

West Valley Demonstration Project

Doc. Number WVNS-SD-63H

Revision Number 4

Revision Date 12/11/95
Engineering Release # 2404

Attachment F

SYSTEM DESCRIPTION

OFF-GAS & VESSEL VENT SYSTEM SYSTEM 63H

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WV-1818, Rev. 1

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WVNS RECORD OF REVISION

DOCUMENT

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Rev. No.	Description of Changes	Revision On Page(s)	Dated
0	Original Issue	All	07/20/92
1	Per ECN #8083	All	06/28/94
2	Per ECN #8659	All	02/01/95
3	Per ECN #9064	All	07/06/95
4	Per ECN #9456 and #9473	Section 2 - 9, 19, 26, 47, 48, 51 Section 3 - 4, 16, 22, 28 Section 4 - 1, 3, 4, 5, 6 Section 6 - 6, 9, 10, 25, 30 APPENDIX A - 2 APPENDIX B - All APPENDIX C - All APPENDIX D - 2, 3	12/11/95

WVNS RECORD OF REVISION CONTINUATION FORM

<u>Rev. No.</u>	<u>Description of Changes</u>	<u>Revision On Page(s)</u>	<u>Dated</u>
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SYSTEM DESCRIPTION
OFF-GAS AND VESSEL VENT SYSTEM
(SYSTEM 63H)

R.F. VANCE

Whenever any doubt exists about the accuracy of any information contained in this system description, the Cognizant System Engineer should be contacted.

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SUMMARY

The In-Cell Vessel Ventilation and Off-Gas Treatment System provides essential services to the high level waste vitrification system, and to the facility operators. It provides a means to maintain in-cell tankage at slight vacuum for contamination control. Additionally, it collects radioactively contaminated materials from the off-gases inside the shielded cell to assure radiation exposures to operators are kept As Low As Reasonably Achievable.

The major operations of the In-Cell Vessel Ventilation and Off-Gas Treatment System and of the associated Out-of-Cell Off-Gas Treatment System, are depicted in the figure. Terms used throughout the text are defined in Tables 1 and 2. The Out-of-Cell Off-Gas Treatment System (System 64) is described by WVNS-SD-012.

