NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

GADS Task Force

Design Sub-Group Final Report

to ensure
the reliability of the
bulk power system

October 8, 2010

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Scope

Purpose

The Generating Availability Data System (GADS) Task Force Design Sub-Group was tasked with reviewing and recommending whether Generation Owners on the NERC Compliance Registry should report GADS data on a mandatory basis, and to evaluate current design documents and make recommendations for additions, modifications or deletions to those documents.

Background

GADS Design Data is used heavily in filtering event and performance data results in pc-GAR and other GADS software products. It is also key in reliability assessment, loss-of-load expectations, and other models of generation performance. Without accurate design data, it is impossible to isolate peer units for benchmarking, goal setting, checking reliability of plant designs, monitoring generation aging, etc. As Design Data has not been reviewed or revised in several decades for the vast majority of reporting units, this sub-group's work will be vital in supporting grid reliability improvements.

Membership

The GADS Task Force Design Sub-Group was comprised of twelve members. Mike Curley and Ron Niebo represented NERC in the Design Group, and were available for consultation on an as-needed basis. The Design Sub-Group wishes to thank them for their invaluable insights during group discussions.

Governance

The GADS Task Force Design Sub-Group reports to the GADS Task Force Leadership as outlined in the GADS Task Force Scope and other founding documents. This report was provided to them for their consideration during the recent face-to-face meeting in Tucker, GA from September 30 to October 1, 2010.

Design Sub-Group Main Activities

1. Review GADS Design Data and determine what data currently collected is needed to support and improve Bulk Power System (BPS) reliability.

2. Review GADS Design Data and determine what data <u>not</u> currently collected is needed to support and improve BPS reliability.

3. Determine if collection of GADS Design Data identified above should be mandatory, in whole or in part, for Generation Owners on the NERC Compliance Registry.

4. Determine whether periodic reviews/ confirmations of GADS Design Data should be required for Generation Owners on the NERC Compliance Registry.

Discussions

GADS Reporting – Mandatory or Optional?

Discussion began with the topic of mandatory vs non-mandatory reporting of GADS data. Specifically, should Generation Owners/Operators on NERC's Compliance Registry report all, portions, or none of their data on a mandatory basis? There were a variety of opinions expressed by the group, summed up into two main camps/trains of thought.

- GADS reporting should be mandatory, as the most complete, accurate and timely reporting invariably seems to occur when that reporting is being mandated by regulatory agencies.
- GADS reporting should not be mandatory, as unknown/undesirable downstream events (e.g., compliance audits w/associated fines, penalties, etc.) could be implemented at some point in the future, despite best intentions not to do so.

The consensus view in the group was that reporting of GADS data should be mandatory, with enforcement in accordance with Section 1600, Requests for Data or Information, of the NERC Rules of Procedure. There were dissenting views within the group on this issue.

Following is a representative dissenting view on mandatory reporting:

> *"GADS should not be made mandatory. Requiring all generators to participate means that some type of enforcement mechanism must exist. Even if GADS is made mandatory under Section 1600, what keeps it from someday becoming a standard with all the associated fines and penalties? My company currently voluntarily reports for a large number of units (some as small as 2MW). Because we use GADS data for some compensation goals, we already have a number of compliance issues surrounding the data. We currently review all the event data and conduct more in-depth reviews to see that all events are reported. This can be an extremely large administrative burden. We do not need any additional oversight that may be required in the future. Opening the door with mandatory reporting could lead to a future burdensome data collection process and other unintended consequences. If the GADS participation problems are confined to certain regions, they need to be addressed by the regional reliability entity."*

Recommendation:

Reporting of GADS should be mandatory in order to ensure a complete data set, enhancing the statistical validity of any conclusions drawn from it. Enforcement should be in accordance with Section 1600 of the NERC Rules of Procedure, under which NERC cannot impose penalties for failure to comply with a request. Enforcement should not be through the Standards process.

- The committee's recommendation to make reporting to NERC GADS mandatory is based on the belief that NERC and/or FERC will not audit or review reporting for compliance – and that no fines/penalties will be levied.

- The reporting entity will determine the necessary level of data review and verification required to meet the NERC GADS reporting requirement.

If reporting of GADS data does become mandatory, reporting requirements should be specified based on a unit's size and connection to the bulk power grid. The criteria presented in NERC's "Statement of Compliance Registry Criteria" would be a logical starting point for discussion. Continued quarterly reporting of data is considered acceptable regardless of unit size.

Design Data Forms – Too Much Data?

Discussions occurred early on as to whether or not too much design data was being requested, regardless of whether reporting of GADS data was determined to be mandatory or optional. In general, it was agreed that many of the Design Data Forms request much more information than would reasonably be required to ensure grid reliability. To address this issue, two possible courses of action were discussed:

- Evaluate each form in order to determine which fields are necessary and which are not, and delete those fields deemed not necessary.
- Evaluate each form in order to determine which fields are necessary and which are not, and designate those fields deemed necessary as "mandatory" and those fields deemed not necessary as "optional".

Recommendation:

The consensus view in the group was that the latter option was the best solution. Based on this decision, the group reviewed and marked-up each Design Data Form included in Appendix E of the GADS Data Reporting Instructions to specify/designate each field as mandatory or optional. These mark-ups were submitted as part of the group's minutes, and have been consolidated and attached to this report.

Design Data Forms – Content and Accuracy

Discussions centered on two main questions: 1. Is the current printed content on these forms adequate as-is, or does the content need updated to eliminate old technologies, update current technologies and/or add new technologies? 2. Given that much of the current design data was submitted years – or even decades – ago, should periodic updates to the Design Data Forms be requested or required? If so, at what periodicity?

Regarding Question 1, it quickly became obvious that the printed content was out-of-date in many respects (e.g., some current equipment manufacturers are not listed, some listed equipment manufacturers are no longer in business, information for certain ancillary systems affecting performance (e.g., fogging, power augmentation) is not requested, etc.). Mike Curley indicated that a separate group was currently working the issue, and that any inputs provided by the group would be accepted for consideration. Representative comments have been included in marked-up Design Data Forms attached to this report.

Regarding Question 2, many group members agreed that any data previously submitted was likely out-of-date given equipment and plant changes completed over time (e.g., installation of dense packs, installation of SCR, FGD, etc.). In addition, design data updates have likely been "lost in the shuffle" during changes in plant ownership and/or plant management. The group determined that a periodic review of design data was a best-practice that should be encouraged and/or required.

Recommendation:

Design Data Forms are out of date, both in terms of content and currency. Design Data Forms should be updated to reflect current manufacturers, technologies, etc. For example, current Design Data Forms do not allow the specification of different manufacturers for different turbine sections. Design Data Forms should be modified to allow this differentiation.

Design Data Forms should be required to be reviewed and updated every 5 years, as a minimum. The first recommended update would be January 1, 2012, depending upon process timelines. It would be helpful if design data was available for review/modification on-line (similar to event and performance data) in order to minimize or eliminate paperwork burden.

NOTE: Team members recommend that submissions with blank fields not be allowed, as blank fields could easily be misinterpreted and facilitate erroneous equipment comparisons. The team recommends additional selections of "Not Applicable", "Non-Responsive" and "Don't Know".

Additional Discussion and Recommendations

General Topics

Q1: Should unit retirement dates be collected in order to complement/augment existing data being gathered on unit in-service dates?

A1: Team members recommend that Retirement Dates not be added to Design Data Forms due to the sensitive nature of that information. In any event, retirement dates are typically not known well in advance of actual retirement. Team members agreed, however, that Change of Ownership Dates should be added to Design Data Forms.

Q2: Should Regional Offices receive GADS data for the units within their regions for use in analyzing the reliability of those units?

A2: Team members recommend that Regional Offices should be allowed to receive GADS data for the units within their regions, so long as data confidentiality is maintained (i.e., so long as Regional Offices are held to the same confidentiality standards as NERC).

Q3: What is time impact of GADS data collection? If GADS were not mandatory, would your company collect the information anyway?

A3: The time impact of GADS data collection cannot be accurately quantified by team members due to the number of people involved in the GADS data collection and reporting process, the varying “event intensity” from week-to-week, season-to-season, etc. Suffice it to say that there is a significant number of man-hours devoted to GADS data collection and reporting. Nonetheless, the team unanimously agreed that we would continue to collect and report the information whether or not it was made mandatory.

Q4: Should solar data be collected?

A4: Team members recommend that solar data be collected in a manner similar to wind. The amount of solar generation will only increase over time, comprising a larger and larger part of the nation’s – and the world’s – power supply. The intermittent nature of this and other renewable resources (such as wind) could negatively impact the reliability of the grid if their performance were not closely monitored and analyzed using GADS or similar databases.

Q5: How should we resolve the differences between the GADS reporting process and the ISO reporting process?

A5: Team members recommend that all reporting be conformed to one standard such that one data set could be submitted to multiple entities (e.g. PJM, NERC, RFC) as desired or required. Case-in-point: Units within the PJM footprint submit their data to PJM in the PJM or NERC format. PJM then submits that data to NERC on behalf of the reporting entities. Team members recommend that legal agreements between NERC and individual ISOs be generated in order to absolve ISOs of responsibility for the accuracy and completeness of any data they submit to NERC on behalf of their reporting entities.

Design Sub-group Topics

Q1: What, if anything, could/should be done to ensure that the GADS Design Data (as well as Event and Performance Data) is accurate?

A1.1: Team members recommend that periodic standardized training be conducted for all persons involved in the GADS data collection and reporting process. Standardized training materials would best be provided by NERC in order to ensure delivery of a consistent message.

A1.2: All persons involved in the determination of cause codes, event descriptions, etc. should be knowledgeable in plant operations and maintenance for their units and have a demonstrated attention to detail. More specifically, these persons should not be someone with little or no familiarity with the units for which they’re reporting (with the possible exception of data entry clerks whose sole responsibility is the input of that information into a computer application).

A1.3: Internal “double-checking” of data should be encouraged as a best-practice, but should not be required. Reporting accuracy and data verification is the responsibility of the reporting entity, and any submissions made should not be auditable beyond standard error-checking routines already in-place.

Unit Design Data

Fossil Steam

Instructions

Use these forms to report design and installed equipment information for FOSSIL (steam) units. FOSSIL units are those units with a single steam generator connected to a single or cross compound turbine-generator drive train. Report units that have multiple steam generators and/or multiple turbine-generators connected by headers using the forms found under the heading "MISCELLANEOUS."

Data reported on these forms should reflect the current condition and design of the unit. Do not report data for start-up equipment or that not used to carry normal load unless specifically requested.

You will notice some data fields designated as M1 and M2. These indicate that the equipment being reported may have been supplied by more than one manufacturer. Use fields designated as M1 to report all the data associated with one manufacturer's equipment and M2 for the other.

Utility name:

Station name:

Unit name:

Data reporter:

Telephone number:

Date:

GENERAL UNIT DATA

1. Identification

A series of codes uniquely identifies your utility and units. NERC assigned a unique code to identify your utility. You must assign the unique code that will identify the FOSSIL unit being reported. This code may be any number from 100 to 199 or 600 to 649. Enter the unique utility and unit code and the full name of the unit below:

☐☐☐ Utility Code ☐☐☐ Unit Code

Name of Unit

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

2. Date the Unit 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 the unit entered service:

☐☐☐☐ Year ☐☐ Month ☐☐ Day

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

3. Unit Loading Characteristics at Time of Unit's Design

Enter the number from the list below that best describes the mode of operation the unit *was originally designed for:*

☐

1 - *Base load with minor load following*
2 - *Periodic start-up, load follow daily, reduced load nightly*
3 - *Weekly start-up, load follow daily, reduced load nightly*
4 - *Daily start-up, load follow daily, off-line nightly*
5 - *Start-up chiefly to meet daily peaks*
9 - *Other, describe* ______________________________

4. Design and Construction Contractors

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

____________________ Architect/Engineer
____________________ Constructor

5. Boiler - Manufacturer

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

______________________ Boiler manufacturer

______________________ Manufacturers' model or series name or number

6. Boiler - Enclosure

Is 50% or more of the boiler is outdoors (not enclosed in building framing and siding)?

☐ 1 – Yes 2 – No

7. Boiler - Nameplate Conditions

Enter the following steam conditions for the MAIN STEAM LINES at the full load, valves wide open design point:

☐☐☐☐☐☐☐☐ Steam flow rate (in lbs/hr)

☐☐☐☐ Design temperature (EF)

☐☐☐☐ Design pressure (psig)

8. Boiler - Fuel Firing System

☐ Enter the type of fuel firing system the unit *was designed for:*

A - *Front OR Back* - wall mounted burners on either the front OR the back of the furnace.
B - *Opposed* - wall mounted burners on BOTH the front and back of the furnace.
C - *Vertical* - burners are mounted on the ceiling of the furnace.
D - *Tangential* - firing from the corners of the furnace with burners capable of directing the fireball up or down.
E - *Cyclone* - horizontal (burner) cylinders connected to furnace walls wherein fuel and air are combusted in a controlled environment. Combustion gases exit through re-entrant throat into furnace, and slag drains to slag tanks. Cyclone burners may be installed in either single walls or opposed walls.
F - *Concentric* - staged combustion system, designed primarily for NO_2 control, in which the walls are blanketed with air.
G - *Circulating fluidized bed* - upward flow of air holds the fuel and sorbent particles (e.g., limestone) in suspension in the combustion zone. Partially burned fuel passes into a collector and is routed back into the combustion zone.
H - *Bubbling fluidized bed* - similar to circulating fluidized bed except the partially burned fuel is not recirculated.
I - *Stoker* - overfeed method combined with suspension firing.

9. Boiler - Type of Circulation

☐ Enter the type of circulation the boiler *was originally designed for*:

- 1 - *Natural* (thermal) - water flows through furnace wall tubes unaided by circulating pumps. Primarily used with subcritical units.
- 2 - *Controlled* (forced or pump assisted thermal) - water flows through furnace wall tubes aided by boiler recirculation pumps located in the downcomers or lower headers of the boiler. Used on some subcritical units.
- 3 - *Once through* - no recirculation of water through the furnace wall tubes and no steam drum. Used on supercritical and some subcritical units.

10. Boiler - Circulation System

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

____________________ Boiler recirculation pump(s) manufacturer(s).

____________________ TOTAL number of boiler recirculation pumps; include installed spares.

____________________ MINIMUM number of boiler recirculation pumps required to obtain maximum capacity from the unit.

M1 ☐ M2 ☐ Enter the type of boiler recirculation pump(s) at the unit:

- 1 - *Injection* (or injection seal) - controlled-leakage boiler 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 sealed unit.
- 9 - *Other, describe* ____

11. Boiler - Type of Furnace Bottom

☐ Enter the type of furnace bottom the boiler *was originally designed for:*

- 1 - *Dry bottom* - no slag tanks at furnace throat area (throat area is clear). Bottom ash drops through throat to bottom ash water hoppers. Design used when ash melting temperature is greater than temperature on furnace wall, allowing for relatively dry furnace wall conditions.
- 2 - *Wet Bottom* - slag tanks installed at furnace throat to contain and remove molten ash from the furnace.

12. Boiler - Furnace (Surface) Release Rate

Enter the furnace (surface) release rate of the PRIMARY FUEL. This rate is specified in the boiler contract as the heat available per hour, in Btu's per square foot of heat absorbing surface in the furnace. The absorbing surface includes the furnace tube walls and the first convection superheater and reheater tubes. If the furnace contains superheater and reheater platens which extend into the furnace, these absorbing surfaces should be included also.

☐☐☐☐☐☐☐☐ Furnace (surface) release rate (in Btu's/SqFt/Hr)

▲

13. Boiler - Furnace Volumetric Heat Release Rate

Enter the furnace volumetric heat release rate. This rate is the total quantity of thermal energy released into the furnace by the PRIMARY FUEL at its higher heating value (HHV). The volumetric heat release rate is expressed in Btu's per cubic foot of furnace volume per hour. It does not include the heat added by the preheated air or the heat unavailable due to the evaporation of moisture in the fuel and the combustion of hydrogen.

☐☐☐☐☐☐☐☐ Furnace volumetric heat release rate (in Btu's/CuFt/Hr)

14. Boiler - Primary and Secondary Design Fuels

Enter information on the characteristics of the primary and secondary fuels considered in the DESIGN of the unit. These fuels are used to sustain load on the unit: where PRIMARY is the first fuel of choice for economic or control reasons, or that fuel contributing 50% or more of the load- carrying Btu's. Fuel characteristics are based on design specifications. Additional notes are provided where appropriate.

Primary Fuel ☐☐

Secondary Fuel ☐☐

Fuel Codes

CC	Coal	**PR**	Propane
LI	Lignite	**SL**	Sludge Gas
PE	Peat	**GE**	Geothermal
WD	Wood	**NU**	Nuclear
OO	Oil	**WM**	Wind
DI	Distillate Oil (#2)	**SO**	Solar
KE	Kerosene	**WH**	Waste Heat
JP	JP4 or JP5	**OS**	Other - Solid (Tons)
WA	Water	**OL**	Other - Liquid (BBL)
GG	Gas	**OG**	Other - Gas (Cu.Ft.)

Fuel Characteristics

☐☐☐☐☐☐☐	☐☐☐☐☐☐☐	Average Heat Content in Fuel (Btu/lb, Btu/bbl, Btu/CuFt)
☐☐▲☐	☐☐▲☐	% Ash Content (to one decimal place) (Btu/lb,Btu/bbl,Btu/CuF
☐▲☐	☐▲☐	% Sulfur Content (to one decimal place) (Btu/lb Btu/bbl Btu/CuF
☐☐▲☐	☐☐▲☐	% Moisture Content (to one decimal place) (Btu/lb.Btu/bbl.Btu/CuF
☐☐☐☐	☐☐☐☐	Ash Softening Temp (EF) (in a reducing atmosphere) (ASTM STD D-1857, Part 26) (coal units only)
☐☐☐	☐☐☐	Grindability Hardgrove Index (ASTM STD D-409, Part 26) (coal units only)
☐☐▲☐	☐☐▲☐	% Vanadium & Phosphorous (to one decimal place) (oil units only)

15. Boiler - Fuel Oil Forwarding System

Some units are equipped with a fuel oil forwarding system that transfers oil from the main storage tanks to smaller tanks closer to the unit. (Complete Item 18, below, if interim storage tanks are not used.) Enter the following data on the fuel oil forwarding system:

____________________ Fuel forwarding/transfer pump(s) manufacturer(s).

____________________ Manufacturer(s) of the motor(s) that drives the fuel forwarding/ transfer pump(s).

____________________ TOTAL number of fuel forwarding/transfer pumps; include installed spares.

____________________ MINIMUM number of pumps required to obtain maximum capacity from the unit.

16. Boiler - Burner System (General)

Enter the following information on the burner systems installed at the unit (this includes the nozzles, igniter, air registers, and the wind box arrangements):

Conventional Burners

____________________ Primary fuel burner(s) manufacturer(s)

____________________ TOTAL number of primary fuel burners.

Low No_x Burners

____________________ Manufacturer(s)

____________________ TOTAL number of Low No_x Burners; include installed spares.

____________________ MINIMUM number of Low No_x Burners required to obtain maximum capacity from the unit.

Installation date:
☐☐☐☐ Year ☐ Month ☒ Day

17. Boiler - 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 unit 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.

