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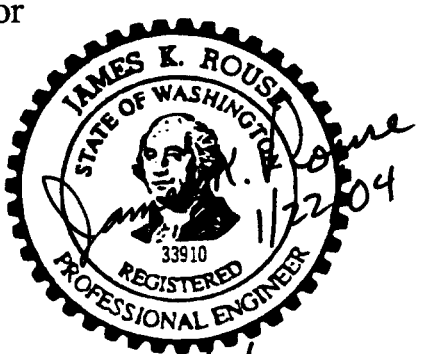

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History Sheet

Rev	Date	Reason for revision	Revised by
0	January 22, 2004	Issued For Permitting Use	Jim Rouse

Contents

Acronyms and Abbreviations

ABS	Absorber
ADBR	Adsorber
AEA	*Atomic Energy Act*
Cl	Chloride
DOE	Department of Energy
F	Fluoride
FCLR	Film Cooler
HEME	High Efficiency Mist Eliminator
HEPA	High Efficiency Particulate Air
HLW	High Level Waste
HOP	HLW Melter Offgas System
HTR	Heater
HX	Heat Exchanger
MTG/d	Metric Tons per Day
NO_x	Nitrous Oxides
PVV	Process Vessel Vent
SBS	Submerged Bed Scrubber
SCO	Selective Catalytic Oxidizer
SCR	Selective Catalytic Reducer
SVOC	Semi-Volatile Organic Compound
VOC	Volatile Organic Compound
VSL	Vessel
WESP	Wet Electrostatic Precipitator
WTP	Waste Treatment Plant

1 Introduction

The HLW Vitrification Facility has been designed to vitrify mixed waste in a joule-heated ceramic melter and treat the resulting offgas in a manner that protects human health and the environment. Bypasses are designed into the HLW Vitrification Facility offgas system to:

- allow maintenance of air pollution control equipment without stopping melter ventilation,
- maintain a ventilation path to the facility stack, and
- prevent and/or minimize melter pressurization.

This document describes these potential HLW Vitrification Facility bypass events.

2 Applicable Documents

Process Flow Diagrams associated with the HLW melter offgas system are:

- 24590-HLW-M5-V17T-P0002, *Process Flow Diagram - HLW Vitrification - Melter 1 (System HMP)*
- 24590-HLW-M5-V17T-P0003, *Process Flow Diagram - HLW Vit Melter 1 - Primary Offgas Treatment (System HOP)*
- 24590-HLW-M5-V17T-P0004, *Process Flow Diagram - HLW Vitrification - Melter 1 - Secondary Offgas Treatment (System HOP)*
- 24590-HLW-M5-V17T-P20002, *Process Flow Diagram - HLW Vitrification - Melter 2 (System HMP)*
- 24590-HLW-M5-V17T-P20003, *Process Flow Diagram - HLW Vit Melter 2 - Primary Offgas Treatment (System HOP)*
- 24590-HLW-M5-V17T-P20004, *Process Flow Diagram - HLW Vitrification - Melter 2 - Secondary Offgas Treatment (System HOP)*

Additional process information can be obtained within 24590-HLW-3YD-HOP-00001, *Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems).*

3 System Summary

The HLW Facility contains two identical offgas treatment systems, one for each of the two HLW Melters. Both offgas systems contain three process sub-systems. These sub-systems are designed for specific purposes and use "best available control" technologies. These systems are defined as follows:

- Primary Melter Offgas Treatment System
  - Film Cooler (HOP-FCLR-00001/2)
  - Melter Pressure Control Subsystem
    - Melter pressure controls/instrumentation
    - Main offgas line
    - Standby offgas line

