Genesee Power Station
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Flint, Michigan 48505

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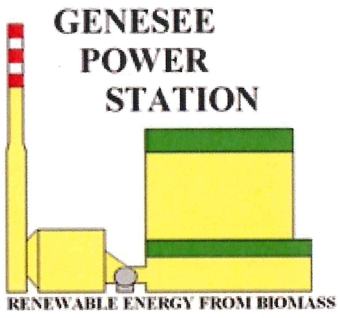
Emission Minimization Plan for Start-up and Shutdown



1.0 INTRODUCTION

This plan is prepared in accordance with the requirements of the air permit in order to minimize emissions during start-up and shutdown of the main boiler at Genesee Power Station (GPS).

2.0 DESCRIPTION OF FACILITY AND TYPICAL SCHEDULE OF START-UP AND SHUTDOWN

GPS operates an electrical generating station consisting of one (1) spreader-stoker biomass boiler with a maximum heat input rating of 523 Million British thermal unit per hour (MMBtu/hr), providing steam at 1,280 psig and 950 °F to a 35 MW (net) steam turbine generator. EU-BOILER is subject to the *National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters* codified at 40 CFR Part 63, Subpart DDDDD (Boiler MACT). The boiler at design load can burn approximately 39 tons of biomass fuel (with a moisture content of 27%) per hour. The boiler is equipped with a hydrograte stoker. The biomass fuel is uniformly distributed over the grate by means of air sweep feeder. Combustion air is provided to the combustion area by forced draft (FD) and over-fire air (OFA) fan. The steam generator portion consists of both radiant and convection pass tubes and super heater above the stoker.

The schedule for normal and usual start-up and shutdowns of an electrical generating station will vary over the life of the plant. A usual start-up takes place whenever the boiler has been shutdown and cooled, such as what occurs during a lengthy scheduled or unscheduled outage. Typically, during the early life of a power station like GPS, there are two scheduled outages per year for routine inspection and maintenance of equipment. A forced outage may result from an electrical storm, a steam turbine trip, a fan failure, boiler tube leak or other equipment malfunctions. If such a malfunction triggers a complete shutdown, then a normal start-up would follow (i.e., a normal start-up of a cold boiler). Some of these malfunctions, however, could trigger a temporary shutdown (i.e., a temporary discontinuation of the fuel feed to the boiler), in which the correction may be made prior to a complete cool down of the boiler. In such cases, a warm or hot start-up would ensue.

Each occurrence of a forced outage is unplanned, and it is normal to expect some of these occurrences during the year. GPS expects a yearly average of six normal startups, four as a result of unplanned outages. In addition to equipment-related forced outages. GPS may also be dispatched offline by its customer, Consumers Energy, during system emergencies.

STARTUP AND SHUTDOWN FOR BOILER MACT AND ROP COMPLIANCE

GPS operates in accordance with the definition of startup and shutdown required for Boiler MACT compliance. According to 40 CFR §63.7575, startup and shutdown are defined as:

> ***Startup***
> *(1) Either the first-ever firing of fuel in a boiler or process heater for the purpose of supplying useful thermal energy for heating and/or producing electricity, or for any other purpose, or the firing of fuel in a boiler after a shutdown event for any purpose. Startup ends when any of the useful thermal energy from the boiler or process heater is supplied for heating, and/or producing electricity, or for any other purpose, or*
> *(2) The period in which operation of a boiler or process heater is initiated for any purpose. Startup begins with either the first-ever firing of fuel in a boiler or process heater for the purpose of supplying useful thermal energy (such as steam or heat) for heating, cooling or process purposes, or producing*

electricity, or the firing of fuel in a boiler or process heater for any purpose after a shutdown event. Startup ends four hours after when the boiler or process heater supplies useful thermal energy (such as heat or steam) for heating, cooling, or process purposes, or generates electricity, whichever is earlier.