18. Boiler - Fuel Oil Burner Supply System (In-plant)

Enter the following information on the pumps used to forward fuel oil from the main storage tanks or the interim storage tanks (if the unit is so equipped) to the burners:

____________________ Fuel oil burner supply pump(s) manufacturer(s)

____________________ Manufacturer(s) of the motor(s) that drives the fuel oil burner supply pump(s).

____________________ TOTAL number of fuel oil burner supply pumps; include installed spares.

____________________ MINIMUM number of fuel oil burner supply pumps required to obtain maximum capacity from the unit.

19. Boiler - Igniter System

Enter the following information on the igniter system installed at the unit:

____________________ Igniter manufacturer

☐ Enter the type of fuel the igniter(s) *were originally designed for*:

A - Light (distillate) oil
B - Heavy oil
C - Gas
D - Coal
E - Oil and Gas
F - Propane
M - More than one

☐ Enter igniter type:

1 - *Pilot torch lighter* - an oil or gas igniter that uses an electric spark to ignite the fuel.
2 - *Carbon arc* - a carbon or graphite electrode that is energized and used to ignite the fuel.
3 - *High energy arc* - a low voltage, high energy pulse arc that is used to ignite the fuel.
4 - *Plasma arc* - a high dc voltage current used to ionize the air resulting in a high energy arc that ignites the fuel.
9 - *Other, describe* ____

20. Boiler - Coal Handling Systems - Yard Area

Enter the following information on the equipment installed in the coal yard:

____________________ Coal crusher(s) manufacturer(s)

____________________ Stacker/reclaimer system(s) manufacturer(s)

____________________ Number of critical path coal conveyor systems available to the unit.

21. Boiler - Coal Feeders for Pulverizers or Coal Mills

Enter the following information on the coal feeder equipment used to supply coal from the in-plant coal holding bunkers to the pulverizers or coal mills:

____________________ Feeder(s) manufacturer(s).

____________________ Manufacturer(s) of the motor(s) that drives the feeder(s).

____________________ TOTAL number of feeders PER pulverizer or coal mill.

M1 M2

☐ ☐ Enter the type of pulverizer or coal mill feeder(s) at the unit:

1 - *Gravimetric belt* - system that weighs the coal as it is fed to the pulverizer or coal mill.
2 - *Volumetric belt* - system that measures the volume of coal fed to the pulverizer or coal mill.
3 - *Star roll* - a multi-blade rotor that turns about a fixed, hollow, cylindrical core feeding a fixed measure of coal.
4 - *Rotating table* - system that operates by piling coal on a rotating table, and, as the table rotates, a stationary blade diverts the coal to a feed chute to the mill.
9 - *Other, describe* ____

22. Boiler - Pulverizer or Coal Mill Capability

Enter the following information on the capability of the pulverizer(s) or coal mill(s):

____________________ Pulverizer(s) or coal mill(s) manufacturer(s).

____________________ Manufacturers' model number(s) for the pulverizer(s) or coal mill(s).

____________________ Design coal flow rate in lb/hr (per pulverizer or coal mill) using design fuel.

____________________ TOTAL number of pulverizers or coal mills; include installed spares.

____________________ MINIMUM number of pulverizers or coal mills required to obtain maximum capacity from the unit.

M1 M2

☐ ☐ Enter the type of pulverizer(s) or coal mill(s) at the unit:

1 - *Ball* - grinding elements are balls that operate freely in a race on a rotating grinding table.
2 - *Roll race* - rotating grinding table that moves coal through a series of rollers or wheels supported within the pulverizer or coal mill.
3 - *Ball tube* (Hardinge) - horizontal, rotating, grinding cylinder containing steel balls that move within the cylinder and grind or crush the coal.
4 - *Impact* (Attrition) - series of fixed or hinged hammers that rotate within a closed chamber impacting and crushing the coal.
9 - *Other, describe* ____

23. Boiler - Primary Air System

Enter the following information on the primary air system that provides the air needed to transport the coal from the pulverizers or coal mills to the furnace (note: exhausters for pulverizers or coal mills covered in item 24):

____________________ Primary air fan(s) manufacturer(s)

____________________ Manufacturer(s) of the motor(s) that drives the primary air fan(s).

____________________ TOTAL number of primary air fans; include installed spares.

____________________ MINIMUM number of primary air fans required to obtain maximum capacity from the unit.

M1 ☐ M2 ☐ Enter the type of primary air fan(s) at the unit:

Centrifugal - blades mounted on an impeller (or rotor) that rotates within a spiral or volute housing. Mark the type of blades used on this type of fan:

1 - Forward curved
2 - Straight (radial or radial tipped)
3 - Backward curved (air foil or flat)
4 - *Axial* (fixed or variable pitch) - blades attached to central hub parallel to air flow.
9 - *Other, describe* ____

24. Boiler - Exhausters for Pulverizers or Coal Mills

Enter the following information on the exhausters used to transport the pulverized coal from the pulverizer(s) or coal mill(s) to the burner front:

____________________ Exhauster fan(s) manufacturer(s).

____________________ Manufacturer(s) of the motor(s) that drives the exhauster fan(s).

____________________ TOTAL number of exhauster fans; include installed spares.

____________________ MINIMUM number of exhauster fans required to obtain maximum capacity from the unit.

M1 ☐ M2 ☐ Enter the type of exhauster fan(s) at the unit:

Centrifugal - blades mounted on an impeller (or rotor) which rotates within a spiral or volute housing. Mark the type of blades used on this type of fan:

1 - Forward curved
2 - Straight (radial or radial tipped)
3 - Backward curved (air foil or flat)
4 - *Axial* (fixed or variable pitch) - blades attached to central hub parallel to air flow.
9 - *Other, describe* ____

25. Boiler - Balanced Draft or Pressurized Draft

☐ Enter the type of draft the boiler *was designed for*:

1 - *Balanced draft* - equipped with both induced draft and forced draft fans. The furnace operates at positive pressure at air entry and negative pressure at flue gas exit.
2 - *Pressurized draft* - equipped with forced draft fans only. The furnace and draft system operate at positive pressure.

IF the unit was designed as a pressurized draft unit and converted to a balanced draft design, enter the date the conversion was completed:

☐☐☐☐ Year ☐☐ Month ☒☐ Day

26. Boiler - Forced Draft Fan System

Enter the following information on the forced draft fans installed at the unit:

____________________ Forced draft fan(s) manufacturer(s).

____________________ Manufacturer(s) of the motor(s)/steam turbine(s) that drives the forced draft fan(s).

____________________ TOTAL number of forced draft fans; include installed spares.

____________________ MINIMUM number of forced draft fans required to obtain maximum capacity from the unit.

M1 M2
☐ ☐ Enter the type of forced draft fan(s) at the unit:

Centrifugal - blades mounted on an impeller (or rotor) which rotates within a spiral or volute housing. Mark the type of blades used on this type of fan:
1 - Forward curved
2 - Straight (radial or radial tipped)
3 - Backward curved (air foil or flat)
4 - *Axial* (fixed or variable pitch) - blades attached to central hub parallel to air flow.
9 - *Other, describe* ____

M1 M2
☐ ☐ Enter the type of forced draft fan drives(s) at the unit:

1 - Single speed motor
2 - Two speed motor
3 - Variable speed motor
4 - Steam turbine
9 - Other, describe ____

27. Boiler - Induced Draft Fan System

Enter the following information on the induced draft fans installed at the unit:

________________ Induced draft fan(s) manufacturer(s)

________________ Manufacturer(s) of the motor(s)/steam turbine(s) that drives the induced draft fan(s).

________________ TOTAL number of induced draft fans; include installed spares.

________________ MINIMUM number of induced draft fans required to obtain maximum capacity from the unit.

M1 ☐ M2 ☐ Enter the type of induced draft fan(s) at the unit:

Centrifugal - blades mounted on an impeller (or rotor) which rotates within a spiral or volute housing. Mark the type of blades used on this type of fan:

1 - Forward curved
2 - Straight (radial or radial tipped)
3 - Backward curved (air foil or flat)
4 - *Axial* (fixed or variable pitch) - blades attached to central hub parallel to air flow.
9 - *Other, describe* ________________

M1 ☐ M2 ☐ Enter the type of induced draft fan drive(s) at the unit:

1 - Single speed motor
2 - Two speed motor
3 - Variable speed motor
4 - Steam turbine
9 - Other, describe ________________

28. Boiler - Gas Recirculating Fan System

Enter the following information on the gas recirculating fans installed at the unit:

________________ Gas recirculating fan(s) manufacturer(s).

________________ Manufacturer(s) of the motor(s)/steam turbine(s) that drives the gas recirculating fan(s).

________________ TOTAL number of gas recirculating fans; include installed spares.

________________ MINIMUM number of gas recirculating fans required to obtain maximum capacity from the unit.

M1 ☐ M2 ☐ Enter the type of gas recirculating fan(s) at the unit:

Centrifugal - blades mounted on an impeller (or rotor) which rotates within a spiral or volute housing. Mark the type of blades used on this type of fan:

1 - Forward curved
2 - Straight (radial or radial tipped)
3 - Backward curved (air foil or flat)
4 - *Axial* (fixed or variable pitch) - blades attached to central hub parallel to air flow.
9 - *Other, describe* ________________

28. **Boiler - Gas Recirculating Fan System** (Continued)

M1 M2

☐ ☐ Enter the type of gas recirculating fan drive(s) at the unit:

1 - Single speed motor
2 - Two speed motor
3 - Variable speed motor
4 - Steam Turbine
9 - Other, describe ______________________________

29. **Boiler - Primary Air Heating System**

Enter information about the air heaters used to transfer the excess heat from the flue gases to the incoming primary air for the furnace:

____________ Primary air heater(s) manufacturer(s).

____________ TOTAL number of primary air heaters.

M1 M2

☐ ☐ Enter the type of primary air heater(s) at the unit:

1 - *Regenerative* (Ljungstrom) - rotating heat exchanger that continuously rotates sections (baskets) composed of metal plates from the hot flue gas furnace exit plenum to the furnace intake air plenums.
2 - *Tubular* - hot flue gas from the furnace is channeled through tubes (vertical or horizontal) where the heat is transferred to the furnace intake air passing across the outside of the tubes.
3 - *Steam Coil* - similar to tubular except steam is used to preheat the intake air.
4 - *Regenerative* (Rothemule)
9 - *Other, describe* ______________________________

30. **Boiler - Secondary Air Heating System**

Enter information about the secondary (or backup) air heaters used to transfer the excess heat from the flue gases to the incoming primary air for the furnace:

____________ Secondary air heater(s) manufacturer(s).

____________ TOTAL number of secondary air heaters.

M1 M2

☐ ☐ Enter the type of secondary air heater(s) at the unit:

1 - *Regenerative* (Ljungstrom) - rotating heat exchanger that continuously rotates sections (baskets) composed of metal plates from the hot flue gas furnace exit plenum to the furnace intake air plenums thus heating the intake air.
2 - *Tubular* - hot flue gas from the furnace is channeled through tubes (vertical or horizontal) where the heat is transferred to the furnace intake air passing across the outside of the tubes.
3 - *Steam Coil* - similar to tubular except steam is used to preheat the intake air.
4 - *Regenerative* (Rothemule)
9 - *Other, describe* ______________________________

31. Boiler - Soot Blowers

Enter the following information on the soot blower system installed on the furnace:

____________________ Soot blower(s) manufacturer(s)

____________________ TOTAL number of soot blowers installed on the furnace.

Enter the type(s) of medium(s) used to blow the soot. If a variety of soot blowers are used at the unit, note the number of each type used.

M1		M2		M3	
☐	☐☐☐	☐	☐☐☐	☐	☐☐☐
Type	Number	Type	Number	Type	Number

1 - Steam
2 - Air
3 - Water
4 - Sonic
5 - Steam/Air
9 - Other, describe ____

32. Boiler - Bottom Ash Handling System

____________________ Bottom ash handling system manufacturer.

33. Boiler - Mechanical Fly Ash Precipitator System

Fly ash contained in the furnace exit flue gases can be removed by various types of mechanical precipitators including cyclone collectors, and wet or venturi scrubbers (note: SO_2 scrubbers covered in items 37-48). Enter the following information on the mechanical precipitator equipment:

____________________ Mechanical precipitator manufacturer.

☐ Enter the location of the mechanical precipitator with respect to the air heaters:

1 - Before air heaters
2 - After air heaters
3 - Both - precipitators installed both before and after the air heaters.
9 - Other, describe ____

34. Boiler - Electrostatic Precipitator

Fly ash contained in the furnace exit flue gases can be removed by using an electrostatic precipitator. Enter the following information on the electrostatic precipitator:

____________________ Electrostatic precipitator manufacturer.

☐ Enter the location of the electrostatic precipitator with respect to the air heaters:

1 - Before air heaters
2 - After air heaters
3 - Both - Flue gas is extracted both before and after the air heaters.
9 - Other, describe ____

35. Boiler - Baghouse Fly Ash System

Fly ash contained in the furnace exit flue gas may be removed using fabric or fabric bag filters. Enter the following information on the baghouse fly ash system:

____________________ Baghouse system manufacturer.

____________________ Manufacturer of the baghouse exhauster booster fans.

____________________ Manufacturer of the motor that drives the baghouse booster fans.

____________________ TOTAL number of baghouse booster fans installed on the unit.

☐ Enter the baghouse type:

1 - *Reverse* - clean flue gas is blown in the direction counter to normal operation to remove fly ash from the bag.
2 - *Pulse* (or pulse set) - short bursts of compressed air are blown into the bag to cause a momentary expansion of the bag to dislodge the entrapped fly ash.
3 - *Shaker* - the bag is literally shaken to remove the fly ash collected on its surface.
9 - *Other, describe* ______________________________

☐ Enter the type of baghouse booster fan(s) at the unit:

Centrifugal - blades mounted on an impeller (or rotor) which rotates within a spiral or volute housing. Mark the type of blades used on this type of fan:
1 - Forward curved
2 - Straight (radial or radial tipped)
3 - Backward curved (air foil or flat)
4 - *Axial* (fixed or variable pitch) - blades attached to central hub parallel to air flow.
9 - *Other, describe* ______________________________

36. Boiler - Fly Ash Transport System

Enter the following information on the fly ash removal system:

____________________ Fly ash removal system manufacturer.

☐ Enter the type of fly ash removal system:

1 - *Vacuum* - ash conveying system operates at a vacuum relative to the fly ash collection hoppers.
2 - *Pressure* - ash conveying system operates at a pressure greater than the pressure in the fly ash collection hoppers.
3 - *Vacuum-pressure* - employs the best features of both the vacuum and pressure systems.
4 - *Water* (sluice) - employs water to sluice the ash away from the hoppers.
5 - *Vacuum and water slurry*
9 - *Other, describe* ______________________________

37. FGD Manufacturer

Enter the following information on the FGD system (venturi scrubbers covered in Item 33):

____________________ FGD system manufacturer

38. FGD Installation Date

Enter the date the FGD system was initially operated:

☐☐☐☐ Year ☐☐ Month ☒☒ Day

Was the FGD system a part of the original design of the unit? A “no” answer means the FGD system was a retrofit after the unit entered service.

☐ 1 – Yes 2 – No

39. FGD Cycle Type

☐ Enter the type of FGD cycle used by the unit:

1 - *Single loop* - single recirculation loop for controlling the reagent.
2 - *Dual loop* - two separate and distinct recirculation loops for controlling the reagent (same reagent used in both loops).
3 - *Dual alkali* - two separate and distinct reagents controlled through the use of separate recirculation loops operated in series.
9 - *Other*

40. FGD Absorbing Reagents

The “reagent” is the substance that reacts chemically with the flue gas to remove the resident sulfur dioxide. Name the reagent(s) used in the unit’s FGD system:

______________________ Reagent #1

______________________ Reagent #2 (if dual alkali system)

41. FGD Flow Rates

Enter the following information regarding the flue gas flow rates into the FGD system:

Maximum design flue gas flow rate at the exit of the boiler in actual cubic feet per minute (ACFM).

☐☐☐☐☐☐☐☐

Maximum design flue gas flow rate capable of passing through the FGD system in ACFM.

☐☐☐☐☐☐☐☐

42. FGD By-pass Capacity

The flue gas by-pass capacity is the percent of the total flue gas flow (maximum design condition) that can be by-passed around the FGD while permitting the unit to operate within compliance. Enter the following information:

Percent of scrubber by-pass capacity at compliance levels. (Enter 0% if no by-pass capacity exists.)

☐☐☐▲☐

43. FGD Modules

Several towers may work together in series or in parallel to form a single FGD module, with one or more modules installed at a single unit. Enter the following information:

☐ TOTAL number of FGD modules on the unit
☐ TOTAL number of FGD towers per module
☐ MINIMUM number of FGD modules required to obtain maximum capacity from the unit.
☐ Are the FGD modules shared with another unit? 1 - Yes 2 - No

44. Scrubber/Absorber Tower Type

The scrubber/absorber tower type identifies the interaction methods used between the flue gas and the reagent.

☐ Enter the type combination of types of scrubber/absorber used on the unit:

1 - *Venturi* - a conveying throat to accelerate the inlet flue gas to a higher velocity.
2 - *Spray* - an open gas absorption vessel in which scrubbing slurry is introduced into the gas stream from atomizing nozzles.
3 - *Tray* - tray(s) internal to the scrubber/absorber consists of a horizontal metal surface perforated with holes or slots mounted transversely across the vessel.
4 - *Packed* - a bed of stationary (static) or mobile (moving bed) packing, mounted transversely across the vessel.
5 - *Combination* - two or more of the above-noted designs used in the same tower.
9 - *Other*, describe ____________________

45. FGD Fans

FGD fans are those USED EXCLUSIVELY to induce or force flue gases through the FGD towers. These fans help overcome the pressure drop through the FGD and are IN ADDITION to the boiler I.D. and F.D. fans. Enter the following information:

____________________ FGD fan(s) manufacturer(s).
____________________ Manufacturer(s) of the motor(s) that drives the FGD fan(s).
____________________ TOTAL number of FGD fans; include installed spares.
____________________ MINIMUM number of FGD fans required to obtain maximum capacity from the unit.

M1 M2
☐ ☐ Enter the type of FGD fan(s) at the unit:

Centrifugal - blades mounted on a impeller (or rotor) which rotates within a spiral or volute housing. Mark the type of blades used on this type of fan:

1 - Forward curved
2 - Straight (radial or radial tipped)
3 - Backward curved (air foil or flat)
4 - *Axial* (fixed or variable pitch) - blades attached to central hub parallel to air flow.
9 - *Other, describe* ____________________

M1 M2
☐ ☐ Enter the location of the FGD fan(s) with respect to the FGD:

1 - Before
2 - After
9 - Other, describe ____________________

46. Scrubber Recycle (Liquid) Pumps

Recycle (liquid) pumps circulate reagent through the FGD towers. Enter the following information on the scrubber recycle pumps at the unit:

_____________________ Recycle pump(s) manufacturer(s).

_____________________ Manufacturer(s) of the motor(s) that drives the recycle pump(s)

_____________________ TOTAL number of recycle pumps PER tower; include installed spares.

_____________________ MINIMUM number of recycle pumps required to obtain maximum capacity from the unit.

47. Stack Gas Reheater Methods

After the flue gases leave the FGD system, the exit gases may be heated before discharge through the stack. Two methods commonly used to reheat the flue gases are: direct (injection of hot gases) or indirect (passing through a heat exchanger).

