

Appendix E8: Unit Design Data – Combined Cycle Units and Block Design Data (Voluntary Reporting)

Note: The NERC Board of Trustees approved the *GADS Task Force Report* ([dated July 20, 2011](#))¹, which states that design data collection outside the required nine fields is solely voluntary. However, the GADS staff encourages reporters to report and update GADS design data frequently. This action can be completed by sending in this form to gads@nerc.net. GADS staff encourages using the software for design entry and updating.

Instructions

Submit the data in this section once during the life of each combined cycle/block unit. If a major change is made to a unit which significantly changes its characteristics, then resubmit this section with updated information.

For coded entries, enter a (9) to indicate an alternative other than those specified, and whenever a (9) is entered, write the column number and the answer on the reverse side of the form.

If submitting a copy of the original form, make sure that it is legible.

Unit name: _____

Energy Information

Administration (EIA) Number: _____

Subregion: _____

Telephone number: _____

Location of unit (State): _____

Regional Entity: _____

Data reporter: _____

Date: _____

Here are some definitions used to eliminate some of the ambiguity concerning combined-cycle blocks.

- **Combined-Cycle Block (referred to here as a “Block”)** – By definition, a combined-cycle is a process for generating energy (either electricity or steam) constituted by the marriage of a Brayton Cycle (expand hot gas to turn a gas turbine) with a Rankine Cycle (use heat to boil water to make steam to turn a steam turbine). The combined-cycle block employs electric generating technology that produces electricity from otherwise lost waste heat exiting from one or more gas turbines/jet engines, one or more steam turbines, and balance of plant equipment supporting the production of electricity. In the combined-cycle block, the exiting heat is routed to a conventional boiler or to a heat-recovery steam generator (HRSG) for use by a steam turbine in the production of electricity or steam energy.

There may be more than one block at a plant site. Reporters should complete a form for each individual block.

- **Units** – Each gas turbine/jet engine and each steam turbine is considered a “unit.” Each unit contributes to the total electric generation or steam production of the block. Each unit has its own or shares its generator for providing electric power. They should be considered individual parts of the block.

¹ http://www.nerc.com/pa/RAPA/gads/MandatoryGADS/Revised_Final_Draft_GADSTF_Recommendation_Report.pdf

- Heat Recovery Steam Generator (HRSG) – There may be one or more HRSG or waste heat boilers in a block. Some blocks may have a single HRSG per GT/jet; others may have several GT/jets feeding a single HRSG or any combination thereof. The HRSG does not contribute electricity to the output of the block so is considered a component rather than a “unit.”
- Other Balance of Plant Equipment – There is other equipment in the block used to support the production of electricity/heat energy, but they are not related to any specific generating unit and are also considered components. Submit the data in this section once during the life of each block. If a major change is made to a site that significantly changes its characteristics, then resubmit this section with updated information.

General Block Identification

1. Identification

A series of codes uniquely identifies your utility (or company) and the block. NERC assigned a unique code to identify your company. You must assign a unique code that will identify the block being reported. This block code may be any number from 800 to 899. Enter the unique company and block codes and the full name of the entire block below:

Utility (Company) Codes: _____ Block Codes: _____

Name of Block, including site name _____

2. Date the Block Entered Service

The in-service date establishes the starting point for review of historical performance of the block. Starting dates of each unit may be different. Supply unit dates at the specified location on this form. Using the criteria described below, report the date the block entered service.

Year Month Day

Criteria:

- a. The date the block was first declared available for dispatch at some level of its capability, OR
- b. The date the block first operated at 50% of its generator nameplate megawatt capability (product of the megavolt amperes (MVA) and the rated power factor as stamped on the generator nameplate(s)).

3. Base Loading Characteristics at Time of Unit’s Design

_____ Enter the number from the list below that best describes the mode of operation the block was originally designed for

- 1 – Base loaded with minor load following at night and on weekends
- 2 – Periodic startups with daily load-following and reduced load nightly
- 3 – Weekly startup with daily load-following and reduced load nightly
- 4 – Daily startup with daily load-following and taken off-line nightly
- 5 – Startup chiefly to meet daily peaks
- 6 – Other, describe _____
- 7 – Seasonal Operation

4. Design and Construction Contractors

Identify both the architect/engineer and the general construction contractor responsible for the design and construction of the block. If your utility was the principal designer or general constructor, enter "SELF."

_____ Architect/Engineer
_____ Constructor

5. Total Nameplate Rating of all units in the block (in MW)

Enter the TOTAL capability (sum of all gas turbines/jet engines and steam turbines) MW nameplate or published MW rating of the block. In cases where the turbine's nameplate rating cannot be determined, approximate the rating by multiplying the MVA (megavolt amperes) by the rated power factor found on the nameplate affixed to each unit's generator (or nameplates in the case of cross compound units).