    - ~ Maintenance bypass line
  - Submerged Bed Scrubber (SBS) (HOP-SCB-00001/2)
  - SBS Condensate Receiver Vessel (HOP-VSL-00903/904)
  - Wet Electrostatic Precipitator (WESP) (HOP-WESP-00001/2)
  - High Efficiency Mist Eliminators (HEMEs) (HOP-HEME-00001A/B and 2A/B)
  - HEPA Filter Electric Preheaters (HOP-HTR-00002A/1B/5A/5B)
  - High Efficiency Particulate Air (HEPA) Filters (HOP-HEPA-00001A/1B/2A/2B/7A/7B/8A/8B)
- Secondary Offgas Treatment System
  - Booster Extraction Fans (HOP-FAN-00001A/1B/1C/8A/8B/8C)
  - Activated Carbon Column (sulfur impregnated) (HOP-ADBR-00001A/1B/2A/2B)
  - Silver Mordenite Preheater (HOP-HX-00002/4)
  - Silver Mordenite Column (HOP-ABS-00002/3)
  - Catalyst Skid (HOP-SCO-00002/3)
    - ~ Catalyst Skid Preheater (HOP-HX-00001/3)
    - ~ Catalyst Skid Electric Heater (HOP-HTR-00001/7)
    - ~ Thermal Catalytic Oxidizer (TCO) (HOP-SCO-00001/4)
    - ~ NO_x Selective Catalytic Reducer (SCR) (HOP-SCR-00001/2)
  - Stack Extraction Fans (HOP-FAN-00009A/9B/9C/10A/10B/10C)
- Vessel Ventilation System (System PVV)

The following sections describe the three process offgas treatment systems components and their related process operations. A sketch of the HLW melter offgas system is included as Attachment 1.

3.1 Primary Melter Offgas Treatment System

The offgas treatment system is able to handle a melter capacity of 3.0 MTG/d. The primary offgas treatment system is designed to control the melter pressure, remove heat from the melter offgas to permit appropriate operation of the down-stream equipment, and remove particulates. The system, in conjunction with the fans, is designed to accommodate intermittent offgas surges with seven times (7X) the normal steam generation.

All HLW primary offgas equipment, except filter media, is designed for the life of the facility. The HEME and HEPA filter elements are designed for remote change-out as required.

A pair of HEME/HEPA filter trains will be provided for the HLW melter. One set of HEME/HEPA filters will be in operation while the parallel system is on standby or being maintained. A HEME/HEPA filter set is activated or taken off-line by opening or closing the appropriate inlet valves. The inlet valves will be located in the melter cave with the HEMEs. Isolation valves are also located in the filter cave that can be used for HEPA filter isolation to permit filter media replacement. These isolation and switching valves are remotely maintainable.

3.2 Secondary Offgas Treatment System

The combined primary and vessel ventilation offgas stream is discharged to the secondary offgas treatment system. The secondary offgas system will treat the combined offgas so that it is acceptable for release to the HLW vitrification facility stack. Specifically, the secondary offgas treatment system will remove iodine-129, volatile organic compounds (VOC), NO_x, and volatile halides (i.e. Cl and F) as required, to meet the WTP's air discharge requirements. The system will also be designed to limit potential catalyst poisons from reaching the VOC treatment unit.

The secondary offgas system also contains extraction fans (booster and stack) to provide the motive force to ventilate the system and maintain a vacuum within the HLW melter plenum. It also includes two heat recovery heat exchangers and an electric heater for offgas heating and cooling as appropriate.

The primary offgas treatment system is designed to remove sufficient radionuclides such that the secondary offgas treatment system can be contact or semi-remotely maintained.

3.3 Vessel Ventilation System (System PVV)

The vessel ventilation offgas system will maintain the various HLW process vessels under a slight vacuum relative to the cave to prevent cave contamination. Vessels (such as the melter feed preparation vessel and melter feed vessel) containing slurries with high solids content will be equipped with flushable demisters for aerosol removal. The vessel vent system will not receive any offgas generated from reverse flow diverter pumps and pulse jet agitator operations. The composition of the ventilation air is primarily air with slight chemical and radioactive particulate contamination. No significant acid gas or organic contamination is anticipated for the vessel ventilation offgas.

The vessel ventilation air is combined with the melter offgas prior to entering the HEMEs. The combined offgas streams are treated together in the remaining sections of the primary and secondary offgas treatment systems. A pressure control valve is used to balance the pressure between the vessel ventilation system and the primary offgas treatment systems.

