

Start Up & Shut Down Operation process/ Interlocks.

The following 24/7 Automated Process for Auto Start up and shut down operations is provided below. For completeness, each step has been comprehensively captured, as follows:

1. Preload

- Run fuel feed (FFR) at 100% fuel feed for set amount of time (adjustable)

2. Cold start

- Start ID Fan – run to set PA
- Start Combustion fans – run to cold start speeds/percentage
- Start Ignitors – run until set furnace temperature is reached. Also max time period
- Start fuel feed at set feed rate. Limited by Furnace wall temperature Table (adjustable fuel feed % step and timer)
- Cold start exit temperature (ceramic)

3. Warm start

- Start ID Fan – run to set PA
- Start Combustion fans – run to warm start speeds/percentage
- Start Ignitors – run until set furnace temperature is reached
- Start fuel feed at set feed rate (FFR). Limited by Furnace wall temperature Table (adjustable fuel feed % step and timer)
- Warm start exit temperature (Ceramic temperature)

4. Hot Start

- Start fuel feed at set feed rate (FFR). Controlled by Furnace temperature (adjustable fuel feed % step and timer)
- Enable moving grate
- Diesel burner enabled – controlled by minimum and maximum furnace temperature
- Hot start exit temperature (furnace temperature)

5. Normal running

- Secondary air fan speed controlled by O2 sensor parameters
- Fuel feed steps up to maximum speed but limited by water temperature set point
- Grate speed on period/off period in relation to negative pressures

6. Over Temperature

- Stop fuel feed
- All Combustion fans stop
- ID fan to run to set Pa until furnace temperature below setting
- ID fan run to set speed (adjustable)

7. Shut Down

- Stop fuel feed from store
- Continue to run loading augers for set period (adjustable)
- ID Fan Runs to pa until furnace temp below set point
- Combustion fans continue to run until furnace below set point
- Everything shut down

8. De – Ash / Cleaning

- Enabled from hot start
- Speed linked to FFR
- Boiler air blasts – off period and time between each blaster for the cycle.
- All de-ash augers to have separate settings

Detailed Operating procedures

Fuel feed Rate (FFR)

On Period – Off Period and percentage of set periods.

Water temperature set point +5/-5 table or PID?

Reduced by set % if negative pressure difference between furnace and base increases

Combustion Air

Primary, combustion ring and tertiary run to table linked to FFR

Secondary – PID controlled by O2 sensor 4-20ma

Negative Pressure

2 sensors

Sensor 1 located in furnace to give 4-20 ma signal to ID fan control

Sensor 2 located in the base to give 4-20ma signal of neg pressure below the fuel mass

Difference between 2 readings used to control grate speed and also FFR e.g.

No difference – grate and fuel feed operate as normal

Higher difference – step 1. increase grate timing. Step 2. Reduce fuel feed...Details to follow

Diesel Burners

Once in hot start operation, they will only operate between two set points of the furnace temperature. Both set points on the screen.

A timer that alarms to indicate it has been running too long.

Linked to FFR so will only operate above a set percentage of FFR

Alarms

Two stage alarm.

Level 1 being a warning but not stop operation

Level 2 Plant goes into shut down mode

Level 3 Emergency stop