Appendix 4.2

Furnace Start Up and Shut Down Procedures

4.2 Furnace Start Up and Shut Down Procedures

4.2.1 Furnace Start Up And Planned Shut Down Procedure

The start-up and shut down of the furnace will be carefully controlled, in accordance with standard operating procedures. The procedures will be developed in detail prior to the commissioning of the furnace. There is a maximum of two planned shutdowns per year and can be up to 5 in total, each of these is a controlled shutdown and start up as outlined in the procedure below

The start-up sequence for the furnace line will be as follows:

- The computerised control system for the line will be started up, which will mean that measurements and interlock systems will be in operation.
- Utilities for the plant such as water, electricity, instrument air, the firewater system and safety systems will then be started up.
- Monitoring of some of these utilities will be carried out, as certain conditions such as firewater availability must be satisfied before the start-up procedure can commence.
- Peripheral equipment, such as the equipment to supply chemicals to the plant, to receive the process steam from the plant and the stack emissions monitoring equipment will then be started up.
- After verification of process parameters such as liquid levels, pressures, steam cycle etc., and adjustment as necessary, the flue gas cleaning systems will be started up.
- The ID-fan will commence running and pre-ventilation of the line for a pre-set time period will occur.
- The oil-fired burners, to initiate the combustion in the furnace, will be started up and the flue gas temperature will be raised to 850°C at a gradient of 50°C per hour.
- Once the temperature in the furnace has stabilised, the supply of waste will then commence and oil firing will be stopped when the process is steady.

The planned shut down sequence for a furnace line will be as follows:

- The waste supply to the furnace will be shut off
- To ensure complete combustion of the waste remaining in the furnace, the oil burners will be re-started to ensure that a temperature of 850°C, as appropriate, will be maintained for a period of up to 1 hour or until all the waste is incinerated.
- The ID fan of the flue gas cleaning system will remain operating to ensure that the flue gases will be treated to the emission limits during the operation.
- The furnace will then be allowed to cool down to a temperature of 200°C at a gradient of 50°C per hour (a period of circa 13 hours) which will be controlled by supplementary firing.

- The furnace line will have stopped incinerating waste for a number of hours, there will be no waste remaining in the furnace and consequently there will be no flue gases to be cleaned. Once the temperature at the stack is sufficiently low at approximately 60°C, the flue gas cleaning systems will be stopped.
- Some utilities to the plant such as instrument air, etc. and the majority of the peripheral equipment will be shut-off.
- Other utilities such as electrical supply will continue operating as they will be required even when the plant is shut down.

4.2.2 Emergency Shutdown Procedure

The emergency shut down will bring the incinerator line to a safe status. The main objectives of the emergency shut down procedure are as follows:

- To shut down the plant safely, avoiding injury to staff or damage to equipment
- to minimise emissions
- to protect equipment from damage caused by temperatures which are too high.

The experience of the operators of Indaver's plants in Meath/Belgium is that an emergency shut down is not a frequent occurrence.

In case of failure of electrical power supply, the plant will switch over to island mode and power itself through the turbine. The plant will reduce in load and remain in a stable condition. If the turbine trips in this condition then the motors and equipment required for the emergency shut down will be powered by the emergency generator.

4.2.2.1 The emergency shut down will be automatically executed in two steps.

Step 1 is the waste burn out. As soon as the emergency shut down commences all waste supply will be stopped immediately. The ID-fan will be stopped. The water supply to the cooling section will be stopped. An emergency supply may be provided for use in the cooling section, if the temperature of the flue gases exceeds 250ºC. This option will be decided at detailed design stage.

The injection of activated carbon/clay and lime will stop and may be reactivated by the operator, manually, once the reason for the shut down is known and it is determined that there will be no risk in doing so.

The inertia of the ID-fan will ensure that the flue gases will continue to be evacuated through the flue gas cleaning systems, prior to the start-up of the ID-fan via the auxiliary motor, which will be powered by the emergency generator.

In the grate furnace, air to burn out the residual waste will be drawn into the furnace because the inertia of the ID-fan will maintain under-pressure in the furnace. During this period the flue gas flow will drop quickly to less than 20 % of the normal flow. At this stage the waste in the furnace will be almost completely burned. Only a few bigger waste parts will still be smouldering. The auxiliary motor (with gear box) of the ID-fan will then engage and continue on partial load.

The power of this motor will be sufficient to evacuate the remaining flue gas through the flue gas cleaning system.

Step 2 is the cooling step. Once there is no more waste in the furnace, the ID fan will continue to pull air through the furnace boiler for a controlled cool down to protect the refractory and boiler from to rapid a cool down which could lead to mechanical failure. The ID fan can then be stopped once the plant is below 60° C.

During any emergency shutdown, while there is waste in the furnace all the flue gases pass through the gas cleaning system and are emitted through the stack. As stated above, the ID Fan is kept operating during the shutdown by means of an auxiliary motor and an emergency generator. In the event of an emergency shutdown and failure of the emergency generator the inertia of the ID Fan would continue to draw the flue gases through the gas cleaning system for an initial period. It is highly unlikely that there would be both an emergency shutdown and a failure of the emergency generator at the same time.

While step 1 of the shutdown sequence is underway, the combustion gases will continue to pass through the flue gas cleaning systems and the bag house filter and particulates will be removed as efficiently as during normal operations (except in the case of catastrophic failure of the baghouse). The activated carbon/clay/lime mixture present on the sleeves of the bag house filter will continue to remove heavy metals, dioxins, HCI, HF and SO2 from the combustion gases.

The fixed installed emissions monitoring equipment located on the stack will continue to monitor the emissions from the stack. In the event of loss of mains power, the monitoring equipment will be supplied with electricity from the Uninterruptible Power Supply (UPS) and emergency generator

A risk analysis will be carried out on this procedure during the detailed design phase of the project (in the form of a Hazard and Operability Study) during which the final details of the procedure will be decided.

4.2.2.2 Quick stop incineration

During the operation of the plant there can be conditions that force a scenario called quick stop incineration. These conditions are for example when the pressure increases in the furnace. If this occurs, the first stage alarm will indicate to the operator that the pressure is increasing and if no action is taken by the operator, then the second stage alarm will increase the ID fan speed to reduce the pressure. If this does not reduce the pressure then waste feeding will be stopped and the air supplied to the furnace for combustion will be reduced or stopped and the ID fan will reduce to ensure that the waste on the grate is still combusting in a controlled manor. The operator can then resolve the issue that lead to the quick stop incineration conditions and return the plant to normal operating conditions.

The fixed installed emissions monitoring equipment located on the stack will continue to monitor the emissions from the stack during this time.