A through 130D/230D, 131A/231A through 131D/231D, 132A/232A through 132D/232D, 134A/234A through 134D/234D, 135A/235A through 135D/235D, 136A/236A through 136D/236D, and 137A/237A through 137D/237D) and displayed on the DCS graphic operator interface stations.

22) HP drum metal temperature is measured by temperature elements (TE-101A/201A through TE-101D/201D) and is displayed on the DCS graphic operator interface stations. High differential temperature between the drum metal interior and exterior temperatures opens the HP startup vent valve.

23) HP superheater outlet temperature is measured by temperature elements (TE-106/206) and is displayed on the DCS graphic operator interface stations. High temperature is alarmed in the DCS when the temperature rises above 1,065° F.

24) HP superheater desuperheater inlet and outlet temperatures are measured by temperature elements (inlet: TE-104A/204A and 104B/204B and outlet: TE-105A/205A and TE-105B/205B) and are displayed on the DCS graphic operator interface stations.

25) HP economizer inlet and outlet temperatures are measured by temperature elements (inlet: TE-102/202 and outlet: TE-103/203) and are displayed on the DCS graphic operator interface stations.

26) Reheater inlet and outlet temperatures are measured by temperature elements (inlet: TE-108A/208A and 108B/208B and outlet: TE-110/210) and are displayed on the DCS graphic operator interface stations. High temperature is alarmed in the DCS when the outlet temperature rises above 1,065° F.

27) IP steam temperature is measured by temperature elements (TE-115/215) and is displayed on the DCS graphic operator interface stations.

28) Reheater desuperheater inlet and outlet temperatures are measured by temperature elements (inlet: TE-108A/208A and TE-108B/208B and outlet: TE-109A/209A and TE-109B/209B) and are displayed on the DCS graphic operator interface stations.

29) IP economizer inlet and outlet temperatures are measured by temperature elements (inlet: TE-112/212 and outlet: TE-113/213) and are displayed on the DCS graphic operator interface stations.

30) LP superheater outlet temperature is measured by temperature elements (TE-125/225) and is displayed on the DCS graphic operator interface stations.

31) LP economizer inlet and outlet temperatures are measured by temperature elements (inlet: TE-124/224 and outlet: TE-127/227) and are displayed on the DCS graphic operator interface stations.

32) The superheated HP steam temperature control valve (ACV-1705/2705) will be automatically controlled to maintain superheated HP steam temperature. This valve controls the spray water flow to the HP steam desuperheater that is located in the HRSG HP steam path between HP Superheater 2 and HP Superheater 3.

33) The superheated reheat steam temperature control valve (ACV-1501/2501) will be automatically controlled to maintain superheated reheat steam temperature. This valve controls the spray water flow to the hot reheat steam desuperheater that is located in the HRSG hot reheat steam path between Reheat Superheater 1 and Reheat Superheater 2.

3.3 Automatic Protection

To protect system equipment, actions are automatically taken if certain system components malfunction. The operator cannot intervene to cancel these actions because of system design. Protective actions include the following:

Overload and Short-Circuit Protection--The scanner air blowers and stack dampers will trip on motor overload or short circuit. The motors for motoroperated valves will trip on motor overload or short circuit. All miscellaneous small power loads will trip on overload or short circuit.

Control Valve Operator Failure--The system control valves fail in the positions indicated on the P&ID if the valve operator fails due to loss of control air or signal.

Turbine Water Induction Protection--Instrumentation and interlocks are provided in the Heat Recovery Steam Generator System to isolate the steam turbine from possible sources of water.

4.0 System Operation

4.1 Normal Operation

All components of the Heat Recovery Steam Generator System are controlled through the DCS Depictions of the DCS graphics for the Heat Recovery Steam Generator System are shown on Figures 9A-1 through 9A-6.

4.1.1 HRSGs

Prior to startup of the HRSG, the prerequisites listed in Section 5.2 and the HRSG MANUFACTURER'S Instruction Manual must be satisfied. The operator must configure the steam and water valves as required for startup before starting the combustion turbine/HRSG. The operator must confirm that the HRSG drums are at startup water level (SWL). If the drums are not at SWL, the operator must follow HRSG MANUFACTURER'S's filling instructions in the Instruction Manual. The HRSG vents and drains must be opened in accordance with the manufacturer's requirements by operator action from the DCS operator interface stations.

Upon satisfaction of all prerequisites, the HRSG can be put into service by starting the combustion turbine. Refer to the combustion turbine instruction manual provided by SWPC and the Combustion Turbine (TGK) and Combustion Turbine Control and Instrumentation (TGN) System Descriptions.

4.2 Abnormal Operation

4.3 Integrated Unit Operation

4.3.1 Normal Unit Startup

Prior to starting the combustion turbine/HRSG, the following equipment/systems must be in service. One condensate pump must be running to supply condensate to the LP drum, economizers, and LP bypass desuperheaters. One boiler feed pump per HRSG must be running to supply HP feedwater to the HP drum economizer, the HP steam attemperator, the main steam bypass desuperheater, and to supply IP feedwater to the IP drum, economizer the reheat steam bypass desuperheater, turbine ventilator line desuperheater, and the reheater attemperator. The steam generated in the HRSG will initially be dumped to the condenser, so the condenser must be available with vacuum established. The associated blowdown tank in the Boiler Vents and Drains System (SGF) must be ready for service. The Main Steam System (SGG), Reheat Steam System (SGJ), and Low-Pressure Steam System (SGL) must be ready to receive steam. The drain valves in these systems should be open to drain condensate to the condenser as the piping is warmed.