_____ Total block rating (MW) based on sum of nameplate ratings on all units (in XXXX.X format).

6. Does the block have co-generation (steam for other than electric generation) capabilities (yes/no)?

_____ 1 – Yes 2 – No

7. What is the number of gas turbines/jet engines per Heat Recovery Steam Generator (HRSG)?

Identify the number of gas turbines/jet engines feeding exhaust gases into a single HRSG:

8. What is the number of gas turbines/jet engines – Heat Recovery Steam Generator (HRSG) Trains

Identify the number of sets of gas turbines/jet engines and HRSG trains supplying steam to the steam turbine:

9. Total number of gas turbines/jet engines in block

Identify the number of GT/Jets used for generating power:

10. Total number of Heat Recovery Steam Generator (HRSG) in block

Identify the number of HRSG supplying steam to the steam turbine:

11. Total number of Steam Turbines in block

Identify the number of steam turbines receiving steam for generating power:

**For each Gas Turbine (GT) or Jet Engine (JE) complete items #12 to #65
(If you have 3 GT, then complete items #12-65 once for each GT.)**

Gas Turbine or Jet Engine Data

12. Identification

A series of codes uniquely identifies your utility (company), the combined-cycle block and its units. NERC assigned a unique code to identify your company. You must assign the unique code that will identify the GAS TURBINE/JET ENGINE unit being reported. This code may be any number from 300 to 399 or 700-799. Enter the unique company, block and unit code and the full name of each gas turbine/jet engine below:

Utility (Company) Codes: _____ Block Codes: _____

Name of unit _____

13. Date the gas turbine/jet engine Entered Service

The in-service date establishes the starting point for review of historical performance of each unit. Using the criteria described below, report the date this gas turbine/jet engine entered service.

Year	Month	Day
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Criteria:

- a. The date the block was first declared available for dispatch at some level of its capability, OR
- b. The date the block first operated at 50% of its generator nameplate megawatt capability (product of the megavolt amperes (MVA) and the rated power factor as stamped on the generator nameplate(s)).

14. Design and Construction Contractors

Identify both the architect/engineer and the general construction contractor responsible for the design and construction of the block. If your utility was the principal designer or general constructor, enter "SELF."

_____ Architect/Engineer

_____ Constructor

15. Gas turbine/jet engine nameplate rating in MW

The nameplate is the design capacity stamped on the gas turbines/jet engines or published on the guarantee flow diagram. In cases where the gas turbine's nameplate rating cannot be determined, approximate the rating by multiplying the MVA (megavolt amperes) by the rated power factor found on the nameplate affixed to each unit's generator (or nameplates in the case of cross compound units).

Gas turbine/jet engine rating (MW) (in XXXX.X format): _____

16. Engine Manufacturer - (1) Pratt & Whitney; (2) General Electric; (3) Westinghouse; (4) ABB Gas Turbine Power Division; (5) Rolls Royce; (6) Cooper Bessemer; (7) Worthington; (8) Allison; (9) Other, describe

17. **Engine type** – (1) Gas turbine single shaft; (2) Gas turbine split shaft; (3) Jet engine; (9) Other

18. **Expander turbines, number per unit if applicable:**

19. **Type expander**, if applicable – (1) Single flow; (2) Double flow

20. **Cycle type** – (1) Reheat; (2) Simple; (3) Regenerative; (4) Recuperative; (5) Intercooled; (6) Pre-cooled; (7) Complex; (8) Compound; (9) Other, describe

21. **Start-up system** – (1) Air; (2) Auxiliary motor; (3) Electric motor; (4) Natural gas; (5) Flow turbine; (6) Supercharging fan; (7) Hydraulic; (9) Other, describe

22. **Start-up type** – (1) Automatic, on site; (2) Automatic, remote; (9) Other, describe

23. **Type of Fuel(s) that will be used:**

Fuel Codes

BM	Biomass	OO	Oil
CC	Coal	OS	Other-Solid (Tons)
DI	Distillate Oil (No. 2)	PC	Petroleum Coke
GE	Geothermal	PE	Peat
GG	Gas	PR	Propane
JP	JP4 or JP5	SL	Sludge Gas
KE	Kerosene	SO	Solar
LI	Lignite	WA	Water
NU	Nuclear	WD	Wood
OG	Other-Gas (Cu. Ft.)	WH	Waste Heat
OL	Other-Liquid (BBL)	WM	Wind

24. **Enter (1) if sound attenuators located at inlet:**

25. **Enter (1) if sound attenuators located at outlet:**

26. **Enter (1) if sound attenuators located in building enclosures:**

27. **Time in seconds for normal cold start to full load:**

28. **Time in seconds for emergency cold start to full load:**

29. Black start capability

_____ 1 – Yes 2 – No

30. Engine Model Number (MS 7001EA, W501AA, FT4A11, etc.)

Gas Turbine Selective Non-Catalytic Reduction System (SNCR)