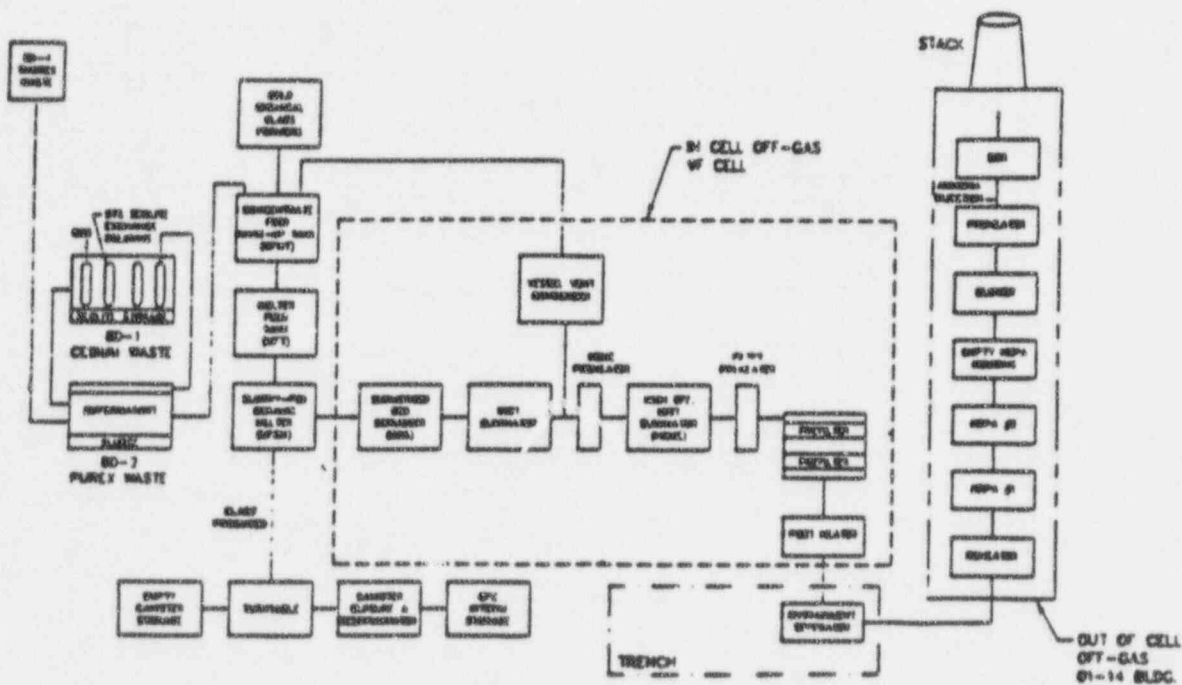


Figure: Vessel Ventilation & In-Cell Off-Gas Treatment Systems

Table 1: Definition of Terms

Term	Definition
01-14	The building housing the out-of-cell HEPA filters, blowers, and NO _x abatement equipment
8D-3	The underground tank that receives the condensate from the Vessel Ventilation System condenser
8D-4	The underground tank that receives liquid wastes
ALARA	As Low As Reasonably Achievable, the prevailing philosophy of radiation exposure control
CFMT	Concentrator Feed Make-up Tank
CS	Carbon Steel
DF	Decontamination Factor, the ratio of the contaminant inlet and outlet concentrations
DOP	DiOctyl Phthalate (di-2-ethyl hexyl phthalate), a challenge aerosol used to test HEPA filters
EDE	Effective Dose Equivalent
EDR	Equipment Decontamination Room
FHT	Melter Feed Hold Tank
HEME	High Efficiency Mist Eliminator
HEPA	High Efficiency Particulate Air
IDLH	Immediately Dangerous to Life and Health NO: 100 ppm NO ₂ : 50 ppm
IRTS	Integrated Radwaste Treatment System
NDE	Non-Destructive Examination
PEEK	Polyetheretherketone
P&ID	Process and Instrument Diagram
Quality Level B	Failure could cause loss of 1-6 months operation. See "Quality Management Manual," WVDP-002.
Quality Level C	Failure could cause loss of 1-4 weeks operation. See "Quality Management Manual," WVDP-002.

Table 1: Definition of Terms (Concluded)

Term	Definition
Quality Level N	Failure would cause loss of <1 week operation. See "Quality Management Manual," WVDP-002.
RTD	Resistance Temperature Device
SMCI	Specialty Maintenance & Construction Inc., the vendor for much of the in-cell off-gas equipment
SS	Stainless Steel
Safety Class B	Generally, risks 1 or more injuries off-site, &/or 1 or more fatalities on-site. Radiologically risks >50 mSv (>5 Rem) EDE on-site, &/or 5 to 250 mSv (0.5 to 25 Rem) EDE off-site. Chemically risks >1 IDLH on-site. Environmentally risks significant transient damage lasting less than 30 days. See "Quality Management Manual," WVDP-002.
Safety Class C	Generally, risk of injury to over 5 workers. Radiologically risks 10 to 50 mSv (1 to 5 Rem) to dosimetry qualified workers, 0.1 to 50 mSv (0.01 to 5 Rem) to non-qualified workers, or 0.1 to 5 mSv (0.01 to 0.5 Rem) to the public. Chemically risks of greater than 1 STEL to workers. Environmentally, minor damage risked. See "Quality Management Manual," WVDP-002.
Safety Class N	Generally, risks routinely accepted by workers and the public. Radiologically risks <0.1 mSv (<0.01 Rem) to workers or the public. Chemically risks routinely accepted by workers and the public. Environmentally, no damage risked. See "Quality Management Manual," WVDP-002.
STEL	Short Term Exposure Limit NO ₂ : 1 ppm NO: Not Established
SBS	Submerged Bed Scrubber
SFCM	Slurry Fed Ceramic Melter
VF	Vitrification Facility
WVDP	West Valley Demonstration Project
WVNS	West Valley Nuclear Services Company