☐ Enter the type of stack gas reheating method used at the unit:

1 - *In-line* - installation of a heat exchanger in the flue gas duct downstream of the mist eliminators.
2 - *Direct combustion* - firing of gas or oil burners and mixing product gases with the cooler scrubbed flue gas.
3 - *Indirect hot air* - heating of ambient air in an external heat exchanger (using steam) and injecting this heated air into scrubbed flue gas discharge.
4 - *Waste heat recovery* - use of unscrubbed flue gas in a heat exchanger to reheat the scrubbed stack gas.
5 - *Exit gas recirculation* - a portion of the scrubbed gas is diverted from the exit stream, reheated by a heat exchanger and then injected into the scrubbed flue gas before entering the stacks.
6 - *By-pass reheater* - by-pass of a portion of the hot unscrubbed flue gas around the FGD system for injection into the cooler scrubbed flue gas.
9 - *Other, describe* ____

48. FGD Primary Mist Eliminator

Enter the following information on the FGD primary mist eliminators:

☐ Enter the type of mist eliminator(s) used in the FGD towers:

1 - *Impingement* (or inertial impaction) - open or chevron vanes placed in the gas stream divert and collect the mist on their surfaces and direct the droplets away.
2 - *Electrostatic* - mist removal through the use of an electrostatic field.
3 - *Centrifugal* - uses baffles that impart a centrifugal force on the gas.
4 - *Cyclonic* - uses tangential inlets which impart a swirl or cyclonic action to the gas as it passes through the separator chamber.
9 - *Other, describe* ____

A “mist eliminator stage” is a single set of separate and distinct elements through which the flue gas must pass.

☐ Enter the total number of mist eliminator stages on each FGD tower.

49. Steam Turbine - Manufacturer

Enter the name of the manufacturer of the steam turbine:

____________________ Steam turbine manufacturer Recommendation: Manufacturer by section.

50. Steam Turbine - Enclosure

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

☐ 1– Yes 2 – No

51. 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 (megavoltamperes) 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).

▲

52. 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* ____

53. 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)

54. Steam Turbine - Steam Conditions

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

	Main Steam	First Reheat	Second Reheat
Temperature (EF)	☐☐☐☐	☐☐☐☐	☐☐☐☐
Pressure (psig)	☐☐☐☐	☐☐☐☐	☐☐☐☐

55. 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.
▲

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.
▲

☐☐☐ The last stage blade length (inches) of the low pressure turbine, measured from hub to end of top of blade.
▲

56. 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 startup.
2 - *Full arc* - main steam is admitted to all sectors of the turbine’s first stage at startup.
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 ____________________

57. 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 ____________________

58. Generator - Manufacturer

Enter the name of the manufacturer of the electric generator:

____________________ Generator manufacturer

59. Generator - Enclosure

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

☐ 1 – Yes 2 – No

60. 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	☐☐☐☐ ▲	☐☐☐☐ ▲	☐☐☐☐ ▲
Megavoltamperes (MVA) Capability	☐☐☐☐	☐☐☐☐	☐☐☐☐
RPM	☐☐☐☐	☐☐☐☐	☐☐☐☐
Power Factor (enter as %)	☐☐☐☐ ▲	☐☐☐☐ ▲	☐☐☐☐ ▲

*Cross compound units.

61. Generator - Cooling System

Two types of cooling methods are typically used. First is the "innercooled" 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 innercooled and rotor innercooled.
2 - Stator conventionally cooled and rotor conventionally cooled.
3 - Stator innercooled and rotor conventionally cooled.
9 - Other, describe ____________________

Enter the mediums used to cool the generator's stator and rotor:

☐	**Stator**	**Medium**	**Rotor**	☐
	_A_	Air	_A_	
	_H_	Hydrogen	_H_	
	_O_	Oil	_O_	
	_W_	Water	_W_	

62. Generator - Hydrogen Pressure

☐☐☐ Enter the generator hydrogen pressure IN PSIG at nameplate MVA.
▲

63. 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 dc is obtained by rectifying ac from generator terminals, and dc is fed into rotor by collector rings.
2 - *Rotating dc generator* - exciter supplies dc from a commutator into the main rotor by means of collector rings.
3 - *Brushless* - an ac (rotating armature type) exciter 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 ac 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 ____________________

64. Auxiliary Systems - Main Condenser

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

____________________ Main condenser manufacturer

____________________ 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 value 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 ____

65. 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 ____

66. 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 boiler. 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 manufacturer

Enter the % of the condensate flow at maximum unit capacity that can be treated:

☐☐☐.☐ % Treated

67. 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 unit.

68. 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 unit.

69. Auxiliary Systems - Feedwater (Boiler Feed) Pumps

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

____________________ Feedwater (boiler 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 unit.

☐☐☐.☐ PERCENT (%) of the unit's maximum capacity that can be achieved with a single feedwater pump.

70. Auxiliary Systems - Feedwater (Boiler Feed) Pump Drives

Enter the following information for the feedwater (boiler feed) pump drives:

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

M1 ☐ M2 ☐ Enter the type of equipment used to drive the feedwater (boiler feed) pumps:

1 - Motor - single speed
2 - Motor - two speed
3 - Motor - variable speed
4 - Steam turbine
5 - Shaft
6 - Motor gear
7 - Steam gear
8 - Shaft gear
9 - Other, describe ________________

M1 ☐ M2 ☐ Specify coupling type used for feedwater (boiler feed) pump.

1 - Hydraulic
2 - Mechanical
9 - Other, describe ________________

71. Auxiliary Systems - Startup Feedwater (Boiler Feed) Pumps

Enter the following information for the startup feedwater pump(s) at the unit:

________________ Startup feedwater pump(s) manufacturer(s).

________________ Manufacturer(s) of the motor(s) that drives the startup feedwater pump(s).

☐☐☐▲☐ PERCENT (%) of the unit's maximum capacity that can be achieved with a single startup feedwater pump.

M1 ☐ M2 ☐ Indicate the additional capabilities of the startup feedwater pump:

1 - ADDITIVE: operated in conjunction with the feedwater (boiler feed) pumps.
2 - REPLACEMENT: can carry load when the feedwater pumps are inoperative.
3 - STARTUP only: cannot be used in lieu of the feedwater pumps.
9 - Other, describe ________________

72. Auxiliary Systems - High Pressure Feedwater Heaters

High pressure feedwater heaters are those heat exchangers between the feedwater (boiler feed) pumps discharge and the economizer inlet. Enter the following information for the HIGH pressure feedwater heaters at the unit:

________________ 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.

72. Auxiliary Systems - High Pressure Feedwater Heaters (Continued)

M1 M2
☐ ☐ 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 ____________________

73. 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 at the unit:

____________________ 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.

M1 M2
☐ ☐ 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 ____________________

74. 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 unit 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 at the unit:

____________________ 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.

M1 M2
☐ ☐ 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 ____________________

75. Auxiliary Systems - Deaerator Heater

Enter the following information on the deaerator heater at the unit:

____________________ Deaerator manufacturer(s)

M1 ☐ M2 ☐ 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 ______________________________

76. Auxiliary Systems - Heater Drain Pumps

Enter the following information for the heater drain pumps at the unit:

____________________ Heater drain pump(s) manufacturer(s).

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

77. 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 unit DURING WINTER SEASON.

78. Auxiliary Systems - Cooling Tower and Auxiliaries

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

____________________ Cooling tower manufacturer(s)

____________________ Cooling tower fan(s) manufacturer(s).

____________________ Manufacturer(s) of the motor(s) that drives the cooling tower fan(s).

M1 ☐ M2 ☐ Enter the type of cooling tower(s) used:

1 - *Mechanical draft* (induced, forced, cross-flow and counterflow) - 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.

78. Auxiliary Systems - Cooling Tower and Auxiliaries (Continued)

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 unit.

79. Balance of Plant - Main Transformer

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

____________ Main transformer(s) manufacturer(s).

____________ TOTAL number of main transformers; include installed spares.

____________ Megavoltampere (MVA) size of the main transformer(s).

____________ HIGH SIDE voltage in kilovolts (kV) of the main transformer(s) at 55E.

M1 ☐ M2 ☐ Enter the type of MAIN transformer at the unit:

1 - Single phase
2 - Three phase
9 - Other, describe ____________________

80. Balance of Plant - Unit Auxiliary Transformer

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

____________ Unit auxiliary transformer(s) manufacturer(s).

____________ TOTAL number of unit auxiliary transformer(s).

____________ LOW SIDE voltage in kilovolts (kV) of the unit auxiliary transformer(s) at 55E.

81. 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 unit auxiliaries during unit start-up and shutdown. It also may be used when the unit 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 55E.

____________________ LOW SIDE voltage in kilovolts (kV) of the station service transformer(s) at 55E.

82. Balance of Plant - Auxiliary (Start-up) Boiler

Enter the following information on the auxiliary boiler at the unit:

____________________ Auxiliary boiler manufacturer(s).

83. Balance of Plant - Auxiliary Generator

Enter the following information on the auxiliary generator at the unit:

____________________ Auxiliary generator manufacturer(s).

Is the auxiliary generator shaft driven?

M1 M2
☐ ☐ 1 – Yes 2 – No

84. Balance of Plant - Plant Process Computer

Enter the following information for the plant process computer(s):

____________________ Plant process computer manufacturer(s).

M1 M2
☐ ☐ Enter the number of plant process computers available to the unit:

1 - One computer for this unit only.
2 - Two computers for this unit only.
3 - One computer shared by one or more units.
4 - Two computers shared by one or more units.
9 - Other, describe ____

M1 M2
☐ ☐ Describe how the plant process computers are linked within the plant:

1 - Centralized
2 - Distributive
3 - Stand alone
9 - Other, describe ____

84. Balance of Plant - Plant Process Computer (Continued)

M1 M2
☐ ☐ Enter the system capability of the plant process computer:

1 - Monitor only
2 - Monitor and control
9 - Other, describe ____________________

85. CEMS - General

____________________ System vendor

First-certified date:

☐☐☐☐ Year ☐ Month ☒☐ Day

☐ Monitoring technique

1 - Extractive
2 - Dilution
3 - In Situ

☐ Analysis Method

1 - Wet
2 - Dry
9 - Other, describe ____________________

86. CEMS - Pollutant Gas and Diluent Gas Analyzers/Monitors

1. Sulfur Dioxide (SO_2) Analyzers

____________________ Manufacturer(s)

____________________ Model number(s)

M1 M2
☐☐ ☐☐ Number of installed analyzers

M1 M2
☐☐ ☐☐ Number of installed spare analyzers

M1 M2
☐ ☐ Type(s)

1 - Ultraviolet
2 - Infrared
3 - Fluorescence
9 - Other, describe ______________________________

M1 M2
☐ ☐ Instrument range (parts per million)

1 - 0 - 50
2 - 0 - 150
3 - 0 - 500
9 - Other, describe ______________________________

M1 M2
☐ ☐ Shared? (1 - Yes, 2 - No)

2. Oxides of Nitrogen (NO_x) Analyzers

____________________ Manufacturer(s)

____________________ Model number(s)

M1 M2
☐☐ ☐☐ Number of installed analyzers

M1 M2
☐☐ ☐☐ Number of installed spare analyzers

M1 M2
☐ ☐ Type(s)

1 - Infrared
2 - Chemiluminescent

86. CEMS - Pollutant Gas and Diluent Gas Analyzers/Monitors (Continued)

9 - Other, describe ____

M1 M2
☐ ☐ Instrument range (parts per million)

1 - 0 - 50
2 - 0 - 150
3 - 0 - 500
9 - Other, describe ____

M1 M2
☐ ☐ Shared? (1 - Yes, 2 - No)

3. Carbon Monoxide (CO) Analyzers

____________________ Manufacturer(s)

____________________ Model number(s)

M1 M2
☐☐ ☐☐ Number of installed analyzers

M1 M2
☐☐ ☐☐ Number of installed spare analyzers

M1 M2
☐ ☐ Type(s)

1 - Infrared solid state
2 - Infrared luft
3 - Gas filter correlation
9 - Other, describe ____

M1 M2
☐ ☐ Instrument range (parts per million)

1 - 0 - 50
2 - 0 - 150
3 - 0 - 500
9 - Other, describe ____

86. CEMS - Pollutant Gas and Diluent Gas Analyzers/Monitors (Continued)

4. Carbon Dioxide (CO_2) Analyzers

____________________ Manufacturer(s)

____________________ Model number(s)

M1 M2
☐☐ ☐☐ Number of installed analyzers

M1 M2
☐☐ ☐☐ Number of installed spare analyzers

M1 M2
☐ ☐ Instrument range (parts per million)

1 - 0 - 50
2 - 0 - 150
3 - 0 - 500
9 - Other, describe ____

M1 M2
☐ ☐ Shared? (1 - Yes, 2 - No)

5. Oxygen (O_2) Analyzers

____________________ Manufacturer(s)

____________________ Model number(s)

M1 M2
☐☐ ☐☐ Number of installed analyzers

M1 M2
☐☐ ☐☐ Number of installed spare analyzers

M1 M2
☐ ☐ Type(s)

1 - Zirconia oxide
2 - Paramagretic
3 - Fuel cell
9 - Other, describe ____

M1 M2
☐ ☐ Instrument range (parts per million)

1 - 0 - 50
2 - 0 - 150
3 - 0 - 500
9 - Other, describe ____

M1 M2
☐ ☐ Shared? (1 - Yes, 2 - No)

86. CEMS - Pollutant Gas and Diluent Gas Analyzers/Monitors (Continued)

6. Opacity Monitors

____________________ Manufacturer(s)

____________________ Model number(s)

M1 ☐☐ M2 ☐☐ Number of installed analyzers

M1 ☐☐ M2 ☐☐ Number of installed spare analyzers

M1 ☐ M2 ☐ Probe placement (if unit is equipped with a FGD system)

1 - Before scrubber
2 - After scrubber

87. CEMS - Flue Gas Flow Monitors

____________________ Manufacturer(s)

____________________ Model number(s)

M1 ☐☐ M2 ☐☐ Number of installed monitors

M1 ☐☐ M2 ☐☐ Number of installed spare monitors

Volumetric Flow Rate (ACFM):

M1 ☐☐☐☐☐☐☐☐ M2 ☐☐☐☐☐☐☐☐

M1 ☐ M2 ☐ Flow rate measurement technique

1 - Thermal sensing (hot-wire anemometer or dispersion)
2 - Differential pressure array
3 - Acoustic velocimetry (ulrasonic transducers)
4 - Combination
9 - Other, describe ____

88. CEMS - Data Acquisition and Reporting System

____________________ Hardware manufacturer

☐ Hardware architecture

1 - Vendor-supplied dedicated system
2 - Modified existing plant computer
3 - Stand alone, pc-based system not supplied by CEMS system vendor
9 - Other, describe ____

____________________ Software supplier

☐ Shared? (1 - Yes, 2 - No)

NO$_X$ REDUCTION SYSTEMS

These systems include Selective Non-catalytic Reduction, Selective Catalytic Reduction, Catalytic Air Heaters, and Staged NO$_X$ Reduction, which is a combination of the three methods. Excluded from this category are Low NO$_X$ burners (see Item 16, Page E-9), combustion modifications, and flue gas recirculation.

Please complete the following information for the NO$_X$ Reduction Systems installed on your unit. (The appropriate items under each method should be completed for a Staged NO$_X$ Reduction System).

89. Selective Non-Catalytic Reduction System (SNCR)

☐ Reagent

1 - Ammonia
2 - Urea
9 - Other, describe ____

☐ Injector Type

1 - Wall nozzles
2 - Lance
9 - Other, describe ____

☐ Injection Equipment Location

1 - Furnace
2 - Superheater
3 - Economizer
9 - Other, describe ____

____________________ Number of Injectors

89. Selective Non-Catalytic Reduction System (SNCR) (Continued)

☐ Carrier Gas Type

1 - Steam
2 - Air
9 - Other, describe ____________________

____________ Total flow rate (lb./hr.)

____________ Pressure at nozzle (psi)

____________ Nozzle exit velocity (ft./sec.)

90. Selective Catalytic Reduction System (SCR)

☐ Reactor

1 - Separate
2 - In Duct

____________ Flue gas take-off location

☐ Reagent

1 - Ammonia
2 - Urea
9 - Other, describe ____________________

☐ Ammonia Injection Grid Location

1 - Furnace
2 - Superheater
3 - Economizer
4 - Zoned

☐ Duct Configuration

1 - Flow straighteners
2 - Turning vanes
3 - Dampers

90. Selective Catalytic Reduction System (SCR) (Continued)

☐ Catalyst Element Type

1 - Plate
2 - Honeycomb
9 - Other, describe ______________________________

☐ Catalyst Support Material

1 - Stainless steel
2 - Carbon steel
9 - Other, describe ______________________________

☐ Catalytic Material Configuration

1 - Vertical
2 - Horizontal
9 - Other, describe ______________________________

__________ Surface face area (sq. ft.)

__________ Catalyst volume (cu. ft.)

__________ Number of layers

__________ Layer thickness (inches)

☐ Sootblowers (if applicable)

1 - Air
2 - Steam
3 - Both air and steam

__________ Manufacturer(s)

__________ Number of sootblowers

91. Catalytic Air Heaters

☐ Element Type

1 - Laminar surface
2 - Turbulent surface
9 - Other, describe ______________________

☐ Support Material, if any

1 - Stainless steel
2 - Carbon steel
9 - Other, describe ______________________

☐ Catalyst Material Configuration

1 - Horizontal air shaft
2 - Carbon steel
9 - Other, describe ______________________

______________ Total face area (sq. ft.)
______________ Open face area (sq. ft.)
______________ Layer thickness (inches)

Unit Design Data

Diesel

Instructions

Submit the data in this section once during the life of each diesel 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, a (9) is entered to indicate an alternative other than those specified. Whenever a (9) is entered, write the column number and the answer on the reverse side of the form.