4 Description of Bypass Events

The HLW Offgas system (HOP) has the following alternate flow paths that the melter offgas could be diverted to during certain upset or off-normal (i.e., maintenance) events:

- Offgas Standby Jumper
- Melter Pressure Relief Valve
- Submerged Bed Scrubber Maintenance Bypass
- HEME/HEPA Trains
- Activated Carbon Unit Bypass
- Secondary Offgas Bypass

The following sections provide a process description of each alternate flow path, what causes them to be activated, level of abatement when activated, and melter feeding/cold cap condition required for activation:

4.1 Offgas Standby Jumper

The standby offgas line supplements control of the melter plenum pressure under high offgas surge situations or if there is a blockage in the main offgas line to the submerged bed scrubber. The melter plenum pressure is controlled at a sufficient vacuum set point relative to the melter cave to avoid contamination release to the melter cave, prevent inadvertent glass pour, and prevent damage from occurring to the primary treatment system. This is accomplished by providing an alternate path by way of the standby offgas line for melter offgas. The standby offgas line is identical in size to the primary offgas line and runs parallel to the primary line from the melter to the submerged bed scrubber.

The standby line will normally be isolated from the offgas via a fast-acting valve. At a low vacuum set point, this valve will automatically open, providing an additional or alternative (if the primary is restricted) path for the melter offgas to flow. The standby offgas pipe extends to the bottom of the submerged bed scrubber packed bed, identical to the primary pipe. Thus, during melter surges the cross-sectional area available for offgas flow effectively doubles, decreasing the pressure drop between the melter and the submerged bed scrubber and helping to reestablish normal melter vacuum. In case of pluggage in the primary offgas pipe between the melter and the submerged bed scrubber, the standby system would also activate, allowing melter pressure control to continue. Once the cause of the standby system being activated is rectified, the valve would be closed by operator initiation, returning all of the melter offgas to the primary offgas film cooler and offgas pipe. An air purge will be used to keep the standby offgas line clean and prevent blocking.

The standby offgas jumper is automatically activated based on the melter plenum vacuum via a pressure control interlock. Activation of the standby jumper is most likely to occur under melter feeding conditions and during an upset condition (i.e., melter surge). No loss of offgas abatement occurs upon activation of the standby jumper since the offgas is routed to the same destination (i.e., the SBS) as the primary offgas jumper.

4.2 Melter Pressure Relief Device

In the unlikely event that an offgas surge exceeds the capacity of the melter offgas pressure control system, a pressure relief device is provided to vent the melter gases to the melter cave. These gases would be filtered by the C5 filter system.

The melter pressure relief device is a pressure-activated flapper valve that is mounted on the standby offgas jumper. It is mechanically designed to automatically open when the melter plenum reaches a predetermined "positive" pressure relative to the melter cave. The melter will begin venting to the melter cave once the plenum pressure exceeds the melter cave pressure. The primary purpose of this valve is to prevent the melter from over-pressurizing to such a degree that it pushes glass out of the melter pour spouts. The pressure relief valve automatically closes when the melter plenum pressure falls back below its set point.

Activation of the pressure relief valve is most likely to occur under melter feeding conditions and during a significant upset condition (i.e., valve misalignment, large melter surge, loss of extraction fan operation, etc.). Melter offgas vented into the melter cave would bypass all offgas treatment steps, but would be treated by the C5 ventilation HEPA filters. Except for extreme scenarios, offgas release to the melter cave would not be expected to continue for more than a few seconds to a minute. Through a combination of injected air minimization, melter feed termination, and increased fan speed, the melter offgas pressure control system is designed to compensate for upset conditions and automatically restore the melter plenum to vacuum. The HOP extraction fans can be operated via backup generators in case of loss of

offsite power. They are also operated in a 50% fashion whereby each extraction fan set (booster and stack) has two operation fans with a unique backup fan. In the event of single fan failure in either fan set, the remaining operational "50%" fan allows continued melter ventilation while the standby fan is started and ramps up to operational speeds.