31. SNCR reagent – (1) Ammonia; (2) Urea; (9) Other, describe _____

32. SNCR injector type – (1) Wall nozzle; (2) Lance; (9) Other, describe _____

33. SNCR injection equipment location – (1) Furnace; (2) Super-heater; (3) Economizer; (9) Other, describe _____

34. Number of SNCR injectors _____

35. SNCR carrier gas type – (1) Steam; (2) Air; (9) Other, describe _____

36. SNCR carrier gas total flow rate (thousands of lbs./hr.) i.e. 6,000,000 lbs./hr. enter 6000 _____

37. SNCR carrier gas pressure at nozzle (psi) _____

38. SNCR carrier gas nozzle exit velocity (thousands of ft./sec.) _____

Gas Turbine Selective Catalytic Reduction System (SCR)

39. SCR reactor – (1) Separate; (2) In Duct _____

40. SCR reagent – (1) Ammonia; (2) Urea; (9) Other, describe _____

41. SCR ammonia injection grid location – (1) Furnace;(2) Super-heater; (3) Economizer; (4) Zoned _____

42. SCR duct configuration – (1) Flow straighteners; (2) Turning vanes; (3) Dampers _____

43. SCR Catalyst Element Type (1) Plate; (2) Honeycomb; (9) Other, describe _____

44. SCR catalyst support material – (1) Stainless steel; (2) Carbon steel; (9) Other, describe _____

45. SCR catalytic material configuration – (1) Vertical; (2) Horizontal; (9) Other, describe _____

46. SCR catalyst surface face area (thousands of square feet) _____

47. SCR catalyst volume (thousands of cubic feet) _____

48. Number of SCR catalytic layers _____

49. SCR catalytic layer thickness (1/1000 inches) _____

50. SCR sootblower type – (1) Air; (2) Steam; (3) Both

51. SCR sootblower manufacturer

Gas Turbine Catalytic Air Heaters (CAH)

52. CAH element type – (1) Laminar surface; (2) Turbulent surface; (9) Other, describe

53. CAH catalyst material – (1) Titanium oxide; (2) Vanadium pentoxide; (3) Iron (II) oxide; (4) Molybdenum oxide; (9) Other, describe

54. CAH catalyst support material – (1) Stainless steel; (2) Carbon steel; (9) Other, describe

55. CAH catalyst material configuration – (1) Horizontal air shaft; (2) Vertical air shaft

56. CAH catalyst material total face area (thousands of square feet)

57. CAH catalyst material open face area (thousands of square feet)

58. CAH catalyst material layer thickness (1/1000 inches)

For Electric Generator on Each GT/Jet Engine

59. Generator – Manufacturer

Enter the name of the manufacturer of the electric generator:

60. Number of generators per gas turbine/jet engine:

61. Generator – Enclosure

Is 50% or more of the generator outdoors (not enclosed in building framing and siding)? Yes/no:

62. Generator – Ratings and Power Factor

Enter the following information about the generator:

Design (Nameplate) Item	Main Generator	Second* Shaft	Third* Shaft
Voltage to nearest one-tenth kV	_____	_____	_____
Megavolt amperes (MVA) Capability	_____	_____	_____
RPM	_____	_____	_____
Power Factor (enter as %)	_____	_____	_____

*Cross compound units

63. Generator – Cooling System

Two types of cooling methods are typically used. First is the “inner cooled” method, where the cooling medium is in direct contact with the conductor copper or is separated by materials having little thermal resistance. The other is the “conventional” cooling method where the heat generated within the windings must flow through the major ground insulation before reaching the cooling medium.

Enter the type of cooling method used by the generator: _____

- 1 – Stator inner cooled and rotor inner cooled.
- 2 – Stator conventionally cooled and rotor conventionally cooled.
- 3 – Stator inner cooled and rotor conventionally cooled.
- 9 – *Other, describe* _____

Enter the mediums used to cool the generator’s stator (air, hydrogen, oil, water): _____

Enter the mediums used to cool the generator’s rotor (air, hydrogen, oil, water): _____

64. Generator – Hydrogen Pressure

Enter the generator hydrogen pressure IN PSIG at nameplate MVA (XX.X format): _____

65. Exciter – Configuration

Enter the following information about the main exciter:

Exciter manufacturer: _____

TOTAL number of exciters; include installed spares: _____

MINIMUM number of exciters required to obtain maximum capacity from the unit: _____

ENTER the type of main exciter used at the unit from the list below: _____

- 1 – *Static* – static excitation where D.C. is obtained by rectifying A.C. from generator terminals and D.C. is fed into rotor by collector rings.
- 2 – *Rotating D.C. generator* – exciter supplies D.C. from a commutator into the main rotor by means of collector rings.
- 3 – *Brushless* – an A.C. exciter (rotating armature type) whose output is rectified by a semiconductor device to provide excitation to an electric machine. The semiconductor device would be mounted on and rotate with the A.C. exciter armature.
- 4 – *Alternator rectifier*
- 9 – *Other, describe* _____