Upon satisfaction of all prerequisites, the HRSG can be put into service by starting the combustion turbine. Refer to the combustion turbine instruction manual provided by SWPC and the following system descriptions: Boiler Feed (FWA), Condensate (FWC), Boiler Vents and Drains (SGF), Main Steam (SGG), Reheat Steam (SGJ), Low-Pressure Steam (SGL), Combustion Turbine (TGK), and Combustion Turbine Control and Instrumentation (TGN).

4.3.2 Normal Unit Shutdown

The HRSG must remain in service as long as the combustion turbine is operating and steam turbine generation is required. The HRSG can be taken out of service by reducing load on the combustion turbine and eventually stopping the combustion turbine. As the combustion turbine load is reduced, HRSG steam generation and steam turbine load will also be reduced. The steam turbine will eventually trip, causing main steam to be bypassed to the cold reheat system, hot reheat steam to be bypassed to the condenser, and LP steam to be bypassed to the condenser. Once the HRSG stops generating steam, the HRSG can be taken out of service. Refer to the combustion turbine instruction manual provided by SWPC, the steam turbine instruction manual from MHI, and the following system descriptions: Condensate (FWC), Main Steam (SGG), Reheat Steam (SGJ), Low-Pressure Steam (SGL), Steam Turbine (TGA), Steam Turbine Control and Instrumentation (TGF), Combustion Turbine (TGK), and Combustion Turbine Control and Instrumentation (TGN).

4.3.3 Unit Trip Shutdown

During a unit trip or a combustion turbine trip, the HRSG will remain in service as long as the HRSG is generating steam. The steam generated in the HRSG will be bypassed to the condenser. Once the HRSG stops generating steam, the HRSG can be taken out of service. During a steam turbine trip, the HRSG will remain in service by bypassing all the steam to the condenser. The HRSG can remain in bypass mode until the steam turbine is restarted. If a long-term steam turbine shutdown is anticipated, the HRSG can be taken out of service as described in Article 4.3.2.

5.0 System Operating Instructions Startup Prerequisites

5.1 Purpose

This operating instruction describes the procedures required to prepare the Heat Recovery Steam Generator System for operation. The procedures required to operate the Heat Recovery Steam Generator System are included in Section 4.0.

5.2 Prerequisites

1) Valve startup positions verified.
2) AC power supply systems ready to support operation of the Heat Recovery Steam Generator System.
3) Main Steam System (SGG) ready to support operation of the Heat Recovery Steam Generator System.
4) Reheat Steam System (SGJ) ready to support operation of the Heat Recovery Steam Generator System.
5) Low-Pressure Steam System (SGL) ready to support operation of the Heat Recovery Steam Generator System.
6) Ammonia Storage and Supply System (CGE) ready to support operation of the Heat Recovery Steam Generator System.
7) Boiler Vents and Drains System (SGF) ready to support operation of the Heat Recovery Steam Generator System.
8) Steam Turbine System (TGA) ready to support operation of the Heat Recovery Steam Generator System.
9) Combustion Turbine System (TGK) ready to support operation of the Heat Recovery Steam Generator System.
10) Condenser Air Extraction System (HRB) in service.
11) Circulating Water System (HRC) in service.
12) Boiler Feed System (FWA) in service.
13) Condensate System (FWC) in service.
14) Cycle Chemical Feed System (FWE) in service.

15) Continuous Emissions Monitoring System (SAA) in service.

16) Steam Cycle Sampling and Analysis System (SAC) in service.

17) Compresed Air System (CAA) in service.

18) DCIS in service.

19) Freeze Protection System previously in service (if required by ambient temperature conditions).

20) All instruments need to be functional prior to startup of the Heat Recovery Steam Generator System.

5.3 Precautions

Familiarity with the Heat Recovery Steam Generator System components and controls is essential for safe operation and protection of the equipment. The following instruction books should be reviewed before operating system:

HRSG MANUFACTURER'S Instruction Manual for HRSGs and accessories.

6.0 Reference Materials

6.1 Manufacturer's Document Reference

The following lists major equipment procurement contracts and their scope. Manufacturer's drawings and instruction manuals are filed under that contract number:

Contract xx.xxxx--HRSG MANUFACTURER’S:

Furnishing HRSGs and accessories.

6.2 Design Document Reference

Piping and Instrument Diagrams (P&IDs):

See HRSG MANUFACTURER’S P&IDs.

Arrangement Drawings:

1BSA-M1001A.

1BSA-M1001B.

2BSA-M1001A.

BSA-M1001B.

Electrical One-Line Diagrams:

CAPC-E1211.

CAPC-E1212.

Electrical Schematic Diagrams:

-1SGA-K2000 Series