Table 2: Definition of Units

Measure	SI Unit	SI Name	English Unit	Equalities
Amount of Substance	mol	gram molecular weight	lb _m -mol SCF	mol = 0.0022 lb-mol mol = 0.837 SCF _(60 F)
Angle	rad	radian	degrees	2π rad = 360 degrees
Current	A	Ampere	amp	A = amp
Dose	Gy	Gray	Rad	Gy = 100 Rad
Dose Equivalent	Sv	Sievert	Rem	Sv = 100 Rem
Energy	J	Joule	Btu	kJ = 0.948 Btu
Force	N	Newton	lb _f	N = 0.225 lb _f
Length	m	meter	ft	m = 3.28 ft
Mass	g	gram	lb _m	kg = 2.20 lb _m
Potential	V	Volt	v	V = v
Power	W	Watt	w hp	W = w W = 1.34 x 10 ⁻³ hp
Pressure	Pa	Pascal	psi	kPa = 0.145 psi
Temperature	°C K	Celcius Kelvin	°F °R	t _(C) = (5/9)x(t _(F) -32°) T _(K) = (5/9)x(T _(R))
Time	s min h	second minute hour	sec min hr	s = sec min = min h = hr
Volume	L m ³	liter cubic meter	gal ft ³	L = 0.264 gal m ³ = 35.3 ft ³
Modifiers				
Millionth	μ	micro-	10 ⁻⁶	
Thousandth	m	milli-	10 ⁻³	
Thousand	k	kilo-	10 ³	
Million	M	Mega-	10 ⁶	

1.0 FUNCTIONS AND DESIGN CRITERIA

1.1 Functions

The in-cell portion of the Vessel Ventilation and Off-Gas Treatment System provides essential services to the high level waste vitrification system, and to the facility operators.

- It provides for the safe removal of the process gases from the melter and other related vessels while maintaining vessels and ducting at slight vacuum for contamination control.
- It collects radioactively contaminated materials from the off-gases inside the shielded cell to assure radiation exposures to operators are kept As Low As Reasonably Achievable (ALARA).

1.2 Design Criteria

The In-Cell Vessel Ventilation and Off-Gas Treatment System described by this document is designed to meet the criteria promulgated by WVNS-DC-011, "General CTS Component Design Criteria," and WVNS-DC-022, "Vitrification of High-Level Wastes."

The in-cell vessel ventilation and off-gas treatment equipment has a design life of 7 years.

Once started, the Off-Gas and Vessel Vent System can be operated regardless of whether feed is directed to the melter.

1.2.1 Process Requirements

The Off-Gas and Vessel Vent System, with the VF Ex-Cell Off-Gas System (System 64), is designed to maintain a slight vacuum, about 1 kPa (5 InWG), on process components. The vessel ventilation equipment is to maintain the vacuum regardless of whether waste is being fed to the melter, whether the Concentrator Feed Make-up Tank (CFMT) is contributing steam at a rate of up to 1.04 Mg/h (2300 lb_m/hr) to the vessel vent header (This corresponds to a boiling rate of 1.06 m³/h (280 gal/hr) from the CMFT.), or whether the off-gas jumper from the melter to the Off-Gas and Vessel Vent System is plugged. The vessel ventilation equipment is to condense, and direct to tank 8D-3, all of the steam produced by operation of the CFMT, allowing only the humidity in the ventilation gases to enter the off-gas treatment equipment.

The off-gas treatment equipment is to receive off-gases from the melter when it is operated to produce glass at a rate of 45 kg/h (100 lb_m/hr). The off-gas equipment is to accommodate off-gases resulting from the high waste feed rate of 150 L/h (40 gal/hr) associated with melter start-up operation. The system is also to receive additional gases and vapors from the vessel ventilation equipment.