ENTER the type(s) of exciter drive(s) used by the main exciter IF it is rotating: _____

- 1 – Shaft direct

- 2 – Shaft gear
- 3 – Motor
- 9 – Other, describe _____

**For each Heat Recovery Steam Generator (HRSG) Complete items #66 to #87
(If you have 3 HRSGs, then complete items #66-87 once for each HRSG.)**

66. Enter the unit code information for each GT/Jet Engine that supplies heat energy to this single HRSG.

Utility (Company Code): _____ Unit Code "A": _____ Block Code: _____

Name of unit "A", including site name: _____

Utility (Company Code): _____ Unit Code "B": _____ Block Code: _____

Name of unit "B", including site name: _____

Utility (Company Code): _____ Unit Code "C": _____ Block Code: _____

Name of unit "C", including site name: _____

Utility (Company Code): _____ Unit Code "D": _____ Block Code: _____

Name of unit "D", including site name: _____

67. HRSG – Manufacturer

Enter the name of the manufacturer and the model or series name or number of the HRSG:

HRSG manufacturer: _____

HRSG model or series name/number: _____

68. HRSG – Enclosure

Is 50% or more of the HRSG outdoors (not enclosed in building framing and siding)? (Y/N): _____

69. HRSG – Nameplate Steam Conditions With Duct Burners

Enter the following steam conditions at the full load, valves-wide-open design point at the exit of the HRSG to the steam turbine when the HRSG is experiencing supplemental firing:

High Pressure

Steam flow rate (in lbs/hr): _____

Design temperature (°F): _____

Design pressure (psig): _____

Intermediate Pressure

Steam flow rate (in lbs/hr): _____

Design temperature (°F): _____

Design pressure (psig): _____

Low Pressure

Steam flow rate (in lbs/hr): _____
Design temperature (°F): _____
Design pressure (psig): _____

Reheat Pressure

Steam flow rate (in lbs/hr): _____
Design temperature (°F): _____
Design pressure (psig): _____

70. HRSG – Nameplate Steam Conditions Without Duct Burners

Enter the following steam conditions at the full load, valves-wide-open design point at the exit of the HRSG to the steam turbine when the HRSG is not experiencing supplemental firing:

High Pressure

Steam flow rate (in lbs/hr): _____
Design temperature (°F): _____
Design pressure (psig): _____

Intermediate Pressure

Steam flow rate (in lbs/hr): _____
Design temperature (°F): _____
Design pressure (psig): _____

Low Pressure

Steam flow rate (in lbs/hr): _____
Design temperature (°F): _____
Design pressure (psig): _____

Reheat Pressure

Steam flow rate (in lbs/hr): _____
Design temperature (°F): _____
Design pressure (psig): _____

71. Is the HRSG top-supported (pressure parts hang like in a utility boiler) or bottom-supported? _____

72. Does the HRSG have vertical or horizontal heat exchangers? _____

73. Is the duct insulation cold casing (insulation on the inside of the duct) or hot casing (insulation on the outside of the duct)? _____

74. HRSG Supplemental Firing (duct burners)

Does the HRSG have the capability of supplemental firing (duct firing) (y/n)? _____

Is the HRSG supplemental used “normally, as needed” or only in extreme emergency? _____

75. HRSG bypass capabilities

Does the HRSG have bypass capability? (y/n)? _____

76. Does the HRSG have a drum or is it a once-through design? _____

77. HRSG – Circulation System

Enter the following information on the pumps used to recirculate water through the HRSG:

HRSG recirculation pump(s) manufacturer(s): _____

TOTAL number of HRSG recirculation pumps; include installed spares: _____

MINIMUM number of HRSG recirculation pumps required to obtain maximum capacity from this HRSG: _____

Enter the type of HRSG recirculation pump(s) at the block: _____

- 1 – *Injection* (or injection seal) – controlled-leakage HRSG recirculation pumps mounted vertically with a rigid shaft designed to carry its own thrust.
- 2 – *Leakless* (or canned, canned-motor, or zero-leakage) – pump and its motor are an integral pressurized and sealed component.
- 9 – *Other, describe* _____

78. HRSG – Duct-Burner System (General)

Enter the following information on the duct burner systems installed for use by this HRSG:

Duct fuel burner(s) manufacturer(s): _____

TOTAL number of duct fuel burners: _____

79. HRSG – Duct-Burner Management System

Enter the name of the manufacturer of each of the following burner management systems:

Manufacturer of the combustion control system that coordinates the feedwater, air, and fuel subsystems for continuous HRSG operation:

Manufacturer of the burner management system that monitors only the fuel and air mixture during all phases of operation to prevent the formation of an explosive mixture:

80. Auxiliary Systems – Feedwater (HRSG Feed) Pumps

The feedwater (HRSG feed) pumps move the feedwater through the feedwater system into the HRSG. Enter the following information on the feedwater pumps installed at this HRSG:

Feedwater (HRSG feed) pump(s) manufacturer(s):

Normal operating speed (RPM) of the feedwater pumps: _____

TOTAL number of feedwater pumps. Include installed spares: _____

MINIMUM number of feedwater pumps required to obtain maximum capacity from the HRSG: _____

PERCENT (%) of the HRSG's maximum capacity that can be achieved with a single feedwater pump (XXX.X format): _____

81. Auxiliary Systems – Feedwater (HRSG Feed) Pump Drives

Manufacturer(s) of motor(s) or steam turbine(s) that drives the feedwater pump(s).

Enter the type of HRSG recirculation pump(s) at the block: _____

- | | |
|----------------------------|----------------|
| 1 – Motor – single speed | 5 – Shaft |
| 2 – Motor – two speed | 6 – Motor gear |
| 3 – Motor – variable speed | 7 – Steam gear |
| 4 – Steam turbine | 8 – Shaft gear |
| 9 – <i>Other, describe</i> | _____ |

Specify coupling type used for feedwater (HRSG feed) pump: _____

- | |
|----------------------------|
| 1 – Hydraulic |
| 2 – Mechanical |
| 9 – <i>Other, describe</i> |

82. Auxiliary Systems – Start-up Feedwater (HRSG Feed) Pumps

Start-up feedwater pump(s) manufacturer(s):

Manufacturer(s) of the motor(s) that drives the start-up feedwater pump(s):

PERCENT (%) of the HRSG's maximum capacity that can be achieved with a single Start-up feedwater pump (XXX.X format): _____

Indicate the additional capabilities of the start-up feedwater pump: _____

- | |
|---|
| 1 – ADDITIVE: operated in conjunction with the feedwater (HRSG feed) pumps. |
|---|

- 2 – REPLACEMENT: can carry load when the feedwater pumps are inoperative.
- 3 – START-UP only: cannot be used in lieu of the feedwater pumps.
- 9 – *Other, describe* _____

83. Auxiliary Systems – High-pressure Feedwater Heaters

High-pressure feedwater heaters are those heat exchangers between the feedwater (HRSG feed) pumps discharge and the economizer inlet. Enter the following information for the High-pressure feedwater heaters for this HRSG:

High-pressure feedwater heater(s) manufacturer(s):

TOTAL number of high-pressure feedwater heaters: _____

Feedwater heater tube materials used in 50% or more of the tubes: _____

Enter the type of high-pressure feedwater heater(s): _____

- 1 – Horizontal – longitudinal axis of the heater shell is horizontal.
- 2 – Vertical – longitudinal axis of the heater shell is vertical.
- 3 – Both
- 9 – *Other, describe* _____

84. Auxiliary Systems – Intermediate Pressure Feedwater Heaters

Intermediate-pressure feedwater heaters are those heat exchangers between the condensate booster pump discharge and the deaerator. Enter the following information for the intermediate pressure feedwater heaters for this HRSG:

Intermediate-pressure feedwater heater(s) manufacturer(s):

TOTAL number of intermediate-pressure feedwater heaters: _____

Feedwater heater tube materials used in 50% or more of the tubes: _____

Enter the type of INTERMEDIATE-pressure feedwater heater(s): _____

- 1 – Horizontal – longitudinal axis of the heater shell is horizontal.
- 2 – Vertical – longitudinal axis of the heater shell is vertical.
- 3 – Both
- 9 – *Other, describe* _____

85. Auxiliary Systems – Low Pressure Feedwater Heaters

Low-pressure feedwater heaters are those heat exchangers between the condensate pump discharge and the condensate booster pump inlet. If the HRSG does not have condensate booster pumps, the low-pressure feedwater heaters are located between the condensate pumps and the deaerator. Enter the following information for the Low-pressure feedwater heaters for this HRSG:

Low-pressure feedwater heater(s) manufacturer(s):

TOTAL number of low-pressure feedwater heaters: _____

Feedwater heater tube materials used in 50% or more of the tubes: _____

Enter the type of LOW-pressure feedwater heater(s): _____

- 1 – Horizontal – longitudinal axis of the heater shell is horizontal.
- 2 – Vertical – longitudinal axis of the heater shell is vertical.
- 3 – Both
- 9 – *Other, describe* _____

86. Auxiliary Systems – Deaerator Heater

Deaerator manufacturer(s):

Enter the type of deaerator heater(s): _____

- 1 – Spray – high-velocity stream jet atomizes and scrubs the condensate.
- 2 – Tray – series of trays over which the condensate passes and is deaerated.
- 3 – Vacuum – a vacuum condition inside the shell for deaeration.
- 4 – Combination
- 9 – *Other, describe* _____