***Shutdown** means the period in which cessation of operation of a boiler or process heater is initiated for any purpose. Shutdown begins when the boiler or process heater no longer supplies useful thermal energy (such as heat or steam) for heating, cooling, or process purposes and/or generates electricity or when no fuel is being fed to the boiler or process heater, whichever is earlier. Shutdown ends when the boiler or process heater no longer supplies useful thermal energy (such as steam or heat) for heating, cooling, or process purposes and/or generates electricity, and no fuel is being combusted in the boiler or process heater.*

GPS operates in accordance with the definition of startup and shutdown for ROP compliance. For ROP compliance:

Startup is defined as the period of time from initiation of combustion firing until the unit reaches steady state operation. Shutdown is defined as that period of time from the initial lowering of the boiler output until the point at which the combustion process has stopped.

Startup and shutdown are designated in the Data Acquisition and Handling System (DAHs) and in the Implementation Plan maintained at GPS. Table 1 provides online parameters for startup and shutdown for Boiler MACT and ROP compliance. Table 2 defines startup and shutdown according to Boiler MACT and ROP compliance.

Table 1. Unit 1 Time Online Parameters

Parameter	Description	Condition
SUMACT	Startup MACT	Fire eye on & normal mode MACT false & MACT latch reset false
SDMACT	Shutdown MACT	Fire eye on & normal mode MACT false & MACT latch reset true
SUROP	Startup ROP	Fire eye on & normal mode ROP false & ROP latch reset false
SDROP	Shutdown ROP	Fire eye on & normal mode ROP false & ROP latch reset false

Table 2. Startup/Shutdown Definitions in the DAHS

IB MACT DDDDD Compliance	Startup Start	Fire eye on
	Startup End	Generator breaker closed
	Shutdown Start	Feeders/burners off &/or generator breaker open
	Shutdown End	Fire eye off
ROP Compliance	Startup Start	Fire eye on
	Startup End	Load > 8.0
	Shutdown Start	Feeders/burners off &/or load < 8.0
	Shutdown End	Fire eye off

3.0 PROCESS EQUIPMENT & PERMITS

For the Genesee Power Station, all of the emission-related equipment is covered under the air permit and includes the following:

- EU-BOILER
- Selective non-catalytic reduction (SNCR) unit
- Mechanical multi-cyclone separator
- Electrostatic precipitator (ESP)
- Continuous emission monitoring system (CEMS)
- Continuous opacity monitoring system (COMS)

There are several smaller components to the boiler and turbine systems that are involved in start-up and shutdown. Those that can have a direct impact on emissions are addressed in Section 6.0.

4.0 START-UP PROCESS

The startup of the boiler can be divided into the following three phases:

Phase 1 is the period that begins with the start-up of the forced and induced draft fans and the initiation of natural gas combustion to preheat the boiler. The FG and ID fans are turned on and the dampers are opened to initiate a 5-minute furnace purge prior to ignition of the gas burners. The mechanical dust collector and ESP are in service at this time. As presented in Tables 1 and 2, COMS valid readings start on at the same time that the ID fan goes on and CEMS valid reading start during first fire in the boiler.

During Phase 1, which typically lasts for 4-6 hours for cold start, the emissions are primarily carbon monoxide (CO) and oxides of nitrogen (NO_x) from the combustion of natural gas, as well as the release of any residual dust that may have settled in the boiler during the prior shutdown. It is not possible to estimate the small amount of mass of particulate emissions associated with the residual dust that would typically occur during Phase 1, but based on historic opacity monitoring data during this phase of start-up, GPS estimates that the ROP 10% opacity limitation could be exceeded for the first two hourly averaging periods.

The hourly CO concentrations corrected to 7% O_2 (ppmvc) and the CO lb/MMBtu are generally elevated during the Phase 1 start-up on natural gas because the very high stack O_2 concentration contributes to data "blow-up" (in which the conversion from raw ppmvc approaches infinity as stack O_2 approaches the atmospheric concentration of 20.9%). Historically, emissions were adjusted utilizing an EGLE approved protocol (1998 vintage) to mitigate this "data blow-up" issue. As of 2019, with implementation of a new DAHS, a diluent cap of 14% (in accordance with P75 Appendix A), has been implemented within the DAHS to alleviate this issue during a start-up/shutdown event.

For a hot start, Phase 1 will be significantly shortened or eliminated.