High radiation fields are to be confined to the interior of the vitrification cell for ALARA purposes.

The in-cell off-gas treatment equipment is to precondition the melter off-gases before they leave the vitrification cell so the VF Ex-Cell Off-Gas System equipment can be maintained by hands-on methods.

The in-cell equipment is to elevate the temperature of the melter off-gas to well above its dew point before it leaves the vitrification cell, to preclude condensation in the ducting that leads to the 01-14 building.

1.2.2 Structural Requirements

The in-cell equipment is designed to endure the following ambient conditions for at least three years of radioactive waste processing operation.

Temperature	16 to 35 °C	(60 to 95 °F)
Relative Humidity	30 to 80 %	
Nitric Acid Fumes	100 ppm	

The fabrication materials are to resist corrosion from the vitrification cell environment and process fluids.

The number of jumper overlaps is to be minimized. Where overlapping is unavoidable, the jumper anticipated to require the most frequent removal is to be located on top.

All system equipment mountings and supports are to be seismically designed to UBC Zone III, importance factor 1.5, with the addition of a vertical acceleration equal to 2/3 of the horizontal component.

1.2.3 Facility Configuration and Essential Features

The most significant facility configuration feature of the In-Cell Vessel Ventilation and Off-Gas Treatment System is its physical location inside the concrete Vitrification Cell which protects the operators from radiation emanating from the equipment.

Ventilation gases and vapors from the decontamination station, the waste header, the melter Feed Hold Tank (FHT), and the CFMT are continuously collected through jumpers to the vessel ventilation header. Should the vacuum in the SFCM become less than a preset value, a valve will automatically open in a jumper, directing gases and vapors from the SFCM to the vessel vent header. The gases and vapors are directed to the condenser. Condensate is drained through the condensate header to tank 8D-3 for subsequent processing by the Integrated Radwaste Treatment System (IRTS). Gases and uncondensed vapors are directed through a jumper into the In-Cell Off-Gas Treatment System.

Melter off-gases are first quenched and scrubbed of entrained radioactive particulate by the Submerged Bed Scrubber (SBS). The off-gases then pass through a mist eliminator to remove entrained liquid droplets to reduce the liquid burden at the High Efficiency Mist Eliminator (HEME). The liquid accumulated by the mist eliminator is returned to the SBS. The non-condensed vapors and gases from the vessel ventilation condenser are then blended into the off-gases. The combined gases are passed through an electric heater before entering either of two jumpers to a HEME.

NOTE: The reference operating mode of the HEME is "wet" as a mist eliminator. The HEME Preheater makes available the option of operating the HEME as a "washable" dry filter, because it can elevate the temperature of the off-gas to well above its dew point.

Impact wrench operated isolation valves in the jumpers to the HEMEs are used to select which of the two installed parallel off-gas trains (HEME, filter preheater and prefilter) are used. The HEME treats the off-gases to remove the submicron particulate. The coalesced liquid, together with the collected particulate, drains from the pad back to the SBS. The off-gases leaving the HEME pass through an electric preheater to increase the off-gas temperature to well above its dew point, assuring the subsequent prefilter elements do not become wet from entrained water droplets. The prefilters will remove essentially all of the remaining radioactive particulate, retaining it within the shielded vitrification cell.

NOTE: To retain sub-micron radioactive particulate inside the shielded vitrification cell, the most efficient filter elements available, HEPA elements, were specified for use as prefilter elements.

The off-gases from the parallel off-gas trains are directed through jumpers, with impact wrench operated isolation valves, to a common "postheater" housing and duct leading to the 01-14 Building.

The normal state of the In-Cell Vessel Ventilation and Off-Gas Treatment System is the operating mode. It can be operated regardless of the mode of the melter, because it is used to keep the melter and associated equipment under a slight vacuum to control contamination.