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

Utility name:

Station name:

Unit name:

Data reporter:

Telephone number:

Date:

GENERAL DATA	**Col. No.**	
☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
4 1	07	Card code
▨▨▨▨	09	Columns 09 through 12 are blank
☐☐☐☐	13	Year unit first paralleled for load
☐☐	17	Month unit first paralleled for load
☐☐	19	Day unit first paralleled for load

DIESEL ENGINE DATA

☐	21	Diesel engine manufacturer - (1) General Motors; (2) General Electric; (3) Consolidated Diesel Electric; (4) Allis Chalmers; (5) Caterpillar Tractor; (6) Cummins; (7) Fairbanks Morse; (9) Other
☐	22	Fuel, type - (1) No. 2 fuel oil; (2) Diesel oil; (3) JP 5 fuel; (4) Kerosene; (5) Heavy oil; (9) Other
☐☐	23	Cylinders, number per engine
☐	25	Cycle, type - (1) 2-stroke; (2) 4-stroke; (9) Other
☐	25	Startup system, type - (1) Automatic, on site; (2) Automatic remote; (9) Other
☐☐☐	27	Time for normal cold start to full load in seconds
☐☐☐	30	Time for emergency cold start to full load in seconds
☐	33	Coolant, type - (1) Water; (2) Oil; (3) Air; (9) Other
▨ – ▨	34	Columns 34 through 80 are blank
☐☐☐	01	Utility identification number

DIESEL ENGINE DATA (Continued)

☐☐☐	04	Unit identification number
4 2	07	Card code
▨ – ▨	09	Columns 09 through 80 are blank

GENERATOR DATA

☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
4 3	07	Card code
▨▨▨▨▨	09	Columns 09 through 13 are blank
☐☐	14	Manufacturer - (see table of Manufacturers, page E-123)
☐	16	Type - (1) Three-phase, 60-cycle; (9) Other
☐☐☐ , ☐	17	Nameplate voltage to nearest one-tenth KV
☐☐☐☐	21	Nameplate capability MVA, first shaft
☐☐☐☐	25	Speed in RPM, first shaft
☐☐☐☐	29	Nameplate capability MVA, second shaft if any
☐☐☐☐	33	Speed in RPM, second shaft if any
☐☐☐☐	37	Nameplate capability MVA, third shaft if any
☐☐☐☐	41	Speed in RPM, third shaft if any
☐☐	45	Nameplate power factor in percent
☐	47	Cooling medium, stator/rotor - (1) Air/air; (2) Hydrogen/ hydrogen; (3) Oil/hydrogen; (4) Water/hydrogen; (9) Other
☐	48	Cooling method, stator/rotor - (1) Intercooled/intercooled; (2) Conventional/conventional; (3) Intercooled/conventional; (9) Other
☐☐	49	Hydrogen pressure in PSIG at nameplate MVA, if applicable

GENERATOR DATA (Continued)

☐ 49 Number of exciters required by the unit for normal operation at rated Output

☐ 52 Type normal exciters - (1) Rotating DC generator; (2) Rotating alternator rectifier; (3) Static; (9) Other

☐ 53 Type drive for normal exciters, if rotating - (1) Shaft direct; (2) Shaft gear; (3) Motor; (9) Other

☐ 54 Number of spare exciters available to the unit

☐ 55 Enter (1) if more than 50% of generator is outdoors

56 Name of Unit (Columns 56-80)

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Unit Design Data

Gas Turbine or Jet Engine

Instructions

Submit the data in this section once during the life of each gas turbine or jet engine 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, a (9) is entered to indicate an alternative other than those specified. Whenever a (9) is entered, write the column number and the answer on the reverse side of the form.

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

Utility name:

Station name:

Unit name:

Data reporter:

Telephone number:

Date:

GENERAL DATA	**Col. No.**	
☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
3 1	07	Card code
▨▨▨▨	09	Columns 09 through 12 are blank
☐☐☐☐	13	Year unit first paralleled for load
☐☐	17	Month unit first paralleled for load
☒	19	Day unit first paralleled for load

GAS TURBINE OR JET ENGINE DATA

☐	21	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 (10) Add/delete/correct manufacturers.
☐	21	Engine type - (1) Gas turbine single shaft; (2) Gas turbine split shaft; (3) Jet engine; (9) Other
☐☐	22	Engines, number per unit
☐	25	Expander turbines, number per unit if applicable
☐	26	Type expander, if applicable - (1) Single flow; (2) Double flow
☐	27	Cycle type - (1) Reheat; (2) Simple; (3) Regenerative; (4) Recuperative; (5) Intercooled; (6) Precooled; (7) Complex; (8) Compound; (9) Other
☐	28	Startup system - (1) Air; (2) Auxiliary motor; (3) Electric motor; (4) Natural gas; (5) Flow turbine; (6) Supercharging fan; (7) Hydraulic; (9) Other (10) LCI
☐	29	Startup type - (1) Automatic, on site; (2) Automatic, remote; (9) Other

GAS TURBINE OR JET ENGINE DATA (Continued)

☐☐	30	Type of Fuel(s) that will be used (see table of Fuel Codes, page E-124)
☐	32	Enter (1) if sound attenuators located at inlet
☐	33	Enter (1) if sound attenuators located at outlet
☐	34	Enter (1) if sound attenuators located in building enclosures
☐☐☐	35	Time for normal cold start to full load in seconds minutes
☐☐☐	38	Time for emergency cold start to full load in seconds minutes
☐	41	Black start capability - (1) Yes; (2) No
▨ – ▨	42	Columns 42 through 70 are blank
☐☐☐☐☐☐☐☐☐☐	71	Engine Model Number (MS 7001EA, W501AA, FT4A11, etc.)

POLLUTION CONTROL EQUIPMENT DATA

☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
3 2	07	Card code
▨ – ▨	09	Columns 09 through 21 are blank

SELECTIVE NON-CATALYTIC REDUCTION SYSTEM (SNCR) Do you have SNCR?

☐ 22 SNCR reagent - (1) Ammonia; (2) Urea; (9) Other

☐ 23 SNCR injector type - (1) Wall nozzle; (2) Lance; (9) Other

☐ 24 SNCR injection equipment location - (1) Furnace; (2) Super-heater; (3) Economizer; (9) Other

☐☐☐ 25 Number of SNCR injectors

☐ 28 SNCR carrier gas type - (1) Steam; (2) Air; (9) Other

☐☐☐☐ > ☐ 29 SNCR carrier gas total flow rate (thousands of lbs./hr.) i.e. 6,000,000 lbs./hr. enter 6000

☐☐☐☐ 34 SNCR carrier gas pressure at nozzle (psi)

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

SELECTIVE CATALYTIC REDUCTION SYSTEM (SCR) Do you have SCR?

☐ 43 SCR reactor - (1) Separate; (2) In Duct

☐ 44 SCR reagent - (1) Ammonia; (2) Urea; (9) Other

☐ 45 SCR ammonia injection grid location - (1) Furnace; (2) Super-heater; (3) Economizer; (4) Zoned

☐ 46 SCR duct configuration - (1) Flow straighteners; (2) Turning vanes; (3) Dampers

☐ 47 SCR Catalyst Element Type (1) Plate; (2) Honeycomb; (9) Other

☐ 48 SCR catalyst support material - (1) Stainless steel; (2) Carbon steel; (9) Other

☐ 49 SCR catalytic material configuration - (1) Vertical; (2) Horizontal; (9) Other

☐☐☐☐ > ☐ 50 SCR catalyst surface face area (thousands of square feet)

☐☐☐☐ > ☐ 55 SCR catalyst volume (thousands of cubic feet)

☐☐ 60 Number of SCR catalytic layers

SELECTIVE CATALYTIC REDUCTION SYSTEM (SCR) (Continued)

.☐☐☐	62	SCR catalytic layer thickness (1/1000 inches)
☐	65	SCR sootblower type - (1) Air; (2) Steam; (3) Both
☐☐	66	SCR sootblower manufacturer - (see table of Manufacturers - page E-125)

CATALYTIC AIR HEATERS (CAH)

☐	68	CAH element type - (1) Laminar surface; (2) Turbulent surface; (9) Other
☐	69	CAH catalyst material - (1) Titanium oxide; (2) Vanadium pentoxide; (3) Iron (II) oxide; (4) Molybdenum oxide; (9) Other
☐	70	CAH catalyst support material - (1) Stainless steel; (2) Carbon steel; (9) Other
☐	71	CAH catalyst material configuration - (1) Horizontal air shaft; (2) Vertical air shaft
☐☐.☐	72	CAH catalyst material total face area (thousands of square feet)
☐☐.☐	75	CAH catalyst material open face area (thousands of square feet)
.☐☐☐	78	CAH catalyst material layer thickness (1/1000 inches)

GENERATOR DATA

☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
3 3	07	Card code
▨▨▨▨▨	09	Columns 09 through 13 are blank
☐☐	14	Manufacturer (see table of Manufacturers, page E-123)
☐	16	Type - (1) Three-phase, 60-cycle; (9) Other
☐☐☐.☐	13	Nameplate voltage to nearest one-tenth KV

GENERATOR DATA (Continued)

☐☐☐☐ 21 Nameplate capability MVA, first shaft

☐☐☐☐ 25 Speed in RPM, first shaft

☐☐☐☐ 26 Nameplate capability MVA, second shaft if any

☐☐☐☐ 33 Speed in RPM, second shaft if any

☐☐☐☐ 37 Nameplate capability MVA, third shaft if any

☐☐☐☐ 41 Speed in RPM, third shaft if any

☐☐ 45 Nameplate power factor in percent

☐ 47 Cooling medium, stator/rotor - (1) Air/air; (2) Hydrogen/ hydrogen; (3) Oil/hydrogen; (4) Water/hydrogen; (9) Other

☐ 48 Cooling method, stator/rotor - (1) Intercooled/intercooled; (2) Conventional/conventional; (3) Intercooled/ conventional; (9) Other

☐☐ 49 Hydrogen pressure in PSIG at nameplate, MVA, if applicable

☐ 51 Number of exciters required by the unit for normal operation at rated output

☐ 52 Type normal exciters - (1) Rotating DC generator; (2) Rotating alternator rectifier; (3) Static; (9) Other

☐ 53 Type drive for normal exciters, if rotating - (1) Shaft direct; (2) Shaft gear; (3) Motor; (9) Other

☐ 54 Number of spare exciters available to the unit

☐ 55 Enter (1) if more than 50% of generator is outdoors

56 Unit Name (columns 56-80)

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Unit Design Data

Combined Cycle Units and Block Design Data

Company name:

Station name:

Block name:

Data reporter:

Telephone number:

Date:

INSTRUCTIONS

In order to continue this discussion, some terms must be agreed on to eliminate some of the ambiguity concerning combined cycle blocks in general.

- **Combined Cycle Block (referred 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 an electric generating technology in which electricity is produced 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. This design form should be completed for each individual block.

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

- **Heat Recovery Steam Generator (HRSG)** – There may be one or more HRSG or waste heat boiler in a block. Some blocks may have a single HRSG per GT/jet; others may have several GT/jet feeding a single HRSG or any combination thereof. The HRSG does not contribute electricity to the output of the block and so, is considered a component rather than a "unit".

- **Other Balance of Plant Equipment** – There are other equipment in the block used to support the production of electricity/heat energy. They are not related to any specific generating unit and are also considered as 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.

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

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

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 the 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 code and the full name of the entire block below:

Utility (Company) Code: ______________ Block Code: ________________

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 specify location on this form. Using the criteria described below, report the date the block entered service:

Date (Month/day/year) ______________________________________

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 megavoltamperes (MVA) and the rated power factor as stamped on the generator nameplate(s)).

3. Block Loading Characteristics at Time of Design

Enter the number from the list below that best describes the mode of operation for the block as it *was **originally** designed:*

Loading Characteristic: ________________

1 - Base load with minor load following
2 - Periodic start-up, load follow daily, reduced load nightly
3 - Weekly start-up, load follow daily, reduced load nightly
4 - Daily start-up, load follow daily, off-line nightly
5 - Start-up chiefly to meet daily peaks
9 - Other, describe ____

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 company 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 (megavoltamperes) 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:____________________________.

6. Does the block have co-generation (steam for other than electric generation) capabilities (yes/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 or JET ENGINE
COMPLETE ITEMS #12 TO #65
(If you have 3 GTs, 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) Code: _________ Unit Code: ___________ Block Code: _____________

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:

Date (Month/day/year) _______________________________________ Remove day

Criteria:
- a) The date the gas turbine/jet engine was first declared available for dispatch at some level of its capability, OR
- b) The date the gas turbine/jet engine first operated at 50% of its generator nameplate megawatt capability (product of the megavoltamperes (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 unit. If your company was the principal designer or general constructor, enter "SELF"

Architect/Engineer: _________________________________

Constructor: ____

15. Gas turbine/jet engine nameplate rating in MW

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 (megavoltamperes) 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): ______________________

16. Engine manufacturer - (1) Pratt & Whitney; (2) General Electric; (3) Seimans Westinghouse; (4) Alstom (ABB); (5) Rolls Royce; (6) Cooper Bessemer; (7) Worthington; (8) Allison; (9) Other.____ Add/correct/delete manufacturers.

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

21. **Startup system** - (1) Air; (2) Auxiliary motor; (3) Electric motor; (4) Natural gas; (5) Flow turbine; (6) Supercharging fan; (7) Hydraulic; (9) Other (10) LCI

22. **Startup type** - (1) Automatic, on site; (2) Automatic, remote; (9) Other

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

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 for normal cold start to full load in seconds:** ___________________ minutes

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

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) Have?

31. **SNCR reagent** - (1) Ammonia; (2) Urea; (9) Other: ____________________________

32. **SNCR injector type** - (1) Wall nozzle; (2) Lance; (9) Other: _____________________

33. **SNCR injection equipment location** - (1) Furnace; (2) Super-heater; (3) Economizer; (9) Other: _______________________________

34. **Number of SNCR injectors:** _______________________________

35. **SNCR carrier gas type** - (1) Steam; (2) Air; (9) Other: ______________________

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) Have?

39. **CR reactor** - (1) Separate; (2) In Duct; (3) Other: ______________________

40. **40SCR reagent** - (1) Ammonia; (2) Urea; (9) Other: __________________

41. **SCR ammonia injection grid location** - (1) Furnace; (2) Super-heater; (3) Economizer; (4) Zoned; (5) Other: _________________________________

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

43. **SCR Catalyst Element Type** (1) Plate; (2) Honeycomb; (9) Other: _______________

44. **SCR catalyst support material** - (1) Stainless steel; (2) Carbon steel; (9) Other: _______________________________

45. **SCR catalytic material configuration** - (1) Vertical; (2) Horizontal; (9) Other: _______________________

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: _________________________________

53. **CAH catalyst material** - (1) Titanium oxide; (2) Vanadium pentoxide; (3) Iron (II) oxide; 4) Molybdenum oxide; (9) Other: __________________________________

54. **CAH catalyst support material** - (1) Stainless steel; (2) Carbon steel; (9) Other: ______________________________

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:

Generator manufacturer: ____________________

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	☐☐☐☐ >	☐☐☐☐ >	☐☐☐☐ >
Megavoltamperes (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 "innercooled" 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 innercooled and rotor innercooled.
2 - Stator conventionally cooled and rotor conventionally cooled.
3 - Stator innercooled 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:______________________

EXCITER ON EACH GT/JET ENGINE GENERATOR

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 dc is obtained by rectifying ac from generator terminals, and dc is fed into rotor by collector rings.
2 - *Rotating dc generator* - exciter supplies dc from a commutator into the main rotor by means of collector rings.
3 - *Brushless* - an ac (rotating armature type) exciter 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 ac 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 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: ____

68. HRSG - Enclosure

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

69. HRSG - Nameplate Steam Conditions When fired situation

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

HIGH PRESSURE

Steam flow rate (in lbs/hr): ________________________

Design temperature (ºF): _______________

Design pressure (psig): ____________________________

INTERMEDIATE PRESSURE

Steam flow rate (in lbs/hr): ________________________

Design temperature (ºF): _______________

Design pressure (psig): ___________________________

LOW PRESSURE

Steam flow rate (in lbs/hr): ________________________

Design temperature (ºF): ______________

Design pressure (psig): ___________________________

REHEAT PRESSURE

Steam flow rate (in lbs/hr): ________________________

Design temperature (ºF): ______________

Design pressure (psig): ___________________________

70. HRSG - Nameplate Steam Conditions When unfired situation

Enter the following steam conditions at the full load, valves wide open design point at the exist 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 (ºF): ______________

Design pressure (psig): ___________________________

INTERMEDIATE PRESSURE

Steam flow rate (in lbs/hr): ________________________

Design temperature (ºF): ______________

Design pressure (psig): ___________________________

LOW PRESSURE

Steam flow rate (in lbs/hr): ________________________

Design temperature (ºF): ______________

Design pressure (psig): ___________________________

REHEAT PRESSURE

Steam flow rate (in lbs/hr): ________________________

Design temperature (ºF): ______________

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 is 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 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 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 equipment used to drive the feedwater (HRSG feed) pumps: ____________

1 - Motor - single speed
2 - Motor - two speed
3 - Motor - variable speed
4 - Steam turbine
5 - Shaft
6 - Motor gear
7 - Steam gear
8 - Shaft gear
9 - Other, describe

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

1 - Hydraulic
2 - Mechanical
9 - Other, describe ____

82. Auxiliary Systems - Startup Feedwater (HRSG Feed) Pumps

Startup feedwater pump(s) manufacturer(s): ____________________

Manufacturer(s) of the motor(s) that drives the startup feedwater pump(s): ____________________

PERCENT (%) of the HRSG's maximum capacity that can be achieved with a single startup feedwater pump: ________________

Indicate the additional capabilities of the startup 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 - STARTUP 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

COMPLETE ITEMS #88 TO #104

(If you have 3 steam turbines, then complete items #88-104 once for each steam turbine/generator/exciter set)

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, including site name: ____

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

90. Steam Turbine - Manufacturer

Enter the name of the manufacturer of the steam turbine:

Steam turbine manufacturer: ___________________

91. Steam Turbine - Enclosure

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

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 (megavoltamperes) 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 (ºF): _____________ Pressure (psig): _______________

First reheat steam: Temperature (ºF): _____________ Pressure (psig): _______________

Second reheat steam: Temperature (ºF): _____________ 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 startup.
2 - *Full arc* - main steam is admitted to all sectors of the turbine=s first stage at startup.
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	☐☐☐☐ >	☐☐☐☐ >	☐☐☐☐ >
Megavoltamperes (MVA) Capability	☐☐☐☐	☐☐☐☐	☐☐☐☐
RPM	☐☐☐☐	☐☐☐☐	☐☐☐☐
Power Factor (enter as %)	☐☐☐☐ >	☐☐☐☐ >	☐☐☐☐ >

*Cross compound units.

102. Generator - Cooling System

Two types of cooling methods are typically used. First is the Ainnercooled≅ 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 Aconventional≅ 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 innercooled and rotor innercooled.
2 - Stator conventionally cooled and rotor conventionally cooled.
3 - Stator innercooled 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 dc is obtained by rectifying ac from generator terminals, and dc is fed into rotor by collector rings.
2 - *Rotating dc generator* - exciter supplies dc from a commutator into the main rotor by means of collector rings.
3 - *Brushless* - an ac (rotating armature type) exciter 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 ac 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 value 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 Acondensate 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 manufacturer: ____________________

Enter the % of the condensate flow at maximum unit capacity that can be treated: ____________________

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 counterflow) - 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: ____________________

Megavoltampere (MVA) size of the main transformer(s): ____________________

HIGH SIDE voltage in kilovolts (kV) of the main transformer(s) at 55E: ____________________

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 55E: ____________________

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 55E: ____________________

LOW SIDE voltage in kilovolts (kV) of the station service transformer(s) at 55E: ____________________

Unit Design Data

Nuclear

Instructions

Submit the data in this section once during the life of each nuclear 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, a (9) is entered to indicate an alternative other than those specified. Whenever a (9) is entered, write the column number and the answer on the reverse side of the form.