87. Auxiliary Systems – Heater Drain Pumps

Heater drain pump(s) manufacturer(s):

Manufacturer(s) of the motor(s) that drives the heater drain pump(s):

**For each Steam Turbine (ST) Complete items #88 to #104
(If you have 3 ST, then complete items #88-104 once for each ST.)**

88. Identification

A series of codes uniquely identifies your company and generating units. NERC assigned a unique code to identify your company. You must assign the unique code that will identify the STEAM TURBINE unit being reported. This code may be any number from 100 to 199 or 600-649. Enter the unique company, block and generating-unit code and the full name of each steam turbine below:

Company Code: _____ Unit Code : _____ Block Code: _____

Name of unit “A”, including site name: _____

89. Does the steam turbine have bypass capability? (y/n) _____

90. Steam Turbine – Enclosure

Is 50% or more of the steam turbine outdoors (not enclosed in building framing and siding)? (Y/N)

91. Steam Turbine – Manufacturer

Enter the name of the manufacturer of the steam turbine:

92. Steam Turbine – Nameplate Rating in MW

Nameplate is the design capacity stamped on the steam turbine’s nameplate or published on the turbine guarantee flow diagram. In cases where the steam turbine’s nameplate rating cannot be determined, approximate the rating by multiplying the MVA (megavolt amperes) by the rated power factor found on the nameplate affixed to the unit’s generator (or nameplates in the case of cross compound units).

Steam turbine’s nameplate rating (MW) (in XXXX.X format): _____

93. Steam Turbine – Type of Steam Turbine

Identify the steam turbine’s casing or shaft arrangement.

Enter the type of steam turbine at the unit: _____

- 1 – *Single casing* – single (simple) turbine having one pressure casing (cylinder).
- 2 – *Tandem compound* – two or more casings coupled together in line.
- 3 – *Cross compound* – two cross-connected single casing or tandem compound turbine sets where the shafts are not in line.
- 4 – *Triple compound* – three cross-connected single casing or tandem compound turbine sets.
- 9 – *Other, describe* _____

94. Steam Turbine – Manufacturer’s Building Block or Design Codes

Steam turbine building blocks or manufacturer’s design codes are assigned by the manufacturer to designate a series of turbine designs, LM5000 or W501 for example. Enter the following information:

Manufacturer’s code, first shaft: _____

Manufacturer’s code, second shaft (cross or triple compound units): _____

Turbine configuration and number of exhaust flows (e.g., tandem compound, four flow): _____

95. Steam Turbine – Steam Conditions

Enter the following information on the Main, First Reheat, and Second Reheat Steam design conditions:

Main steam: Temperature (°F): _____ Pressure (psig): _____

First reheat steam: Temperature (°F): _____ Pressure (psig): _____

Second reheat steam: Temperature (°F): _____ Pressure (psig): _____

96. Steam Turbine – High, Intermediate, and Low-pressure Sections

Enter the following information describing various sections of the steam turbine:

High-Pressure Casings

TOTAL number of high pressure casings, cylinders or shells: _____

Back pressure of the high pressure condenser (if applicable) to the nearest one-tenth inch of mercury at the nameplate capacity and design water temperature. (XX.X format): _____

Combined High-pressure/Intermediate Pressure Casings

TOTAL number of high/intermediate-pressure casings, cylinders or shells: _____

Intermediate Pressure Casings

TOTAL number of intermediate-pressure casings, cylinders or shells: _____

Combined Intermediate/Low-pressure Casings

TOTAL number of intermediate/low-pressure casings, cylinders or shells: _____

Low-pressure Casings

TOTAL number of low-pressure casings, cylinders or shells: _____

Back pressure of the low pressure condenser to the nearest one-tenth inch of mercury at nameplate capacity and design water temperature. (XX.X format): _____

The last stage blade length (inches) of the low-pressure turbine, measured from hub to end of top of blade. (XX.X format): _____

97. Steam Turbine – Governing System

Enter the following information for the steam turbine governing system:

Enter the type of governing system used at the unit: _____

1 – *Partial arc* – main steam flow is restricted to one sector of the turbine’s first stage at start-up.

2 – *Full arc* – main steam is admitted to all sectors of the turbine’s first stage at start-up.

3 – *Either* – capable of admitting steam using either partial or full arc techniques.