The equipment is designed to be maintained remotely, thereby allowing the concrete wall to provide protection for the people performing maintenance work. The systems are also designed to be remotely decontaminated. This allows the walls to provide protection for the decommissioning crews after the system's useful life is completed. Except for the vessel ventilation header and the off-gas discharge header, the equipment is also designed to be remotely dismantled.

To allow for equipment maintenance without having to suspend melter feed operation, a redundant train of off-gas treatment equipment was installed.

1.2.4 Maintenance

All items of equipment in the system requiring periodic routine maintenance are designed for remote maintenance or replacement. Equipment with likely operating lives of less than seven years are designed to be either remotely replaceable, or have installed backups.

Normally, one of the installed redundant off-gas trains (HEME, filter preheater, prefilter) is operated while the other off-gas train is valved out-of-service. While out-of-service, maintenance operations can be performed. A train is placed into service by opening the isolation valves in the jumpers upstream from the HEME and downstream from the prefilter. A train is removed from service by closing the same two isolation valves.

The vessel ventilation header, structural supports and service wall are non-maintenance items.

1.2.5 Surveillance and In-Service Inspection

Surveillance and in-service inspections are necessarily performed remotely. Surveillance is accomplished by observation through shield windows in the vitrification cell walls, and by television cameras as available. In-service inspection is accomplished by carefully monitoring the available instruments.

1.2.6 Instrumentation and Control

The system is generally passive, with only one in-cell assembly that is subject to periodic automatic motion, the vessel ventilation pressure control valve and its associated actuator. The opening in the control valve throat is automatically modulated to maintain a slight vacuum in the vessel ventilation header. This is done to maintain a slight vacuum in the primary process systems, relative to the vitrification cell atmosphere, for purposes of contamination control. Pressure controls are depicted schematically in Figure 1.2-1.

NOTE: Pressure in the system is controlled by motive forces provided by the blowers located downstream in the VF Ex-Cell Off-Gas System. Flow is largely determined by operating characteristics in the Primary Process System, mostly by the film cooler and injection air rates at the melter. Temperature control, except at the SBS, is provided by out-of-cell modulation of the power supply to electric heaters, and is based upon in-cell temperature readings.

Besides maintaining the primary process system components under a slight vacuum, the vessel ventilation equipment is also used to control the steam that is evolved from the CFMT. This steam is condensed and cycled back to the tank farm for subsequent processing by the IRTS.