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

Utility name:

Station name:

Unit name:

Data reporter:

Telephone number:

Date:

GENERAL DATA

	Col. No.	
☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
2 1	07	Card code
▨▨▨▨	09	Columns 09 through 12 are blank
☐☐☐☐	13	Year unit first paralleled for load
☐☐	17	Month unit first paralleled for load
☒☒	19	Day unit first paralleled for load

NUCLEAR REACTOR DATA

☐	21	Manufacturer - (1) Westinghouse; (2) General Electric; (3) Babcock and Wilcox; (4) Combustion Engineering; (5) General Atomics; (9) Other
☐	22	Type - (1) Pressurized (light) water (PWR); (2) Boiling (light) water (BWR); (3) CANDU; (9) Other Need additional choices.
☐☐☐☐	23	Nameplate capacity in MWt
☐☐☐☐	27	Outlet temperature in EF at nameplate capacity
☐☐☐☐	31	Outlet pressure in PSIG at nameplate capacity
☐☐☐☐☐☐☐	35	Reactor flow in thousands of pounds per hour at nameplate capacity
☐☐☐☐☐☐☐	42	Secondary loop flow in thousands of pounds per hour at nameplate Capacity, if applicable
☐	49	Number of primary loop or recirculating pumps
☐	50	Primary loop or recirculating pump manufacturer - (1) Westinghouse; 2) Worthington; (3) Byron-Jackson; (4) Ingersoll- Rand; (9) Other

NUCLEAR REACTOR DATA (Continued)

☐		51	Primary loop or recirculating pump type drives - (1) Motor variable speed; (2) Motor constant speed; (9) Other
☐		52	Steam generator manufacturer, if applicable - (1) Westinghouse; (2) Combustion Engineering; (3) Babcock and Wilcox; (4) Foster Wheeler; (9) Other Need additional choices.
☐	FOR COMMENT	53	Type of control rod drive - (1) Magnetic jack; (2) Hydraulic water; (3) Rack and pin; (9) Other
☐	FOR COMMENT	54	Control rod configuration - (1) Cruciform; (2) Rod cluster; (9) Other
☐	FOR COMMENT	55	Enter (1) if chemical shim is used
☐☐	FOR COMMENT	56	Initial weight of uranium in thousands of pounds
☐	FOR COMMENT	60	Highest initial enrichment to one-tenth percent
☐		62	Fuel type - (1) U-235 oxide; (9) Other
☐	FOR COMMENT	63	Fuel cladding material - (1) Zirconium; (2) Stainless steel; (9) Other
☐		64	Containment type - (1) Dry; (2) Pressure suppression; (9) Other

ARCHITECT/ENGINEERING DATA

☐☐	65	Architect/Engineer - (1) All A/E work inhouse; (2) Burns & Roe; (3) Black & Veatch; (4) Bechtel; (5) Brown & Root; (6) Durham & Richardson; (7) Ebasco Services; (8) Gibbs & Hill; (9) Gilbert Associates; (10) Offshore Power Systems; (11) Ralph M Parsons; 12) Pioneer Services & Engineering; (13) Sargent & Lundy; (14) Stone & Webster; (15) United Engineers & Constructors; (99) Other
▨ – ▨	67	Columns 67 through 80 are blank

STEAM TURBINE DATA

☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
2 2	07	Card code
▨▨▨▨▨	09	Columns 09 through 13 are blank Recommendation: Manufacturer by section.
☐☐	14	Manufacturer (see table of Manufacturers, page E-123)
☐	16	Type - (1) Single cylinder; (2) Tandem compound; (3) Cross Compound; (4) Triple compound; (9) Other
☐	17	Enter (1) if more than 50% of turbine is outdoors
☐☐☐☐	18	Total nameplate capacity in MW
☐☐☐☐	22	Main steam pressure in PSIG, full load at throttle
☐☐☐☐	26	Main steam temperature in EF, full load at throttle
☐☐☐☐	30	First reheat temperature in EF, if applicable
☐☐☐☐	34	Second reheat temperature in EF, if applicable
☐☐	38	Back pressure to nearest one-tenth inch of Hg for nameplate capacity and design water temperature

CONDENSER DATA

☐	40	Manufacturer - (1) Foster Wheeler; (2) Ingersoll-Rand; (3) Westinghouse; (4) Yuba; (5) Worthington; (6) C. H. Wheeler; (9) Other
☐	41	Passes - (1) Single; (2) Double
☐	42	Number of shells
☐	43	Tube material - (1) Arsenical Admirality; (2) Arsenical Aluminum Brass; (3) Stainless Steel; (4) Cupro-Nickel; (5) Aluminum Bronze; (6) Arsenical Phosphorized Copper; (9) Other
☐	44	Type cooling water - (1) Fresh; (2) Salt
☐	45	Cooling water origin - (1) River; (2) Lake; (3) Ocean or bay; (4) Cooling tower

CONDENSER DATA (Continued)

☐ 46 Number of condensate pumps

☐ 47 Condensate pump manufacturer - (1) Worthington; (2) Allis Chalmers; (3) Byron-Jackson; (4) DeLaval; (5) Ingersoll-Rand; (6) Fairbanks-Morse; (7) Pacific Pump; (9) Other

☐ 48 Number of circulating water pumps

☐ 49 Circulating water pump manufacturer - (1) Worthington; (2) Allis Chalmers; (3) Ingersoll-Rand; (4) Westinghouse; (5) Foster Wheeler; (9) Other

AUXILIARIES DATA

☐ 50 Number of secondary loop or single loop feed pumps required for normal operation at full load

☐ 51 Number of spare feed pumps which are approximately the same size as one normally used pump

☐ 52 Number of spare or startup feed pumps which are smaller than one normally used pump

☐ 53 Normal feed pump manufacturer - (1) Worthington; (2) DeLaval; (3) Ingersoll-Rand; (4) Byron-Jackson; (5) Pacific Pump; (9) Other

☐ 54 Normal feed pump type drive - (1) Motor; (2) Steam; (3) Shaft; (4) Motor gear; (5) Steam gear; (6) Shaft gear; (9) Other

☐ 55 Normal feed pump, enter (1) if hydraulic coupling(s) used

☐ 56 Normal feed pump maximum speed in RPM - (1) Under 2000; (2) 2000-2999; (3) 3000-3999; (4) 4000-4999; (5) 5000-5999; (6) 6000-6999; (7) 7000-7999; (8) 8000-8999; (9) 9000 plus

☐ 57 Number of feed water heaters on high side of feed pump

☐ 58 High pressure feed water heater manufacturer - (1) Foster Wheeler; (2) Worthington; (3) Westinghouse; (4) Yuba; (5) Baldwin-Lima-Hamilton; (6) Southwestern Engineering; (9) Other

☐☐ 59 Number of feed water heaters on low side of feed pump

AUXILIARIES DATA (Continued)

☐	61	Low pressure feed water heater manufacturer - (1) Foster Wheeler; (2) Worthington; (3) Westinghouse; (4) Yuba; (5) Baldwin-Lima-Hamilton; (6) Southwestern Engineering; (9) Other
☐	62	Computer system supplier, if applicable - (1) Westinghouse; (2) General Electric; (3) International Business Machines; (4) Leeds and Northrup; (5) Radio Corporation of America; (9) Other
☐	63	Number of computer, if applicable - (1) Two computers for this unit only; (2) One computer for this unit only; (3) Two computers shared by one or more other units; (4) One computer shared by one or more other units; (9) Other
☐	64	Computer system capability, if applicable - (1) Monitor only; (2) Monitor and control
▨ – ▨	65	Columns 65 through 80 are blank

GENERATOR DATA

☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
2 3	07	Card code
▨▨▨▨▨	08	Columns 09 through 13 are blank
☐☐	14	Manufacturer (see table of Manufacturers, page E-123)
☐	16	Type - (1) Three-phase, 60-cycle; (9) Other
☐☐☐.☐	17	Nameplate voltage to nearest one-tenth KV
☐☐☐☐	21	Nameplate capability MVA, first shaft
☐☐☐☐	25	Speed in RPM, first shaft
☐☐☐☐	29	Nameplate capability MVA, second shaft if any
☐☐☐☐	33	Speed in RPM, second shaft if any
☐☐☐☐	37	Nameplate capability MVA, third shaft if any

GENERATOR DATA (Continued)

☐☐☐☐	41	Speed in RPM, third shaft if any
☐☐	45	Nameplate power factor in percent
☐	47	Cooling medium, stator/rotor - (1) Air/air; (2) Hydrogen/hydrogen; (3) Oil/hydrogen; (4) Water/hydrogen; (9) Other
☐	48	Cooling method, stator/rotor -(1)Intercooled/ intercooled; 2) Conventional/conventional; (3) Intercooled/conventional; (9) Other
☐☐	49	Hydrogen pressure in PSIG at nameplate MVA, if applicable
☐	51	Number of exciters required by the unit for normal operation at rated output
☐	52	Type normal exciters - (1) Rotating DC generator; (2) Rotating alternator rectifier; (3) Static; (9) Other
☐	53	Type drive for normal exciters, if rotating - (1) Shaft direct; (2) Shaft gear; (3) Motor; (9) Other
☐	54	Number of spare exciters available to the unit
☐	55	Enter (1) if more than 50% of generator is outdoors
	56	Name of Unit (Columns 56-80)

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Unit Design Data

Hydro or Pumped Storage

Instructions

Submit the data in this section once during the life of each pumped storage or hydro 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, a (9) is entered to indicate an alternative other than those specified. Whenever a (9) is entered, write the column number and the answer on the reverse side of the form.

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

Utility name:

Station name:

Unit name:

Data Reporter:

Telephone number:

Date:

GENERAL DATA	Col. No.	
☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
5 1	07	Card code
▨▨▨▨	09	These columns are blank
☐☐☐☐	13	Year unit first in service (see page II-1)
☐☐	17	Month unit first in service
☒☒	19	Day unit first in service

HYDRO TURBINE/PUMP DATA

☐	21	Hydro or Pumped Storage - (1) Hydro; (2) Pump/turbine; (3) Pump
☐	22	Turbine/Pump manufacturer - (0) Allis Chalmers; (1) Pelton; (2) S. Morgan Smith; (3) Newport News; (4) Worthington; (5) Dobie; (6) I.P. Morris; (7) W.S. Morgan; 8) B.L. Hamilton; (9) Other;
☐	23	Turbine/Pump impulse type - (1) Horizontal; (2) Vertical; (9) Other
☐	24	Turbine/Pump reaction type - (1) Francis; (2) Kaplan – adjustable blade propeller; (3) Fix blade propeller; (4) Pump/turbine; (9) Other
☐☐☐☐	25	Turbine rated head to nearest foot
☐☐☐	29	Turbine rated speed to nearest RPM
☐☐☐☐☐☐	32	Turbine rating in horsepower to nearest 100 hp
☐	38	Turbine runner, type - (1) Single; (2) Twin; (3) Triplex; (4) Double

		discharge; (9) Other
☐☐	39	Number of buckets/blades per runner
☐	41	Governor type - (1) Gate shaft; (2) Actuator; (3) Cabinet type; (4) Electric; (5) Electro hydraulic, speed sensing; (6) Electronic hydraulic, speed sensing; (7) Mechanical, speed sensing; (9) Other
☐	42	Turbine bearing type - (1) Water lubricated; (2) Oil lubricated; (9) Other
☐	43	Thrust bearing location - (1) Above generator; (2) Below generator
☐	44	Guide bearing, location - (1) Above generator; (2) Below generator
▨ – ▨	45	Columns 45 through 80 are blank

****

☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
5 2	07	Card code
▨ – ▨	09	Columns 9 through 17 are blank
☐☐☐☐	18	Nameplate rating of unit (MVA times power factor)
▨ – ▨	22	Columns 22 through 80 are blank

HYDRO TURBINE/PUMP DATA (Continued)

GENERATOR DATA

☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
5 3	07	Card code
▨ – ▨	09	Columns 09 through 13 are blank
☐☐	14	Generator Manufacturer – (See Table of Manufacturers Codes)
☐	16	Generator type - (1) Three-phase, 60 cycle; (2) other
☐☐☐ . ☐	17	Nameplate voltage to nearest one-tenth KV
☐☐☐☐	21	Nameplate capability MVA, first shaft
☐☐☐☐	25	Speed in RPM, first shaft
☐☐☐☐	29	Nameplate capability MVA, second shaft if any
☐☐☐☐	33	Speed in RPM, second shaft if any
☐☐☐☐	37	Nameplate capability MVA, third shaft in any
☐☐☐☐	41	Speed in RPM, third shaft in any
☐☐	45	Nameplate power factor in percent

☐	47	Cooling medium, stator/rotor - (1) Air/air; (2) Hydrogen/hydrogen; (3) Oil/hydrogen; (4) Water/Hydrogen; (5) Air/water; (9) Other
☐	48	Cooling method stator/rotor - (1) Intercooled/intercooled; (2) Conventional/conventional; (3) Inner cooled/conventional; (9) Other
☐☐	49	Hydrogen pressure in PSIG at nameplante MVA, if applicable.
☐	51	Number of exciters required by the unit for normal operation at rated Output.
☐	52	Type normal exciters – (1) Rotating DC generator; (2) Rotating alternator rectifier; (3) Static; (9) Other.
☐	53	Type drive for normal exciters, if rotating – (1) Shaft direct; (2) Shaft gear; (3) Motor; (9) Other.
☐	54	Number of spare exciters available to the unit
☐	55	Enter (1) if more than 50% of the generator is outdoors.
	56	Name of Unit (Columns 56 through 80)

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Unit Design data

Miscellaneous

Instructions

Use these forms when no other forms in this appendix are appropriate. Specifically, use them for multi-boiler/multi-turbine and geothermal units.

Submit the data in this section once during the life of each miscellaneous 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, a (9) is entered to indicate an alternative other than those specified. Whenever a (9) is entered, write the column number and the answer on the reverse side of the form.

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

Utility name:

Station name:

Unit name:

Data reporter:

Telephone number:

Date:

GENERAL DATA	Col. No.	
☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
8 1	07	Card code
▨▨▨▨	09	Columns 09 through 12 are blank
☐☐☐☐	13	Year unit first paralleled for load
☐☐	17	Month unit first paralleled for load
☒☒	19	Day unit first paralleled for load
☐	21	Energy source - (1) Fossil (Multi-Boiler - Multi-Turbine); (3) Geothermal; (4) More than one; (9) Other
☐	22	Energy medium - (1) Water and/or steam; (2) Heavy water and/or steam; (3) Liquid metal; (4) Gas; (5) More than one; (6) Direct conversion; (9) Other
☐	23	Enter (1) if header unit
☐	24	Enter (1) if noncondensing steam turbine
▨ – ▨	25	Columns 25 through 80 are blank

POLLUTION CONTROL EQUIPMENT

☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
8 2	07	Card code
▨ – ▨	09	Columns 09 through 17 are blank
☐☐☐☐	16	Nameplate MW Rating of the unit

SELECTIVE NON-CATALYTIC REDUCTION SYSTEM (SNCR)

☐	22	R reagent - (1) Ammonia; (2) Urea; (9) Other
☐	23	SNCR injector type - (1) Wall nozzle; (2) Lance; (9) Other
☐	21	SNCR injection equipment location - (1) Furnace; (2) Superheater; (3) Economizer; (9) Other
☐☐☐	25	Number of SNCR injectors
☐	28	SNCR carrier gas type - (1) Steam; (2) Air; (9) Other
☐☐☐☐ ˎ ☐	26	R carrier gas total flow rate (thousands of lbs./hr.) i.e. 6,000,000 lbs./hr. enter 6000
☐☐☐☐	33	SNCR carrier gas pressure at nozzle (psi)
☐☐☐☐ ˎ ☐	38	SNCR carrier gas nozzle exit velocity (thousands of ft./sec.)

SELECTIVE CATALYTIC REDUCTION SYSTEM (SCR)

☐	43	reactor - (1) Separate; (2) In Duct
☐	41	SCR reagent - (1) Ammonia; (2) Urea; (9) Other
☐	45	SCR ammonia injection grid location - (1) Furnace; (2) Superheater; (3) Economizer; (4) Zoned
☐	46	SCR duct configuration - (1) Flow straighteners; (2) Turning vanes; (3) Dampers

SELECTIVE CATALYTIC REDUCTION SYSTEM (SCR) (Continued)

☐	47	SCR Catalyst Element Type (1) Plate; (2) Honeycomb; (9) Other
☐	47	SCR catalyst support material – (1) Stainless steel; (2) Carbon steel; (9) Other
☐	48	SCR catalytic material configuration – (1) Vertical; (2) Horizontal; (9) Other
☐☐☐☐.☐	49	SCR catalyst surface face area (thousands of square feet)
☐☐☐☐.☐	55	SCR catalyst volume (thousands of cubic feet)
☐☐	60	Number of SCR catalytic layers
.☐☐☐	62	SCR catalytic layer thickness (1/1000 inches)
☐	64	SCR sootblower type - (1) Air; (2) Steam; (3) Both
☐☐	65	SCR sootblower manufacturer - (see table of Manufacturers – page E-125)

CATALYTIC AIR HEATERS (CAH)

☐	67	CAH element type - (1) Laminar surface; (2) Turbulent surface; (9) Other
☐	68	CAH catalyst material - (1) Titanium oxide; (2) Vanadium pentoxide; 3) Iron (II) oxide; (4) Molybdenum oxide; (9) Other
☐	69	CAH catalyst support material - (1) Stainless steel; (2) Carbon steel; 9) Other
☐	71	CAH catalyst material configuration - (1) Horizontal air shaft; (2) Vertical air shaft
☐☐.☐	72	CAH catalyst material total face area (thousands of square feet)
☐☐.☐	75	CAH catalyst material open face area (thousands of square feet)
.☐☐☐	78	CAH catalyst material layer thickness (1/1000 inches)

GENERAL DATA

☐☐☐	01	Utility identification number
☐☐☐	04	Unit identification number
8 3	07	Card code
▨▨▨▨▨▨	09	Columns 09 through 14 are blank
☐☐☐☐	15	Total nameplate rating in MW
☐	19	Type electrical output - (1) Three-phase, 60 cycle; (9) Other
▨ – ▨	20	Columns 20 through 55 are blank
	56	Name of Unit (Columns 56-80)

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Unit Design Data

Fluidized Bed Combustion

Instructions

Use these forms to report design and installed equipment information for FLUIDIZED BED COMBUSTION (FBC) units. These units include atmospheric (circulating (CFB) and bubbling (BFB)) fluidized bed only.

Data reported on these forms should reflect the current condition and design of the unit (installed equipment, etc.). Do not report data for start-up equipment or that not used to carry normal load unless specifically requested.