4.3 Submerged Bed Scrubber Maintenance Bypass

The maintenance bypass line is located between the melter and the HEME inlet. It is used to provide an alternate melter ventilation path when maintenance is required on the film cooler, main/standby offgas jumper, the submerged bed scrubber, or on the WESP. The maintenance bypass line would only be opened after the melter has been placed in an idling state (no melter feeding and no cold cap present). The line contains a remotely operated valve, a cooling air supply, and a water spray quenching system. The cooling air partially cools the melter offgas from about 1800°F to about 1000°F. The water spray quenches the offgas from about 1000°F to about 150°F. The cooling air supply also normally provides an air purge when the line is not activated to prevent solids from accumulating in the inlet.

When activated, the submerged bed scrubber maintenance bypass diverts the melter offgas around two of the four particulate removal steps (i.e., submerged bed scrubber and WESP) in the primary offgas system. However, given that the melter is idled and no cold cap is present, the particulate load in the idled offgas would be minimal. The diverted offgas would still be treated by the HEME and HEPA filters which have a combined particulate removal efficiency that significantly exceeds the submerged bed scrubber /WESP combination. Idled melter offgas that is diverted through the maintenance bypass will have a significantly reduced particulate contamination after only HEME/HEPA treatment compared to what is discharged during normal melter feeding operations and abatement by the SBS, WESP, HEME, and HEPA combination. Operation of the SBS maintenance bypass for extended periods (days to weeks) would be expected while maintenance activities are performed.

4.4 HEME/HEPA Trains

A pair of HEME/HEPA filter trains will be provided for the HLW melter offgas treatment. One set of HEME/HEPA filters will be in operation while the parallel system is on standby or being maintained. Parallel filter trains are provided so that filter maintenance does not impact facility throughput and to provide a backup system in case of component failure in the primary train. Filter maintenance can consist of HEME filter flushing, HEME/HEPA filter media replacement, and/or maintenance of other related components. A HEME/HEPA filter set will be activated or taken off-line by opening or closing the appropriate remotely actuated inlet valves. The inlet valves will be located in the melter cave with the HEMEs. Isolation valves are also located in the filter cave that can be used for HEPA filter isolation only to permit filter media replacement.

When the melter offgas is diverted through either HEME/HEPA filter train, no loss of abatement efficiency occurs since each train contains identical treatment units. Either train can be used during melter feeding operations or to treat idled melter offgas that is diverted through the SBS maintenance bypass.

4.5 Activated Carbon Column Bypass

The activated carbon column is used to remove mercury compounds from the HLW melter offgas. The unit consists of two sulfur impregnated activated carbon beds that will alternate in a lead/lag series arrangement so that the unit has 100% availability. When the lead bed reaches breakthrough, the offgas is

switched to the lag bed for treatment while the lead bed is independently isolated and the spent media replaced. The fresh media/bed is then "valved" back into the offgas stream as the new lag bed.

The overall unit is equipped with a manual bypass that would allow the offgas to bypass the treatment unit if opened. However, the bypass will not be used during normal operations. At least one of the activated carbon beds would always be online for offgas treatment, even if the melter were idled.

4.6 Secondary Offgas Bypass

Other than the activated carbon column, the HLW secondary offgas system also is equipped with a silver mordenite column for iodine/halide removal, a catalyst skid for NO_x and VOC/SVOC destruction, and a gas heat exchanger for heat recovery. Both the silver mordenite column and the catalyst skid will require eventual media change-out. This will require the units to be bypassed from the melter ventilation path. Therefore, the system is equipped with a "secondary offgas" manual bypass that diverts the melter offgas from the activated carbon column discharge directly to the stack extraction fans and the facility stack. This bypass would only be activated after the melter is fully idled and all cold cap remnants have dissipated. (NOTE: The activated carbon column is <u>not</u> bypassed upon activation of the secondary offgas bypass.)

When required, the secondary offgas bypass would be used for several days to weeks to allow sufficient time for media change-out and/or other maintenance activities on the silver mordenite column, catalyst skid, and/or silver mordenite preheater. Although the abatement function of these units would cease while they are bypassed for maintenance, the realized stack emissions are estimated to contain less iodine/halides, NO_x, and VOC/SVOCs than during normal melter feed operations. This is because the melter will be idled and no cold cap will be present in the melter.

Attachment 1

HLW Melter Offgas System