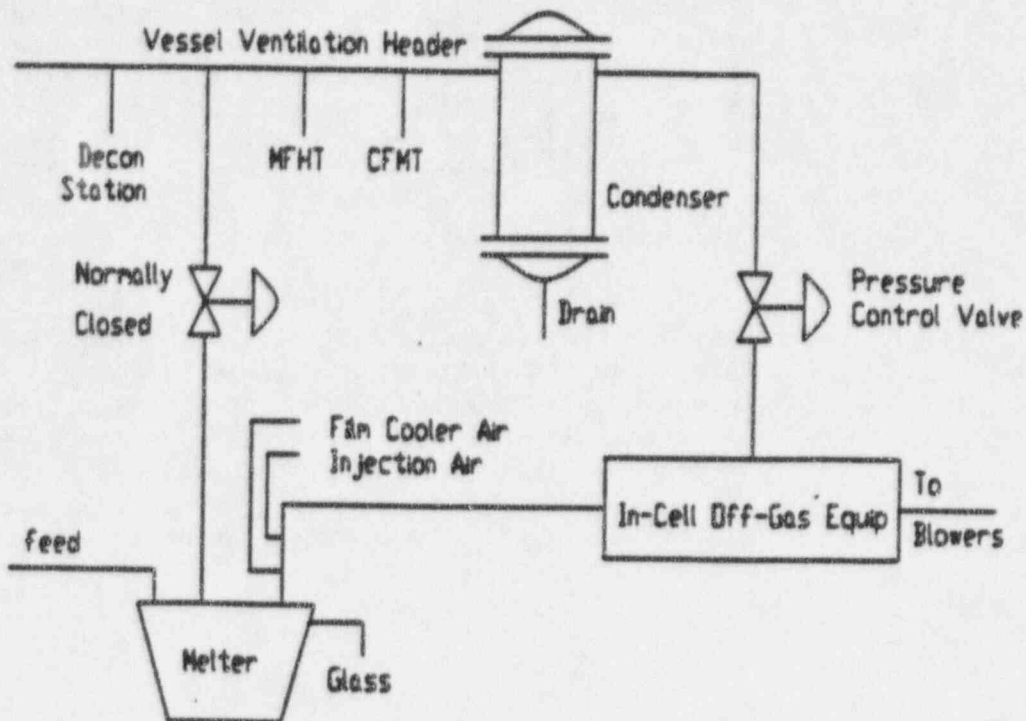


Figure 1.2-1: Pressure Control Schematic

The amount of water that is discharged from the system, in the form of water vapor directed to the stack, is established by controlling the operating temperatures of the SBS and vessel ventilation condenser. A temperature increase at the SBS off-gas outlet results in an increased water vapor expulsion rate. The temperature must be kept low enough, however, to prevent loss of solution from the SBS scrubber. It must also be kept low enough to prevent condensation in the duct between the vitrification facility and the 01-14 Building by keeping the off-gas dew point sufficiently low. Temperature control is provided by modulation of the amount of closed loop cooling water sent to the cooling coils in the SBS bed.

1.2.7 Interfacing Systems

The Vessel Ventilation and In-Cell Off-Gas System components physically interface with the following systems.

- The Waste Mobilization and Transfer System (System 55) accepts condensate from the vessel ventilation condenser into tank 8D-3.
- The Cell Walls and Ex-Cell Arrangement System (System 63F) provides shield wall protection for operators, and shield wall penetrations for instrumentation and utility services.
- The Waste Header System (System 63G) accepts accumulated condensate from the SBS receiver for delivery to tank 8D-4.
- The Primary Process System (System 63I) delivers melter off-gases and CFMT steam to the system, and accepts accumulated condensate from the SBS receiver tank into the CFMT.
- The Canister Decontamination System (System 63J) is ventilated by the vessel ventilation equipment.
- The In-Cell Remote Handling, Maintenance and Viewing System (System 63K) provides the overhead crane and impact wrench to operate the valves in the four off-gas jumpers, in the two HEME drain jumpers, and in the drain from the condenser.
- The VF Deionized Water System (System 63DW) provides deionized water to flush the pads in either of the HEME vessels, the seal loops between the HEME vessels and the SBS, and the seal loop between the condenser and the condensate header.
- The VF Electrical Power Distribution System (System 63ED) provides 480 V, 3 phase, electrical energy to the motor for the SBS solids centering equipment and to the electrical resistance heaters.

- The VF Instrument Air System (System 63IA) provides control air for the valve operator of the vessel ventilation pressure control valve. It also provides purge air to the pressure and level taps in the condenser; the reference, density and level taps in the SBS scrubber and receiver; to the inlet and outlet pressure taps in the mist eliminator housing; to the reference, density and level taps in the HEMEs, and to the inlet and outlet pressure taps for prefilter assemblies.
- The VF Steam and Condensate System (System 63SC) provides high pressure saturated steam to two steam jets. These are the jet from the SBS receiver to the SBS bed, and the jet from the SBS receiver to the waste header.
- The VF Utility Air System (System 63UA) provides purge air to steam jets.
- The VF Ex-Cell Off-Gas System (System 64) provides the motive force to draw a vacuum on the system.
- The VF Cold Chemical System (System 65) provides decontamination or flush solutions to the SBS bed, the SBS receiver, the mist eliminator spray nozzle, the HEME vessels, the vessel ventilation header, and the condenser shell.
- The VF Closed Loop Cooling Water System (System 66) provides cooling water to the heat exchangers in the SBS bed and receiver, and to the tube bundle in the condenser.
- The VF Sampling System (System 69A) provides a means to sample the contents of the SBS.
- The VF Instrumentation and Control Hardware System (System 200A) provides parameter monitoring and control.