You will notice some data fields designated as M1 and M2. These indicate that the equipment being reported may have been supplied by more than one manufacturer. Use fields designated as M1 to report all the data associated with one manufacturer's equipment and M2 for the other.

Utility name: ____

Station name: ____

Unit name: ____

Date reporter: ____

Telephone number: ____

Date: ____

GENERAL UNIT DATA

1. Identification

A series of codes uniquely identifies your utility and units. NERC assigned a unique code to identify your utility. You must assign the unique code that will identify the FBC unit being reported. This code may be any number from 650 to 699. Enter the unique utility and unit code and the full name of the unit below:

☐☐☐ Utility Code ☐☐☐ Unit Code

Name of unit

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

2. Date the Unit Entered Service

The in-service date establishes the starting point for review of the historical performance of each unit. Using the criteria described below, report the date the unit entered service:

☐☐☐☐ Year ☐ Month ☐☐ ~~Day~~

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

3. Unit Loading Characteristics at Time of Unit's Design

Enter the number from the list below that best describes the mode of operation the unit *was originally designed for:*

☐

1 - Base load with minor load following
2 - Periodic start-up, load follow daily, reduced load nightly
3 - Weekly start-up, load follow daily, reduced load nightly
4 - Daily start-up, load follow daily, off-line nightly
5 - Start-up chiefly to meet daily peaks
9 - None of the above

4. ~~Design and Construction Contractors~~

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

______________________ ~~Architect/Engineer~~
______________________ ~~Constructor~~

Is the CFB original or retro fit

5. Boiler - Manufacturer

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

______________________ Boiler manufacturer (original)
______________________ ~~Boiler manufacturer (FBC portion) – retrofit~~
______________________ Manufacturer's model or series name or number (original)
______________________ ~~Manufacturer's model or series name or number (retrofit)~~

6. Boiler - Enclosure

Is 50% or more of the boiler outdoors (not enclosed in building framing and siding)?

☐ 1 – Yes 2 – No

7. Boiler - Nameplate Conditions

Enter the following steam conditions for the MAIN STEAM LINES at the full load, valves wide open design point:

☐☐☐☐☐☐☐☐ Steam flow rate (in lbs/hr)

☐☐☐☐ Design temperature (°F)

☐☐☐☐ Design pressure (psig)

8. Boiler - Fuel Firing System

☐ Enter the type of fuel firing system found in the furnace:

1 - *Circulating fluidized bed (CFB)* - an FBC with no clear region between the relatively dense bed and lean phase. A circulating bed usually has a superficial velocity greater than 13 ft./sec. and has a reinjection/recycle ratio greater than 5. Compared to a bubbling bed, a circulating bed has significantly higher solids concentration throughout the combustor.

2 - *Bubbling fluidized bed (BFB)* - an FBC with a definite region between the relatively dense bed and lean phase. A bubbling bed usually has a superficial velocity of less than 13 ft./sec. and a reinjection/recycle ratio of less than 5. In addition, the fuel and sorbent are usually fed either overbed or underbed.

9. Boiler - Method of Solid Feed to the Boiler

Enter the method of feeding solid fuel, bed material and sorbent into the boiler.

☐ For fuel:

1 - *Over-bed feed (BFB)* - injection of solids above the fluidized bed into a slightly negative pressure environment where the solids then fall into the fluidized bed.
2 - *Under-bed feed (BFB)* - injection of solids through multiple points to the bottom of the fluidized bed into a positive pressure environment.
3 - *Both over-bed and under-bed feed (BFB)* - combination of the two above.
4 - *Within-bed feed (CFB)* - injection of solids through a few feed points to the fluidized bed into a positive pressure environment. (This refers to the method of fuel feed in a circulating bed.)

☐ For sorbent:

1 - Over-bed feed (BFB) - defined above
2 - Under-bed feed (BFB) - defined above
3 - Both over-bed and under-bed feed (BFB) - defined above
4 - Within-bed feed (CFB) - defined above

☐ Feed with fuel:

1 - Yes
2 - No

☐ For bed material:

1 - Over-bed feed (BFB) - defined above
2 - Under-bed feed (BFB) - defined above
3 - Both over-bed and under-bed feed (BFB) - defined above
4 - Within-bed feed (CFB) - defined above

10. Boiler - Type of Circulation

☐ Enter the type of circulation:

1 - *Natural (thermal)* - water flows through furnace wall tubes unaided by circulating pumps (primarily used with subcritical units).
2 - *Controlled (forced or pump-assisted thermal)* - water flows through furnace wall and/or in-bed evaporator tubes aided by boiler recirculation pumps located in the downcomers or lower headers of the boiler (used on some subcritical units).
3 - *Once through* - no recirculation of water through the furnace wall tubes and no steam drum (used on super- and subcritical units).
4 - *Combination natural and controlled*

11. Boiler - Circulation System

Enter the following information on the pump(s) used to recirculate water through the boiler:

____________________ ~~Boiler recirculation pump(s) manufacturer(s).~~

____________________ ~~Number of boiler recirculation pumps per manufacturer; include~~ installed spares.

____________________ TOTAL number of boiler recirculation pumps for the unit.

____________________ MINIMUM number of boiler recirculation pumps required to obtain maximum capacity from the unit.

M1 ☐ M2 ☐ ~~Enter the type of boiler recirculation pump(s) used~~:

1 - *Injection (or injection seal)* - controlled-leakage boiler recirculation pumps mounted vertically with a rigid shaft designed to carry its own thrust.

2 - *Leakless (canned, canned-motor or zero-leakage)* - leakless pump and its motor designed as an integral pressurized sealed unit.

9 - *Other, describe* ____

12. ~~Boiler – Heat Exchanger~~

In bed:	**Reheat**	**Supht**	**Evap**	**Preheat**
Type of heat exchanger	____	____	____	____
Tube materials*	____	____	____	____
Manufacturer	____	____	____	____
Total number of exchangers including spares	____	____	____	____
Miminum number of exchangers for full load operation	____	____	____	____
Location of exchangers (external/internal)	____	____	____	____
Square feet of surface	____	____	____	____

Convective:	**Reheat**	**Supht**	**Evap**	**Preheat**
Type of heat exchanger	____	____	____	____
Tube materials*	____	____	____	____
Manufacturer	____	____	____	____
Total number of exchangers including spares	____	____	____	____
Miminum number of exchangers for full load operation	____	____	____	____
Location of exchangers (external/internal)	____	____	____	____
Square feet of surface	____	____	____	____

Radiant:	**Reheat**	**Supht**	**Evap**	**Preheat**
Type of heat exchanger	____	____	____	____
Tube materials*	____	____	____	____
Manufacturer	____	____	____	____
Total number of exchangers including spares	____	____	____	____
Miminum number of exchangers for full load operation	____	____	____	____
Location of exchangers (external/internal)	____	____	____	____
Square feet of surface	____	____	____	____

*If more than one material is used, indicate each type with the predominant one mentioned first.

13. Boiler - Char Reinjection System

Char (unburned fuel, sorbent, and ash) is captured by the separator and transferred to disposal and/or reinjected into the fluidized bed. Enter the following information on the char reinjection system.

____________________ ~~Separator manufacturer(s).~~

____________________ Number of separators including spares.

____________________ Minimum number of separators for full load operation.

____________________ Type of separator (cyclone, multiclone, ubeam, horizontal).

____________________ ~~Separator recirculation temperature.~~

____________________ ~~Liner (refractory or water cooled).~~

____________________ ~~Type of pressure seal (lockhoppers, rotary valve, gravimetric~~ pump, loop seal).

____________________ Number of char reinjection systems including installed spares.

____________________ ~~High pressure loop seal air fan(s)/blower(s) manufacturer(s).~~

____________________ ~~Manufacturer(s) of the motor(s) that drives the high pressure loop~~ seal fan(s)/blower(s).

____________________ ~~Number of high pressure loop seal fans/blowers per manufacturer;~~ include installed spares.

____________________ TOTAL number of high pressure loop seal fans/blowers for the unit.

____________________ MINIMUM number of high pressure loop seal fans/blowers required to obtain maximum capacity from the unit.

M1 M2
☐ ☐ ~~**Enter the type of high pressure loop seal fan(s)/blower(s) at the unit**~~

~~*Centrifugal* - blades mounted on an impeller (or rotor) which rotates within a spiral or volute housing. Mark the type of blades used on this type of fan:~~

~~1 - Forward curved~~
~~2 - Straight (radial or radial tipped)~~
~~3 - Backward curved (air foil or flat)~~
~~4 - *Axial (fixed or variable pitch)* - blades attached to central hub parallel to air flow.~~
~~5 - *Positive displacement (rotary)* - such blowers are essentially constant-volume blowers with variable discharge pressure. Volume can be varied only by changing the speed or by by-passing or wasting some of the capacity of the machine. The discharge pressure will vary with the resistance on the discharge side of the system.~~
~~9 - *Other, describe* ____________________~~

☐☐☐☐ ☐☐☐☐

14. Boiler - Design Parameters

☐☐☐☐ Percent SO_2 removal

▲

____________________ *Calcium-to-sulfur molar ratio* - moles of calcium in the sorbent divided by the moles of sulfur in the fuel. (This is an indicator of the amount of sorbent required to reduce SO_2 to desired limit.)

____________________ *Reinjection/recycle ratio* - mass flow rate of char material that is reinjected to the combustor divided by the mass flow rate of fuel feed.

____________________ *Average superficial air velocity (ft/sec)* - velocity of air through a fluidized bed. The superficial velocity is based on the cross sectional area of the bed and the total air flow rate. The density used to calculate superficial velocity is based on the average bed temperature and pressure.

____________________ *Fuel feed rate*

____________________ *Sorbent feed rate*

15. Boiler - Furnace (Surface) Release Rate

Enter the furnace (surface) release rate of the PRIMARY FUEL. This rate is specified in the boiler contract as the heat available per hour, in Btu per square foot of heat absorbing surface in the furnace. The absorbing surface includes all heat exchange surfaces (waterwalls, superheaters, external, etc.).

☐☐☐☐☐☐☐☐ Furnace (surface) release rate at maximum continuous rating (in Btu's/SqFt/Hr)

16. Boiler - Furnace Volumetric Heat Release Rate

Enter the furnace volumetric heat release rate of the PRIMARY FUEL. This rate is the total quantity of thermal energy released into the furnace by the fuel at its higher heating value (HHV). The volumetric heat release rate is expressed in Btu per cubic foot of total heat exchanger volume per hour. It does not include the heat added by preheated air or the heat unavailable due to evaporation of moisture in the fuel and combustion of hydrogen.

☐☐☐☐☐☐☐☐ Furnace volumetric heat release rate at maximum continuous rating (in Btu/CuFt/Hr)

17. Boiler - Primary and Secondary Design Fuel, Sorbents, and Non-sorbent

The PRIMARY fuel is defined as that fuel primarily used to sustain load on the unit, (i.e., the first fuel of choice for either economic or control reasons) or that fuel contributing 50% or more of the load-carrying Btu. The SECONDARY fuel is that normally used to sustain load if the PRIMARY fuel is unavailable or uneconomical. Do NOT report ignition or warm-up fuel.

Sorbent is a material (usually a limestone or dolomite) that is fed into the combustor with the solid fuel (coal) thereby reducing the SO_2 that is released during the combustion process.

Non-sorbent is a material other than sorbent that is used to build the bed. All characteristics are based on an ultimate analysis of the as-received fuel using appropriate ASTM testing methods. Additional notes are provided where appropriate.

Primary Fuel ☐☐

Secondary Fuel ☐☐

Fuel Codes

CC	Coal	**PR**	Propane
LI	Lignite	**SL**	Sludge Gas
PE	Peat	**GE**	Geothermal
WD	Wood	**NU**	Nuclear
OO	Oil	**WM**	Wind
DI	Distillate Oil (#2)	**SO**	Solar
KE	Kerosene	**WH**	Waste Heat
JP	JP4 or JP5	**OS**	Other - Solid (Tons)
WA	Water	**OL**	Other - Liquid (BBL)
GG	Gas	**OG**	Other - Gas (Cu.Ft.)

Fuel Characteristics

☐☐☐☐☐☐☐ ☐☐☐☐☐☐☐ ~~Average Heat Content in Fuel~~
(Btu/lb, Btu/bbl, Btu/CuFt)

☐☐▲☐ ☐☐☐▲ ~~% Ash Content (to one decimal place)~~

☐▲☐ ☐▲☐ ~~% Sulfur Content (to one decimal place)~~

☐☐▲☐ ☐☐☐▲ ~~% Moisture Content (to one decimal place)~~

☐☐☐☐ ☐☐☐☐ ~~Ash Softening Temp (°F) (in a reducing atmosphere)~~
(ASTM STD D-1857, Part 26) (coal units only)

☐☐☐ ☐☐☐ ~~Grindability Hardgrove Index~~
(ASTM STD D-409, Part 26) (coal units only)

☐☐▲☐ ☐☐☐▲ ~~% Vanadium & Phosphorous (to one decimal place)~~
(oil units only)

☐☐☐ ☐☐☐ ~~Fuel Top (largest particle) size~~

17. Boiler - Primary and Secondary Design Fuel, Sorbents, and Non-sorbent (Continued)

Sorbent: enter type of sorbent used

Primary	Secondary	Type
☐☐☐	☐☐☐	~~Abrasion Index (identify index used)~~
☐☐☐☐ ▲	☐☐☐☐ ▲	~~% by Mass Magnesium Content (to one decimal place)~~
☐☐☐☐ ▲	☐☐☐☐ ▲	~~% by Mass Calcium Content (to one decimal~~
☐☐☐☐ ▲	☐☐☐☐ ▲	~~% by Mass Carbon Dioxide Content (to one decimal~~ place)
☐☐☐☐ ▲	☐☐☐☐ ▲	~~% by Mass Moisture Content (to one decimal place)~~
☐☐☐	☐☐☐	~~Sorbent top (largest particle size)~~

Non-sorbent:

Pr~~imary~~	~~Secondary~~	~~Type~~
☐☐☐☐	☐☐☐☐	~~Initial Ash Fushion Temperature (ºF)~~
☐☐☐	☐☐☐	~~Non-sorbent Top (largest particle) size~~

18. Boiler - Fuel Oil Forwarding System

The fuel oil forwarding system transfers oil from the main storage tanks to smaller tanks closer to the unit. (See Item 20 for pumps that feed oil directly to the burners.) Enter the following data for this system:

____________________ Fuel forwarding/transfer pump(s) manufacturer(s).

____________________ Manufacturer(s) of the motor(s) that drives the fuel forwarding/transfer pump(s).

____________________ Number of fuel forwarding/transfer pumps per manufacturer; include installed spares.

____________________ TOTAL number of fuel forwarding/transfer pumps for the unit.

____________________ MINIMUM number of pumps required to obtain maximum capacity from the unit.

19. Boiler - Burner Management Systems

Enter the name of the manufacturers for the following burner management systems:

____________________ Manufacturer of the combustion control system that coordinates the feedwater, air, and fuel subsystems for continuous unit 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.

20. Boiler - Fuel Oil Burner Supply System (In-plant)

These are secondary, high pressure pumps within the area of the boiler used to feed fuel oil directly to the burners.

____________________ Fuel oil burner supply pump(s) manufacturer(s).

____________________ Manufacturer(s) of the motor(s) that drives the fuel oil burner supply pump(s).

____________________ Number of fuel oil burner supply pumps per manufacturer; include installed spares.

____________________ TOTAL number of fuel oil burner supply pumps for the unit.

____________________ MINIMUM number of fuel oil burner supply pumps required to obtain maximum capacity from the unit.

21. Boiler - Burner Systems

Enter the following information on the installed burner systems used for the preliminary heatup of the boiler:

Duct burner: yes or no

____________________ Duct burner manufacturer

~~☐☐☐☐☐☐ Btu rating~~

☐ Enter the type of duct burner fuel used:

A - Light (distillate) oil
B - Heavy oil
C - Gas
D - Coal
E - Oil and Gas
F - Propane
M - More than one

~~☐ Enter the type of duct burner used:~~

~~1 - *Pilot torch lighter* - an oil or gas igniter that uses an electric spark to ignite the fuel.~~
~~2 - *Carbon arc* - a carbon or graphite electrode is energized and used to ignite the fuel.~~
~~3 - *High energy arc* - a low voltage, high energy pulse arc is used to ignite the fuel.~~
~~4 - *Plasma arc* - a high dc voltage current is used to ionize the air resulting in a high energy arc that ignites the fuel.~~
~~4 - *Manual* - Ignition torch or lance inserted into boiler by operating personnel.~~
~~5 - *Combination* of any burner types above.~~
~~9 - *Other, describe* ____~~

Warmup burner:

____________________ ~~Warmup burner manufacturer~~

~~☐☐☐☐☐☐ Btu rating~~

☐ Enter the type of warmup burner fuel used:

A - Light (distillate) oil
B - Heavy oil
C - Gas
D - Coal
E - Oil and Gas
F - Propane
M - More than one

~~21. **Boiler - Burner Systems** (Continued)~~

~~☐ Enter the type of warmup burner used:~~

~~1 - *Pilot torch lighter* - an oil or gas igniter that uses an electric spark to ignite the fuel.~~
~~2 - *Carbon arc* - a carbon or graphite electrode is energized and used to ignite the fuel.~~
~~3 - *High energy arc* - a low voltage, high energy pulse arc is used to ignite the fuel.~~
~~4 - *Plasma arc* - a high dc voltage current is used to ionize the air resulting in a high energy arc that ignites the fuel.~~
~~5 - *Manual* - Ignition torch or lance inserted into boiler by operating personnel.~~
~~6 - *Combination* of any burner types above.~~
~~9 - *Other, describe* ____________________________~~

~~**Lance injection burner:**~~

~~____________________ Lance injection burner manufacturer.~~

~~☐☐☐☐☐☐ Btu rating~~

~~☐ Enter the type of lance injection burner fuel used:~~

~~A - Light (distillate) oil~~
~~B - Heavy oil~~
~~C - Gas~~
~~D - Coal~~
~~E - Oil and Gas~~
~~F - Propane~~
~~M - More than one~~

~~☐ Enter the type of lance injection burner used:~~

~~1 - *Pilot torch lighter* - an oil or gas igniter that uses an electric spark to ignite the fuel.~~
~~2 - *Carbon arc* - a carbon or graphite electrode is energized and used to ignite the fuel.~~
~~3 - *High energy arc* - a low voltage, high energy pulse arc is used to ignite the fuel.~~
~~4 - *Plasma arc* - a high dc voltage current is used to ionize the air resulting in a high energy arc that ignites the fuel.~~
~~5 - *Manual* - Ignition torch or lance inserted into boiler by operating personnel.~~
~~6 - *Combination* of any burner types above.~~
~~9 - *Other, describe*~~

22. Boiler - Solid Fuel Handling Systems - Yard Area

Enter the following information on the equipment installed in the solid fuel yard:

______________________ ~~Stacker/reclaimer system manufacturer.~~
______________________ Number of critical path solid fuel conveyor systems available to the UNIT.