- Phase 2 is the period that begins with the initial feeding of wood fuel into the boiler and the simultaneous placing into service of the SNCR (NO_x control) system. Phase 2 lasts until stable combustion is achieved and the gas burner is shut off, usually within 1-3 hours. Stable combustion occurs when the following conditions occur:
    - 8 MW net generation
    - 80,000 pph of steam flow, and
    - less than 10% stack O_2

During a normal start-up, the CO emissions rise rapidly when wood fuel is first introduced into the boiler. As combustion of the wood fuel takes hold, the temperature in the boiler rises, the stack O_2 content rapidly decreases below 10% and the CO emissions decrease. A period of steadily increasing combustion efficiency lasts for 1 – 3 hours as combustion stabilizes. Once steady combustion is achieved, the gas burner is turned off.

- Phase 3 is the following period of increasing load under stable combustion conditions until desired dispatch load is achieved. This period may last from 1-3 hours, depending on the required final load. It may be marked by a period of adjustment of gaseous emissions to more steady-state values, but high values for these parameters (as well as opacity) are not typically observed during this timeframe. The CEMS and COMS continue to be fully operational and provided all required monitoring.

Based on the primary use of natural gas in phase one and the small quantity of wood fuel used during Phase two, and the full capability of all pollution and boiler control systems during Phase 3 (and confirmed by historic data), GPS believes that all of the applicable mass (lb/hr) emission limits (including particulate matter, CO, NO_x, beryllium, benzo(a)pyrene, total gaseous non-methane organics, arsenic, chromium, lead, mercury, hydrogen chloride and acrolein) will be achieved in all phases of normal start-up.

5.0 SHUTDOWN PROCESS

A normal controlled shutdown occurs as follows: first, the load is reduced to 8 MW (net) with approximately 80,000 pph of steam flow (@1,255 psia and 950 °F). The stack O_2 level is still less than 10%. The fuel feed is then shut off. Fan dampers are controlled to minimize opacity during the 15 minutes (maximum) of final wood fuel burnout and during subsequent boiler cool down. As the boiler pressure decays the fans are sequentially boiler cool down. As the boiler pressure decays the fans are sequentially turned off (OFA, FD, ID) and the ESP is deactivated. By natural draft, cooling flow continues through the boiler. The turbine is secured.

A turbine trip or malfunction of other critical equipment can result in a sudden forced shutdown as described in Section 2.0. A forced shutdown differs from a normal shutdown as described above in the following ways:

- ID fan may be left on to accelerate boiler cooling for access to make necessary repairs, and/or
- If the ESP trips offline, there may be high opacity for a short period of time.

6.0 ACTIONS TO MINIMIZE EMISSIONS DURING START-UP AND SHUTDOWN

For the purpose of this plan, GPS will fully maintain its equipment according to the Preventative Maintenance and Malfunction Abatement Plans.

GPS will take the following actions to minimize emissions during start-up:

- Fully use the natural gas burners during start-up to the extent necessary to achieve manufacturers specifications for boiler warm-up.
- Use to the extent feasible, relatively dry wood for start-up.
- Closely monitor CO emission through Phases 1 and 2 to assure proper operation of gas burners and to minimize emissions associated with the first introduction of wood fuel into the boiler.

GPS will minimize emissions during normal shutdown by completing the shutdown as quickly as possible. This will be accomplished by:

- Reducing the load to 8 MW (net), <10% O_2 and 80,000 pph steam flow at the turbine inlet.
- Stopping the fuel feed to the boiler.
- As fuel on the grate is consumed, reduce air and flue gas damper openings to minimize opacity.
- As the boiler pressure decays and the O_2 level rises, the fans may be secured (turned off), maintaining a natural convection flow through the boiler.
- Secure the turbine.
- If the ID fan is left on to accelerate boiler cooling.

Additionally, the Preventative Maintenance and Malfunction Abatement Plan describes measures that may be implemented during malfunctions in order to avoid, if possible, the need for a shutdown and subsequent start-up.

6.0 Plan Updates

This procedure is reviewed by the EH&S Coordinator and updated as needed.

Written By: R. J. Woodard	Date: 6/14/2022
Approved by: T. M. Andreski	Date: 6/14/2022

Figure 1: Plan Approval