9 – *Other, describe* _____

Enter the type of turbine governing system used at the unit: _____

- 1 – *Mechanical hydraulic control (MHC)* – turbine speed monitored and adjusted through mechanical and hydraulic linkages.
- 2 – *Analog electro-hydraulic control (EHC)* – analog signals control electro-hydraulic linkages to monitor and adjust turbine speed.
- 3 – *Digital electro-hydraulic control (DHC)* – same as EHC except signals are digital rather than analog.
- 9 – *Other, describe* _____

98. Steam Turbine – Lube Oil System

Enter the following information for the steam turbine main lube oil system:

Main lube oil system manufacturer:

Main lube oil pump(s) manufacturer:

Manufacturer of the motor(s)/steam turbine(s) that drives the main lube oil pump(s):

TOTAL number of steam turbine main lube oil pumps; include installed spares: _____

Enter the type of driver on the main lube oil pump: _____

- 1 – Motor
- 2 – Shaft
- 3 – Steam turbine
- 9 – *Other, describe* _____

FOR ELECTRIC GENERATOR ON A STEAM TURBINE

99. Generator – Manufacturer

Enter the name of the manufacturer of the electric generator:

Generator manufacturer:

100. Generator – Enclosure

Is 50% or more of the generator outdoors (not enclosed in building framing and siding)? (Y/N)

101. Generator – Ratings and Power Factor

Enter the following information about the generator:

Design (Nameplate) Item	Main Generator	Second* Shaft	Third* Shaft
Voltage to nearest one-tenth kV	_____	_____	_____
Megavolt amperes (MVA) Capability	_____	_____	_____
RPM	_____	_____	_____
Power Factor (enter as %)	_____	_____	_____

102. Generator – Cooling System

Two types of cooling methods are typically used. First is the “inner cooled” method, where the cooling medium is in direct contact with the conductor copper or is separated by materials having little thermal resistance. The other is the “conventional” cooling method where the heat generated within the windings must flow through the major ground insulation before reaching the cooling medium.

Enter the type of cooling method used by the generator: _____

- 1 – Stator inner cooled and rotor inner cooled.
- 2 – Stator conventionally cooled and rotor conventionally cooled.
- 3 – Stator inner cooled and rotor conventionally cooled.
- 9 – *Other, describe* _____

Enter the mediums used to cool the generator’s stator (air, hydrogen, oil, water): _____

Enter the mediums used to cool the generator’s rotor (air, hydrogen, oil, water): _____

103. Generator – Hydrogen Pressure

Enter the generator hydrogen pressure in PSIG at nameplate MVA (XX.X format): _____

Exciter for Each Steam Turbine Generator

104. Exciter – Configuration

Enter the following information about the main exciter:

Exciter manufacturer: _____

TOTAL number of exciters. Include installed spares: _____

MINIMUM number of exciters required to obtain maximum capacity from the unit: _____

Enter the type of main exciter used at the unit: _____

- 1 – *Static* – static excitation where D.C. is obtained by rectifying A.C. from generator terminals and D.C. is fed into rotor by collector rings.

- 2 – *Rotating D.C. generator* – exciter supplies D.C. from a commutator into the main rotor by means of collector rings.
- 3 – *Brushless* – an A.C. exciter (rotating armature type) whose output is rectified by a semiconductor device to provide excitation to an electric machine. The semiconductor device would be mounted on and rotate with the A.C. exciter armature.
- 4 – *Alternator rectifier*
- 9 – *Other, describe* _____

Enter the type(s) of exciter drive(s) used by the main exciter IF it is rotating: _____

- 1 – Shaft direct
- 2 – Shaft gear
- 3 – Motor
- 9 – *Other, describe* _____

Auxiliary Systems

105. Auxiliary Systems – Main Condenser

Enter the following information for the main condenser and its auxiliaries:

Main condenser manufacturer: _____

Type of condenser (water, air): _____

TOTAL number of passes made by the circulating water as it passes through the condenser: _____

TOTAL number of condenser shells: _____

Condenser tube materials used in the majority (50% or more) of the condenser tubes: _____

Air ejector(s) or vacuum pump(s) manufacturer: _____

Enter the type of air-removal equipment used on the condenser: _____

- 1 – Vacuum pump
- 2 – Steam jet air ejector
- 3 – Both
- 9 – *Other, describe* _____

Enter the type of cooling water used in the condenser: _____

- 1 – *Fresh* – salinity values less than 0.50 parts per thousand.
- 2 – *Brackish* – salinity values ranging from approximately 0.50 to 17 parts per thousand.
- 3 – *Salt* – salinity values greater than 17 parts per thousand.
- 9 – *Other, describe* _____

Enter the origin of the circulating water used in the condenser: _____

- 1 – River
- 2 – Lake
- 3 – Ocean or Bay
- 4 – Cooling Tower
- 9 – *Other, describe* _____

106. Auxiliary Systems – Condenser Cleaning System

Enter the following information about the ON-LINE main condenser cleaning system (leave blank if cleaning is manual):

On-line main condenser cleaning system manufacturer: _____

Enter the type of on-line main condenser cleaning system used at the unit: _____

- 1 – Ball sponge rubber
- 2 – Brushes
- 9 – *Other, describe* _____

107. Auxiliary Systems – Condensate Polishing System

A “condensate polisher” is an in-line demineralizer located in the condensate water system to treat water coming from the condenser to the HRSG. It is **not** the demineralizer that prepares raw or untreated water for eventual use in the steam production process.