~~23. Boiler - Solid Fuel Crushers~~

~~Enter the following information on the solid fuel crushing equipment used to supply solid fuel to the in-plant solid fuel-holding bunkers for burning in the boiler:~~

______________________ ~~Crusher(s) manufacturer(s).~~

______________________ ~~Manufacturer(s) of the motor(s) that drives the crusher(s).~~

______________________ ~~Type of crusher(s).~~

______________________ ~~TOTAL number of crushers.~~

24. Boiler - Solid Fuel Feed to Boiler

Enter the following information on the solid fuel feed equipment used to supply solid fuel from the in-plant solid fuel-holding bunkers to the over-bed, under-bed, or within-bed entrance of the boiler:

______________________ ~~Type of crusher(s).~~
______________________ ~~Crusher(s) manufacturer(s).~~
______________________ ~~Manufacturer(s) of the motor(s) that drives the crusher~~(s).
______________________ TOTAL number of crushers.

______________________ Gravimetric feeder manufacturer(s).
______________________ ~~Manufacturer(s) of the motor(s) that d feeder(s).~~
______________________ TOTAL number of gravimetric feeder

Enter type of feeder (i.e Grav, Vol, Pneumatic

______________________ ~~Volumetric feeder manufacturer(s).~~
______________________ ~~Manufacturer(s) of the motor(s) that drives the volumetric feeder(s).~~
______________________ ~~TOTAL number of volumetric feeders.~~

______________________ ~~Pneumatic feeder manufacturer(s).~~
______________________ ~~Manufacturer(s) of the motor(s) that drives the pneumatic feeder(s).~~
______________________ ~~TOTAL number of pneumatic feeders.~~

______________________ ~~Type of pressure seal (lockhoppers, rotary valve, gravimetric pump,~~ loop seal).
______________________ Number of solid fuel trains including installed spares.

~~25. Boiler - Secondary Fuel Feed (other than coal)~~

☐ ~~Type of secondary boiler fuel feed system:~~

~~1 - Lance~~
~~2 - Nozzle~~
~~9 - Other, describe ____________________~~

☐☐☐☐ ~~Percent (%) load carrying capability~~
▲

~~Enter the type of solid fuel feed(s):~~

~~____________ Gravimetric feeder manufacturer(s).~~
~~____________ Manufacturer(s) of the motor(s) that drives the gravimetric feeder(s).~~
~~____________ TOTAL number of gravimetric feeders.~~

~~____________ Volumetric feeder manufacturer(s).~~
~~____________ Manufacturer(s) of the motor(s) that drives the volumetric feeder(s).~~
~~____________ TOTAL number of volumetric feeders.~~

~~____________ Pneumatic feeder manufacturer(s).~~
~~____________ Manufacturer(s) of the motor(s) that drives the pneumatic feeder(s).~~
~~____________ TOTAL number of pneumatic feeders.~~

~~____________ Type of pressure seal (lockhoppers, rotary valve, gravimetric pump, loop seal).~~

~~____________ Number of secondary solid fuel trains including installed spares.~~

26. Boiler - Sorbent Crusher or Pulverizer Capability

Enter the following information on the capability of the installed crusher(s) or pulverizer(s):

____________ ~~Sorbent crusher(s) or pulverizer(s) manufacturer(s).~~

____________ ~~Manufacturers' model number for the sorbent crusher(s) or~~ pulverizer(s).
____________ ~~Design sorbent flow rate in lb/hr PER sorbent crusher or pulverizer~~ using design fuel specifications.
____________ ~~Number of sorbent crushers or pulverizers per manufacturer~~; include installed spares.
____________ TOTAL number of sorbent crushers or pulverizers for the unit.

____________ MINIMUM number of sorbent crushers or pulverizers required to obtain maximum capacity from the unit.
____________ ~~Sorbent stacker/reclaimer manufacturer.~~

26. ~~**Boiler - Sorbent Crusher or Pulverizer Capability (Continued)**~~

M1 M2
☐ ☐ Enter the type of sorbent crusher(s) or pulverizer(s) at the unit:

1 - *Ball* - grinding elements are balls that operate freely in a race on a rotating grinding table.
2 - *Roll race* - rotating grinding table that moves sorbent through a series of rollers or wheels supported within the pulverizer.
3 - *Ball tube (Hardinge)* - horizontal, rotating, grinding cylinder containing steel balls that move within the cylinder and grind or crush the sorbent.
4 - *Impact (Attrition)* - series of fixed or hinged hammers that rotate within a closed chamber impacting and crushing the sorbent.
9 - *Other, describe* ____________________

27. Boiler - Sorbent Feed System to Boiler

see question 24

Enter the following information on the sorbe[illegible]ent used to supply sorbent from the in-plant sorbent-holding bunkers to the boiler:

____________________ Gravimetric feeder manufacturer(s).
____________________ Manufacturer(s) of the motor(s) that drives the gravimetric feeder(s).
____________________ TOTAL number of gravimetric feeders.

____________________ Volumetric feeder manufacturer(s).
____________________ Manufacturer(s) of the motor(s) that drives the volumetric feeder(s).
____________________ TOTAL number of volumetric feeders.

____________________ Pneumatic feeder manufacturer(s).
____________________ Manufacturer(s) of the motor(s) that drives the pneumatic feeder(s).
____________________ TOTAL number of pneumatic feeders.

____________________ Type of pressure seal (lockhoppers, rotary valve, gravimetric pump, loop seal).
____________________ Number of sorbent feed trains including installed spares.

see question 24

28. Boiler - Bed Material Injection Feed System

Bed materials are the solids in the bed or dense phase of the combustor. Enter the following information on the bed material feed equipment used to supply bed material from the in-plant bed material-holding bunkers to the boiler:

____________________ Gravimetric feeder manufacturer(s).
____________________ Manufacturer(s) of the motor(s) that drives the gravimetric feeder(s).
____________________ TOTAL number of gravimetric feeders.

____________________ Volumetric feeder manufacturer(s).
____________________ Manufacturer(s) of the motor(s) that drives the volumetric feeder(s).
____________________ TOTAL number of volumetric feeders.

____________________ Pneumatic feeder manufacturer(s).
____________________ Manufacturer(s) of the motor(s) that drives the pneumatic feeder(s).
____________________ TOTAL number of pneumatic feeders.

____________________ Type of pressure seal (lockhoppers, rotary valve, gravimetric pump, loop seal).
____________________ Number of bed material trains including installed spares.

29. Boiler - Balanced Draft or Pressurized Draft

☐ Enter the type of boiler draft:

1 - *Balanced draft* - equipped with both induced draft and forced draft fans. The furnace operates at positive pressure at air entry and negative pressure at flue gas exit.
2 - *Pressurized draft* - equipped with forced draft fans only. The furnace and draft systems operate at positive pressure.

IF the unit was originally designed as a pressurized draft unit and converted to a balanced draft design, indicate the date the conversion was completed:

☐☐☐☐ Year ☐☐ Month ☐☐ ~~Day~~

30. Boiler - Primary Air (Forced Draft) Fan System

Primary air is used for combustion and/or fluidization processes. Enter the following information on the installed primary air (forced draft) fans:

____________________ ~~Primary air (forced draft) fan(s) manufacturer(s).~~

____________________ ~~Manufacturer(s) of the motor(s)/steam turbine(s) that drives the~~ primary air (forced draft) fan(s).

____________________ ~~Number of primary air (forced draft) fans per manufacturer~~; include installed spares.

____________________ TOTAL number of primary air (forced draft) fans for the unit.

____________________ MINIMUM number of primary air (forced draft) fans required to obtain maximum capacity from the unit.

☐☐☐☐ ~~Horsepower of fan(s)~~

M1 M2

☐ ☐ ~~Enter the type of primary air (forced draft) fan(s) at the unit:~~

~~*Centrifugal* - blades mounted on an impeller (or rotor) which rotates within a spiral or volute housing. Mark the type of blades used on this type of fan:~~

~~1 - Forward curved~~
~~2 - Straight (radial or radial tipped)~~
~~3 - Backward curved (air foil or flat)~~
~~4 - *Axial (fixed or variable pitch)* - blades attached to central hub parallel to air flow.~~
~~9 - *Other, describe*~~ ______________________________

M1 M2

☐ ☐ Enter the type of primary air (forced draft) fan drive(s) at the unit:

1 - Single-speed motor
2 - Two-speed motor
3 - Variable-speed motor
4 - Steam turbine
5 - Fluid drive
9 - Other, describe ______________________________

31. Boiler - Induced Draft Fan System

Enter the following information on the induced draft fans installed at the unit:

______________________ ~~Induced draft fan(s) manufacturer(s)~~

______________________ ~~Manufacturer(s) of the motor(s)/steam turbine(s) that drives the~~ induced draft fan(s).

______________________ ~~Number of induced draft fans per manufacturer; include installed~~ spares.

______________________ TOTAL number of induced draft fans for the unit.

______________________ MINIMUM number of induced draft fans required to obtain maximum capacity from the unit.

☐☐☐☐ ~~Horsepower of fan(s)~~

M1 M2
☐ ☐ ~~Enter the type of induced draft fan(s) at the unit:~~

~~*Centrifugal* - blades mounted on an impeller (or rotor) which rotates within a spiral or volute housing. Mark the type of blades used on this type of fan:~~

~~1 - Forward curved~~
~~2 - Straight (radial or radial tipped)~~
~~3 - Backward curved (air foil or flat)~~
~~4 - *Axial (fixed or variable pitch)* - blades attached to central hub parallel to air flow.~~
~~9 - *Other, describe*~~ ______________________________

M1 M2
☐ ☐ Enter the type of induced draft fan drive(s) at the unit:

1 - Single-speed motor
2 - Two-speed motor
3 - Variable-speed motor
4 - Steam turbine
5 - Fluid drive
9 - Other, describe ______________________________

32. Boiler - Secondary Air Fan System

Secondary air is used for purposes such as fuel transport. Enter the following information on the secondary air fans installed at the unit:

____________________	~~Secondary air fan(s) manufacturer(s).~~
____________________	~~Manufacturer(s) of the motor(s)/steam turbine(s) that drives the~~ secondary air fan(s).
____________________	~~Number of secondary air fans per manufacturer; include installed~~ spares.
____________________	TOTAL number of secondary air fans for the unit.
____________________	MINIMUM number of secondary air fans required to obtain maximum capacity from the unit.

☐☐☐☐ Horsepower of fan(s)

SAME AS A FOSSIL STEAM UNIT
FOR REMAINDER OF FORM.

M1 ☐ M2 ☐ Enter the type of secondar

Centrifugal - blades mounte piral or
volute housing. Mark the typ

1 - Forward curved
2 - Straight (radial or radial tipped)
3 - Backward curved (air foil or flat)

4 - *Axial (fixed or variable pitch)* - blades attached to central hub parallel to air flow.
9 - *Other, describe* ____

M1 ☐ M2 ☐ Enter the type of secondary air fan(s) drives at the unit:

1 - Single-speed motor
2 - Two-speed motor
3 - Variable-speed motor
4 - Steam turbine
5 - Fluid drive
9 - Other, describe ____

33. Boiler - Primary Air Heating System

Enter the following information about the air heaters used to transfer the excess heat from the flue gases to the incoming primary air for the furnace:

____________________	Primary air heater(s) manufacturer(s).
____________________	TOTAL number of primary air heaters per manufacturer.

☐☐☐☐ Air heater outlet temperature.

33. Boiler - Primary Air Heating System (Continued)

M1 M2

☐ ☐ Enter the type of primary air heater(s) at the unit:

1 - *Regenerative (Ljungstrom)* - rotating heat exchanger that continuously rotates sections (baskets) composed of metal plates from the hot flue gas furnace exit plenum to the furnace intake air plenums thus heating the intake air.

2 - *Tubular* - hot flue gas from the furnace is channeled through tubes (vertical or horizontal) where the heat is transferred to the furnace intake air passing across the outside of the tubes.

3 - *Steam Coil* - similar to tubular except steam is used to preheat the intake air.

4 - *Regenerative (Rothemule)* - rotating heat exchanger similar to Regenerative (Ljungstrom) except sections (baskets) remain stationary while the housing rotates.

5 - *Recuperative (plate-type)* - air heater which uses thin, flat, parallel plates with alternate wide and narrow spacing to match the ratio of gas weight to air weight. Thus, flue gas is made to pass through the wider spaced passages (1” to ½”) and the air through the narrower passages (3/4” to ¼”) generally in counter flow relation.

6 - *Heat pipe* - this air heater allows the transfer of very substantial quantities of heat through small surface areas. Hollow pipes with wicking material covering the inside surface area used to transfer the heat in the following manner. A condensible fluid inside the pipes permeates the wicking material by capillary action. When heat is added by the flue gas at one end of the pipes (evaporator), liquid is vaporized in the wick and the vapor moves to the central core. At the air end of the pipes, heat is removed (the condenser) and the vapor condenses back into the wick. Liquid is replenished in the evaporator section by capillary action.

9 - *Other, describe* ________________________________

34. Boiler - Secondary Air Heating System

Enter the following information about the secondary (or backup) air heaters used in the transfer of excess heat from the flue gases to the incoming primary air for the furnace:

____________________ Secondary air heater(s) manufacturer(s).

____________________ TOTAL number of secondary air heaters per manufacturer.

☐☐☐☐ Air heater outlet temperature.

M1 M2

☐ ☐ Enter the type of additional air heater(s) at the unit (see item 33 for definitions of each type):

1 - Regenerative (Ljungstrom)
2 - Tubular
3 - Steam Coil
4 - Regenerative (Rothemule)
5 - Recuperative (plate-type)
6 - Heat Pipe
9 - Other, describe ________________________________

35. Boiler - Soot Blowers

Enter the following information on the soot blower system installed on the furnace:

____________________ Soot blower(s) manufacturer(s).

____________________ TOTAL number of soot blowers installed on the furnace per manufacturer.

Enter the type(s) of medium(s) used to blow the soot. If a variety of soot blowers are used at the unit, note the number of each.

M1		M2		M3	
☐	☐☐☐	☐	☐☐☐	☐	☐☐☐
Type	Number	Type	Number	Type	Number

1 - Steam
2 - Air
3 - Water
4 - Sonic
5 - Steam/Air
9 - Other, describe ____

36. Boiler - Bed Material Coolers

Bed material coolers are heat exchangers used to cool the hot bed material as it is drained from the fluidized bed. Enter the following information on the bed material coolers.

____________________ Bed material cooler manufacturer.

____________________ TOTAL number of bed material coolers installed on the unit.

____________________ Bed material cooler tube materials used in the majority (50% or greater) of the tubes made by each manufacturer.

____________________ Bed material cooler type (screw, counter flow, fluid bed, other).

☐☐☐☐ Exit material temperature (°F).

37. Boiler - Bed Material Handling System

Enter the following information on the bed material handling equipment:

______________________ Bed material handling system manufacturer.

☐ Enter the type of bed material removal system used:

1 - *Vacuum* - bed material conveying system operates at a vacuum relative to the bed material collection hoppers.
2 - *Pressure* - bed material conveying system operates at a pressure greater than the pressure in the bed material collection hoppers.
3 - *Vacuum-pressure* - employs the best features of both the vacuum and pressure systems.
4 - *Water (sluice)* - employs water to sluice the bed material away from the hoppers.
5 - *Vacuum/water slurry* - bed material conveying system operates at a vacuum relative to the bed material collection hoppers.
6 - *Mechanical* - refers to mechanical conveying systems such as conveyor belts, bucket elevators, and screw conveyors.
9 - *Other, describe*

38. Boiler - Char Disposal System

Char (unburned fuel, sorbent, and ash) is captured by the separator and transferred to disposal and/or reinjected into the fluidized bed. Enter the following information on the char disposal handling equipment:

______________________ Char disposal handling system manufacturer.

☐ Enter the type of char disposal system used:

1 - *Vacuum* - char disposal conveying system operates at a vacuum relative to the char disposal collection hoppers.
2 - *Pressure* - char disposal conveying system operates at a pressure greater than the pressure in the char disposal collection hoppers.
3 - *Vacuum-pressure* - employs the best features of both the vacuum and pressure systems.
4 - *Water (sluice)* - employs water to sluice the char disposal away from the hoppers.
5 - *Vacuum/water slurry* - char disposal conveying system operates at a vacuum relative to the char disposal collection hoppers.
6 - *Mechanical* - refers to mechanical conveying systems such as conveyor belts, bucket elevators, and screw conveyors.
9 - *Other, describe* ____

39. Boiler - Electrostatic Precipitator

Fly ash contained in the furnace exit flue gases can be removed by using an electrostatic precipitator. Enter the following information:

______________________ Electrostatic precipitator manufacturer.
______________________ Number of fields.
______________________ Surface collection area (SCA) (ft^2/kacfm) at maximum continuous rating (MCR).

39. Boiler - Electrostatic Precipitator (Continued)

☐ Enter the location of the electrostatic precipitator with respect to the air heaters:

1 - Before air heaters
2 - After air heaters
3 - Both before and after, or between the air heaters

40. Boiler - Baghouse Fly Ash System

Fly ash contained in the furnace exit flue gas is removed using fabric or fabric bag fillers. Enter the following information:

____________________ Baghouse system manufacturer.

____________________ Manufacturer(s) of the baghouse exhauster booster fan(s).

____________________ Manufacturer(s) of the motor(s) that drive the baghouse booster fan(s).

____________________ TOTAL number of baghouse booster fans installed on the unit.

____________________ Air-to-cloth ratio, in ACFM/kft^2.

____________________ Bag material.

☐ Sonic assisted cleaning? 1– Yes 2 – No

☐ Enter the type of baghouse at the unit:

1 - *Reverse* - clean flue gas is blown in a direction counter to normal operation to remove the fly ash from the bag.
2 - *Pulse (or pulse set)* - short bursts of compressed air are blown into the bag to cause a momentary expansion of the bag which dislodges the entrapped fly ash.
3 - *Shaker* - the bag is literally shaken to remove the fly ash collected on its surface.
4 - *Combination (reverse/shaker)*
9 - *Other, describe* ____

☐ Enter the type of baghouse booster fan(s) at the unit:

Centrifugal - blades mounted on an impeller (or rotor) which rotates within a spiral or volute housing. Mark the type of blades used on this type of fan:
1 - Forward curved
2 - Straight (radial or radial tipped)
3 - Backward curved (air foil or flat)
4 - *Axial (fixed or variable pitch)* - blades attached to central hub parallel to air flow.
9 - *Other, describe* ____

~~**41. Boiler - Fly Ash Transport System**~~

~~Enter the following information:~~

~~____________________ Fly ash removal system manufacturer.~~

~~☐ Enter the type of fly ash removal system used:~~

~~1 - *Vacuum* - ash conveying system operates at a vacuum relative to the fly ash collection hoppers. Ash is dry.~~
~~2 - *Pressure* - ash conveying system operates at a pressure greater than the pressure in the fly ash collection hoppers. Ash is dry.~~
~~3 - *Vacuum-pressure* - employs the best features of both the vacuum and pressure systems.~~
~~4 - *Water (sluice)* - employs water to sluice the ash away from the hoppers.~~
~~5 - Vacuum/water slurry - ash conveying system operates at a vacuum relative to the fly ash collection hoppers. Ash is wet.~~
~~6 - *Mechanical* - refers to mechanical conveying systems such as conveyor belts, bucket elevators, and screw conveyors.~~
~~9 - *Other, describe*____~~

42. Steam Turbine - Manufacturer

Enter the name of the manufacturer of t

____________________ Stea

all other equipment should be treat
like a fossil steam unit.

43. Steam Turbine - Enclosure

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

☐ 1 – Yes 2 – No

44. 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 (megavoltamperes) 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).
▲

45. 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* ____

46. 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)

47. Steam Turbine - Steam Conditions

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

	Main Steam	First Reheat	Second Reheat
Temperature (ºF)	☐☐☐☐	☐☐☐☐	☐☐
Pressure (psig)	☐☐☐☐	☐☐☐☐	☐☐

48. Steam Turbine - High, Intermediate, and Low Pressure Sections

Enter the following information describing the 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.

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.

☐☐☐ The last stage blade length (inches) of the low pressure turbine, measured from hub to end
▲ of top of blade.

49. 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 startup.
2 - *Full arc* - main steam is admitted to all sectors of the turbine's first stage at startup.
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* ____________________

50. 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(s).

____________________ Manufacturer(s) 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
4 - More than one
9 - Other, describe ____________________

51. Generator - Manufacturer

Enter the name of the manufacturer of the electric generator:

____________________ Generator manufacturer

52. Generator - Enclosure

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

☐ 1 – Yes 2 – No

53. 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	☐☐☐☐ ▲	☐☐☐☐ ▲	☐☐☐☐ ▲
Megavoltamperes (MVA) Capability	☐☐☐☐	☐☐☐☐	☐☐☐☐
RPM	☐☐☐☐	☐☐☐☐	☐☐☐☐
Power Factor (enter as %)	☐☐☐☐ ▲	☐☐☐☐ ▲	☐☐☐☐ ▲

*Cross compound units.

54. Generator - Cooling System

Two types of cooling methods are typically used. First is the "innercooled" 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 innercooled and rotor innercooled.
2 - Stator conventionally cooled and rotor conventionally cooled.
3 - Stator innercooled and rotor conventionally cooled.
9 - Other, describe ____

Enter the mediums used to cool the generator's stator and rotor:

☐ **Stator**	**Medium**	**Rotor** ☐
A	Air	A
H	Hydrogen	H
O	Oil	O
W	Water	W
M	More than one	M

55. Generator - Hydrogen Pressure

☐☐☐ Enter the generator hydrogen pressure IN PSIG at nameplate MVA.

56. 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 exciters used at the unit:

1 - *Static* - static excitation where dc is obtained by rectifying ac from generator terminals, and dc is fed into rotor by collector rings.
2 - *Rotating dc generator* - exciter supplies dc from a commutator into the main rotor by means of collector rings.
3 - *Brushless* - an ac (rotating armature type) exciter 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 ac 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 ____________________

57. Auxiliary Systems - Main Condenser

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

____________________ Main condenser manufacturer

____________________ 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 or vacuum pump 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 value 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 orgin of the circulating water used in the condenser:

1 - River
2 - Lake
3 - Ocean or Bay
4 - Cooling Tower
5 - Fresh water wells
9 - Other, describe ____________________

58. Auxiliary Systems - Condenser Cleaning System

Enter the following information about the ON-LINE main condenser cleaning system at the unit (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
3 - Chlorination
4 - On-line backwash
9 - Other, describe ____________________

59. 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 boiler. 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 manufacturer

Enter the % treated of the condensate flow at maximum unit capacity that can be treated:

☐☐☐☐ % Treated
   ▲

60. 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).

____________________ Number of condensate pumps per manufacturer; include installed spares.

____________________ TOTAL number of condensate pumps for the unit.

____________________ MINIMUM number of condensate pumps required to obtain maximum capacity from the unit.

61. 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).

____________________ Number of condensate booster pumps per manufacturer; include installed spares.

____________________ TOTAL number of condensate booster pumps for the unit.

____________________ MINIMUM number of condensate booster pumps required for maximum capacity from the unit.

62. Auxiliary Systems - Feedwater (Boiler Feed) Pumps

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

____________________ Feedwater (boiler feed) pump(s) manufacturer(s).

____________________ Operating speed (RPM) of the feedwater pump(s) at full load.

____________________ Number of feedwater pumps per manufacturer; include installed spares.

____________________ TOTAL number of feedwater pumps for the unit.

____________________ MINIMUM number of feedwater pumps required to obtain maximum capacity from the unit.

☐☐☐☐ PERCENT (%) of the unit's maximum capacity that can be achieved with a single feedwater pump.
▲

63. Auxiliary Systems - Feedwater (Boiler Feed) Pump Drives

Enter the following information for the feedwater (boiler feed) pump drives:

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

M1 M2
☐ ☐ Enter the type of equipment used to drive the feedwater (boiler feed) pumps:

1 - Motor - single speed
2 - Motor - two speed
3 - Motor - variable speed
4 - Steam turbine
5 - Shaft
6 - Motor gear
7 - Steam gear
8 - Staft gear
9 - Other, describe

M1 M2
☐ ☐ Specify coupling type used for feedwater (boiler feed) pump.

1 - Hydraulic
2 - Mechanical
9 - Other, describe ____

64. Auxiliary Systems - Startup Feedwater (Boiler Feed) Pumps

Enter the following information for the startup feedwater pump(s) at the unit:

____________________ Startup feedwater pump(s) manufacturer(s).

____________________ Manufacturer(s) of the motor(s) that drives the startup feedwater pump(s).

____________________ TOTAL number of startup feedwater pumps for the unit.

☐☐☐☐ PERCENT (%) of the unit's maximum capacity that can be achieved using a single startup feedwater pump.
▲

M1 M2
☐ ☐ Indicate the additional capabilities of the startup feedwater pump:

1 - ADDITIVE: operated in conjunction with the feedwater (boiler feed) pumps.
2 - REPLACEMENT: can carry load for the feedwater (boiler feed) pumps at such times when the feedwater pumps are inoperative.
3 - STARTUP ONLY: cannot be used in lieu of the feedwater pumps.
9 - Other, describe ____________________

65. Auxiliary Systems - High Pressure Feedwater Heaters

High pressure feedwater heaters are those heat exchangers between the feedwater (boiler feed) pumps discharge and the economizer inlet. Enter the following information for the HIGH pressure feedwater heaters at the unit:

____________________ High pressure feedwater heater(s) manufacturer(s).

____________________ Number of high pressure feedwater heaters per manufacturer.

____________________ Feedwater heater tube materials used in 50% or more of the tubes per manufacturer.

____________________ TOTAL number of high pressure feedwater heaters for the unit.

M1 M2
☐ ☐ Enter the type of HIGH pressure feedwater heater(s):

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

66. 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 at the unit:

____________________ Intermediate pressure feedwater heater(s) manufacturer(s).

____________________ Number of intermediate pressure feedwater heaters per manufacturer.

____________________ Feedwater heater tube materials used in 50% or more of the tubes, per manufacturer.

____________________ TOTAL number of intermediate pressure feedwater heaters for the unit.

M1 M2
☐ ☐ 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* ____________________

67. 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 unit 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 at the unit:

____________________ Low pressure feedwater heater(s) manufacturer(s).

____________________ Number of low pressure feedwater heaters per manufacturer.

____________________ Feedwater heater tube materials used in 50% or more of the tubes, per manufacturer.

____________________ TOTAL number of low pressure feedwater heaters for the unit.

M1 M2
☐ ☐ 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* ____________________

68. Auxiliary Systems - Deaerator Heater

Enter the following information on the deaerator heater at the unit:

____________________ Deaerator manufacturer(s)

M1 M2
☐ ☐ 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*____

69. Auxiliary Systems - Heater Drain Pumps

Enter the following information for the heater drain pumps at the unit:

____________________ Heater drain pump(s) manufacturer(s).

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

70. 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).

____________________ Number of circulating water pumps per manufacturer; include installed spares.

____________________ TOTAL number of circulating water pumps for the unit.

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

71. Auxiliary Systems - Cooling Tower and Auxiliaries

Enter the following information for the cooling tower and all its related auxiliary equipment at the unit:

____________________ Cooling tower manufacturer(s)

____________________ Cooling tower fan(s) manufacturer(s).

____________________ Manufacturer(s) of the motor(s) that drives the cooling tower fan(s).

71. Auxiliary Systems - Cooling Tower and Auxiliaries (Continued)

M1 M2
☐ ☐ Enter the type of cooling tower used by the unit:

1 - *Mechanical draft* (induced, forced, cross-flow and counterflow) - 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).

____________________ Number of cooling tower booster pumps per manufacturer; include installed spares.

____________________ TOTAL number of cooling tower booster pumps for the unit.

____________________ MINIMUM number of cooling tower booster pumps required to obtain maximum capacity from the unit.

72. Balance of Plant - Main Transformer

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

____________________ Main transformer(s) manufacturer(s).

____________________ TOTAL number of main transformers per manufacturer; include installed spares.

____________________ Megavoltampere (MVA) size of the main transformer(s); per manufacturer.

M1 M2
☐ ☐ Enter the type of MAIN transformer at the unit:

1 - Single phase
2 - Three phase
9 - Other, describe ______________________________

73. Balance of Plant - Unit Auxiliary Transformer

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

____________________ Unit auxiliary transformer(s) manufacturer(s).

____________________ TOTAL number of unit auxiliary transformers per manufacturer.

____________________ LOW SIDE voltage in kilovolts (kV) of the unit auxiliary transformer(s) at 55º, per manufacturer.

74. 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 unit auxiliaries during unit start-up and shutdown. It also may be used when the unit auxiliary transformer is not available (or nonexistent).

____________________ Station service transformer(s) manufacturer(s).

____________________ TOTAL number of station service transformers per manufacturer.

____________________ HIGH SIDE voltage in kilovolts (kV) of the station service transformer(s) at 55º, per manufacturer.

____________________ LOW SIDE voltage in kilovolts (kV) of the station service transformer(s) at 55º, per manufacturer.

75. Balance of Plant - Auxiliary (Start-up) Boiler

Enter the following information on the auxiliary boiler at the unit:

____________________ Auxiliary boiler manufacturer(s).

76. Balance of Plant - Auxiliary Generator

Enter the following information on the auxiliary generator at the unit:

____________________ Auxiliary generator manufacturer(s).

Is the auxiliary generator shaft driven?

M1 M2

☐ ☐ 1 – Yes 2 – No

77. Balance of Plant - Plant Process Computer

Enter the following information for the plant process computer(s):

____________________ Plant process computer manufacturer(s).

M1 M2
☐ ☐ Enter the number of plant process computers available to the unit:

1 - One computer for this unit only.
2 - Two computers for this unit only.
3 - One computer shared by one or more units.
4 - Two computers shared by one or more units.
9 - Other, describe ____

M1 M2
☐ ☐ Describe how the plant process computers are linked within the plant:

1 - Centralized
2 - Distributive
3 - Stand alone
9 - Other, describe

77. Balance of Plant - Plant Process Computer (Cont.)

M1 M2
☐ ☐ Enter the system capability of the plant process computer:

1 - Monitor only
2 - Monitor and control
9 - Other, describe ____

78. CEMS - General

____________________ System vendor

First-certified date:
☐☐☐☐ Year ☐ Month ☐☐ Day

☐ Monitoring technique

1 - Extractive
2 - Dilution
3 - In Situ

☐ Analysis Method

1 - Wet
2 - Dry
9 - Other, describe ____

79. CEMS - Pollutant Gas and Diluent Gas Analyzers/Monitors

1. Sulfur Dioxide (SO_2) Analyzers

____________________ Manufacturer(s)

____________________ Model number(s)

M1 M2
☐☐ ☐☐ Number of installed analyzers

M1 M2
☐☐ ☐☐ Number of installed spare analyzers

M1 M2
☐ ☐ Type(s)

1 - Ultraviolet
2 - Infrared
3 - Fluorescence
9 - Other, describe ____

M1 M2
☐ ☐ Instrument range (parts per million)

1 - 0 - 50
2 - 0 - 150
3 - 0 - 500
9 - Other, describe ____

M1 M2
☐ ☐ Shared? (1 - Yes, 2 – No)

2. Oxides of Nitrogen (NO_x) Analyzers

____________________ Manufacturer(s)

____________________ Model number(s)

M1 M2
☐☐ ☐☐ Number of installed analyzers

M1 M2
☐☐ ☐☐ Number of installed spare analyzers

M1 M2
☐ ☐ Type(s)

79. **CEMS - Pollutant Gas and Diluent Gas Analyzers/Monitors** (Continued)

1 - Infrared
2 - Chemiluminescent
9 - Other, describe ______________________________

M1 M2
☐ ☐ Instrument range (parts per million)

1 - 0 - 50
2 - 0 - 150
3 - 0 - 500
9 - Other, describe

M1 M2
☐ ☐ Shared? (1 - Yes, 2 – No)

3. Carbon Monoxide (CO) Analyzers

____________________ Manufacturer(s)

____________________ Model number(s)

M1 M2
☐☐ ☐☐ Number of installed analyzers

M1 M2
☐☐ ☐☐ Number of installed spare analyzers

M1 M2
☐ ☐ Type(s)

1 - Infrared solid state
2 - Infrared luft
3 - Gas filter correlation
9 - Other, describe ______________________________

M1 M2
☐ ☐ Instrument range (parts per million)

1 - 0 - 50
2 - 0 - 150
3 - 0 - 500
9 - Other, describe ______________________________

79. **CEMS - Pollutant Gas and Diluent Gas Analyzers/Monitors** (Continued)

4. Carbon Dioxide (CO_2) Analyzers

____________________ Manufacturer(s)
____________________ Model number(s)

M1 M2
☐☐ ☐☐ Number of installed analyzers

M1 M2
☐☐ ☐☐ Number of installed spare analyzers

M1 M2
☐ ☐ Instrument range (parts per million)

1 - 0 - 50
2 - 0 - 150
3 - 0 - 500
9 - Other, describe ____________________

M1 M2
☐ ☐ Shared? (1 - Yes, 2 - No)

5. Oxygen (O_2) Analyzers

____________________ Manufacturer(s)

____________________ Model number(s)

M1 M2
☐☐ ☐☐ Number of installed analyzers

M1 M2
☐☐ ☐☐ Number of installed spare analyzers

M1 M2
☐ ☐ Type(s)

1 - Zirconia oxide
2 - Paramagretic
3 - Fuel cell
9 - Other, describe

M1 M2
☐ ☐ Instrument range (parts per million)

1 - 0 - 50
2 - 0 - 150
3 - 0 - 500
9 - Other, describe ____________________

M1 M2
☐ ☐ Shared? (1 - Yes, 2 - No)

79. CEMS - Pollutant Gas and Diluent Gas Analyzers/Monitors (Continued)

6. Opacity Monitors

____________________ Manufacturer(s)

____________________ Model number(s)

M1 ☐☐ M2 ☐☐ Number of installed analyzers

M1 ☐☐ M2 ☐☐ Number of installed spare analyzers

M1 ☐ M2 ☐ Probe placement (if unit is equipped with a FGD system)

1 - Before scrubber
2 - After scrubber

80. CEMS - Flue Gas Flow Monitors

____________________ Manufacturer(s)

____________________ Model number(s)

M1 ☐☐ M2 ☐☐ Number of installed monitors

M1 ☐☐ M2 ☐☐ Number of installed spare monitors

Volumetric Flow Rate (ACFM):

M1 ☐☐☐☐☐☐☐☐ M2 ☐☐☐☐☐☐☐☐

M1 ☐ M2 ☐ Flow rate measurement technique

1 - Thermal sensing (hot-wire anemometer or dispersion)
2 - Differential pressure array
3 - Acoustic velocimetry (ulrasonic transducers)
4 - Combination
9 - Other, describe ____

81. CEMS - Data Acquisition and Reporting System

____________________ Hardware manufacturer

☐ Hardware architecture

1 - Vendor-supplied dedicated system
2 - Modified existing plant computer
3 - Stand alone, pc-based system not supplied by CEMS system vendor
9 - Other, describe ______________________________

____________________ Software supplier

☐ Shared? (1 – Yes, 2 - No)

NO$_x$ REDUCTION SYSTEMS

These systems include Selective Non-catalytic Reduction, Selective Catalytic Reduction, Catalytic Air Heaters, and Staged NO$_x$ Reduction, which is a combination of the three methods. Excluded from this category are Low NO$_x$ burners, combustion modifications, and flue gas recirculation.

Please complete the following information for the NO$_x$ Reduction Systems installed on your unit. (The appropriate items under each method should be completed for a Staged NO$_x$ Reduction System).

82. Selective Non-Catalytic Reduction System (SNCR)

☐ Reagent

1 - Ammonia
2 - Urea
9 - Other, describe ______________________________

☐ Injector Type

1 - Wall nozzles
2 - Lance
9 - Other, describe ______________________________

☐ Injection Equipment Location

1 - Furnace
2 - Superheater
3 - Economizer
9 - Other, describe ______________________________

____________________ Number of Injectors

82. Selective Non-Catalytic Reduction System (SNCR) (Continued)

☐ Carrier Gas Type

1 - Steam
2 - Air
9 - Other, describe ______________________________

__________ Total flow rate (lb./hr.)

__________ Pressure at nozzle (psi)

__________ Nozzle exit velocity (ft./sec.)

83. Selective Catalytic Reduction System (SCR)

☐ Reactor

1 - Separate
2 - In Duct

__________ Flue gas take-off location

☐ Reagent

1 - Ammonia
2 - Urea
9 - Other, describe ______________________________

☐ Ammonia Injection Grid Location

1 - Furnace
2 - Superheater
3 - Economizer
4 - Zoned

☐ Duct Configuration

1 - Flow straighteners
2 - Turning vanes
3 - Dampers

☐ Catalyst Element Type

1 - Plate
2 - Honeycomb
9 - Other, describe ______________________________

83. Selective Catalytic Reduction System (SCR) (Continued)

☐ Catalyst Support Material

1 - Stainless steel
2 - Carbon steel
9 - Other, describe ____________________

☐ Catalytic Material Configuration

1 - Vertical
2 - Horizontal
9 - Other, describe ____________________

__________ Surface face area (sq. ft.)

__________ Catalyst volume (cu. ft.)

__________ Number of layers

__________ Layer thickness (inches)

☐ Sootblowers (if applicable)

1 - Air
2 - Steam
3 - Both air and steam

__________ Manufacturer(s)

__________ Number of sootblowers

84. Catalytic Air Heaters

☐ Element Type

1 - Laminar surface
2 - Turbulent surface
9 - Other, describe ______________________________

☐ Support Material, if any

1 - Stainless steel
2 - Carbon steel
9 - Other, describe ______________________________

☐ Catalyst Material Configuration

1 - Horizontal air shaft
2 - Carbon steel
9 - Other, describe ______________________________

__________________ Total face area (sq. ft.)

__________________ Open face area (sq. ft.)

__________________ Layer thickness (inches)