Enter the following information about the condensate polishing system at the unit:

Condensate polishing system manufacture: _____

Enter the % of the condensate flow at maximum unit capacity that can be treated (XX.X format): _____

108. Auxiliary Systems – Condensate Pumps

Enter the following information for the main condensate pumps (those at the discharge of the condenser):

Condensate pump(s) manufacturer(s): _____

Manufacturer(s) of the motor(s) that drives the condensate pump(s): _____

TOTAL number of condensate pumps. Include installed spares: _____

MINIMUM number of condensate pumps required to obtain maximum capacity from the block: _____

109. Auxiliary Systems – Condensate Booster Pumps

Condensate booster pumps increase the pressure of the condensate water between the low-pressure and the intermediate or high-pressure feedwater heaters. Enter the following information for the condensate booster pumps:

Condensate booster pump(s) manufacturer(s): _____
 Manufacturer(s) of the motor(s) that drives the
 condensate booster pump(s): _____

TOTAL number of condensate booster pumps; include installed spares: _____

MINIMUM number of condensate booster pumps required for maximum capacity
 from the block: _____

110. Auxiliary Systems – Circulating Water Pumps

Enter the following information for the circulating water pumps:

Circulating water pump(s) manufacturer(s): _____
 Manufacturer(s) of the motor(s) that drives the
 circulating water pump(s): _____

TOTAL number of circulating water pumps; include installed spares: _____

MINIMUM number of circulating water pumps required to obtain maximum
 capacity from the block DURING WINTER SEASON. _____

111. Auxiliary Systems – Cooling Tower and Auxiliaries

Enter the following information for the cooling towers and all related auxiliary equipment at the block:

Cooling tower manufacturer(s): _____

Cooling tower fan(s) manufacturer(s): _____
 Manufacturer(s) of the motor(s) that
 drives the cooling tower fan(s): _____

Enter the type of cooling tower(s) used: _____

- 1 – *Mechanical draft* (induced, forced, cross-flow and counter-flow) – fan(s) used to move ambient air through the tower.
- 2 – *Atmospheric spray* – air movement is dependent on atmospheric conditions and the aspirating effect of the spray nozzles.
- 3 – *Hyperbolic* (natural draft) – temperature difference between condenser circulating water and ambient air conditions, aided by hyperbolic tower shape, creates natural draft of air through the tower to cool the water.
- 4 – *Deck-filled* – wetted surfaces such as tiers of splash bars or decks aid in the breakup and retention of water drops to increase the evaporation rate.
- 5 – *Coil shed* – a combination structure of a cooling tower installed over a substructure that houses atmospheric coils or sections.
- 9 – *Other, describe* _____

The cooling tower booster pumps increase the pressure of the circulating water and force the water to the top of the cooling tower.

Cooling tower booster pump(s)
 manufacturer(s): _____
 Manufacturer(s) of the motor(s) that drives the
 cooling tower booster pump(s): _____
 TOTAL number of cooling tower booster pumps; include installed spares: _____
 MINIMUM number of cooling tower booster pumps required to obtain maximum
 capacity from the block: _____

Balance of Plant

112. Balance of Plant – Main Transformer

The main transformer is the block step-up transformer connecting the generator (or multiple generators if block is cross compound) to the transmission system. Enter the following information for the MAIN transformer(s) at the block:

Main transformer(s) manufacturer(s): _____
 TOTAL number of main transformers; include installed spares: _____
 Megavolt ampere (MVA) size of the main transformer(s): _____
 HIGH SIDE voltage in kilovolts (kV) of the main transformer(s) at 55 °F: _____

Enter the type of MAIN transformer at the block: _____

- 1 – Single phase
- 2 – Three phase
- 9 – *Other, describe* _____

113. Balance of Plant – Block Auxiliary Transformer

The block auxiliary transformer supplies the auxiliaries when the block is synchronized. Enter the following information for this transformer:

Block auxiliary transformer(s) manufacturer(s): _____
 TOTAL number of block auxiliary transformer(s): _____
 LOW SIDE voltage in kilovolts (kV) of the block auxiliary transformer(s) at 55 °F: _____

114. Balance of Plant – Station Service Transformer

The station service (start-up) transformer supplies power from a station high-voltage bus to the station auxiliaries and also to the block auxiliaries during block start-up and shutdown. It also may be used when the block auxiliary transformer is not available or nonexistent.

Station service transformer(s) manufacturer(s): _____
 TOTAL number of station service transformer(s): _____
 HIGH SIDE voltage in kilovolts (kV) of the station service transformer(s) at 55 °F: _____
 LOW SIDE voltage in kilovolts (kV) of the station service transformer(s) at 55 °F: _____