1.2.8 Quality Assurance

The applicable Safety Classes and Quality Levels for design, fabrication and installation of the system are identified in Table 1.2-1.

Table 1.2-1: Component Quality Assurance		
Component	Safety Class	Quality Level
Vessel Vent Header	C	C
Condenser	C	C
Non-Condensibles Jumper	C	C
Condensate Drain	C	C
Submerged Bed Scrubber	C	B
Mist Eliminator	N	C
HEME Preheater	N	C
Off-Gas Jumpers	C	C
HEMEs	N	C
Filter Preheaters	N	C
Prefilter Assemblies	C	C
Postheater	N	C
Discharge Header	N	C
Service Jumpers	N	C
Vitrification Cell Penetrations & isolation valves	B	B
Instruments; Controlling, Interlocked, &/or Alarmed	N	C
Instruments; Monitoring Only	N	N

1.2.9 Codes and Standards

All of the system equipment was designed and fabricated to rigorous quality standards, thereby assuring that the hardware would be safe for the intended applications. The codes and standards listed in Table 1.2-2 were implemented, as applicable, during design and fabrication.

Table 1.2-2: Applied Codes and Standards	
Codes/Standards	Title
AISC	Manual of Steel Construction
ANSI/ASME-NQA-1	Quality Assurance Program Requirements
ANSI/ASME N509	Nuclear Power Plant Air Cleaning Units and Components
ANSI/ASME N510	Standard for Testing of Nuclear Air-Cleaning Systems
ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI/ASME B31.3	Chemical Plant and Petroleum Refinery Piping
ANSI B46.1	Surface Texture
ANSI Y14.5M	Dimensioning & Tolerancing
ASME B/PV Code Sec. II Sec. V Sec. VIII Sec. IX	Boiler and Pressure Vessel Code Material Specifications NDE Division 1, Pressure Vessels Welding & Brazing Qualification
ASTM A380	Cleaning Descaling Stainless Steel Parts, Equipment and Systems
ASTM D 1056	Sponge and Cellular Rubber Products
AWS A.2.4	Symbols for Welding and NDE
AWS D1.1	Structural Welding
HTRI	Heat Transfer Research Institute
IEEE Standards	Electrical Standards
TEMA	Standards of Tubular Exchanger Manufacturers Association
MIL-F-51068F	Filter-Particulate, High Efficiency, Fire Resistant
MIL-F-51079C	Filter Medium, Fire Resistant, High Efficiency
NEC	National Electrical Code
SSPC-SP10	Steel Structures Painting Council Surface Preparation Specification No. 10, Near-White Blast Cleaning
UBC	Uniform Building Code
UL-586	High Efficiency Air Filter Units

1.2.10 Reliability Assurance

The following steps were taken to assure the greatest practical reliability for the system.

- Fabrication materials were selected to provide the maximum resistance to corrosion from the in-cell and process environments. Because the principle corrosive substance to which the equipment will be exposed is nitric acid, surfaces exposed to the cell environment and to the process fluids were typically fabricated from Type 304L stainless steel. More exotic materials were applied where anticipated process conditions warranted.
- Fabrication materials were selected to provide the maximum resistance to radiation. The metal equipment is not deleteriously affected by beta and gamma radiation. Elastomers do deteriorate from exposure to beta and gamma radiation so application of diaphragm operated valves was minimized, and impact wrench operated valves were used. Teflon also deteriorates from exposure to beta and gamma radiation, so radiation resistant polyetheretherketone (PEEK) was used for certain valve internals, and radiation resistant Viton was used for gasketing. Where calculations revealed that Viton was not mechanically adequate, radiation resistant asbestos was used.
- Wear was minimized by minimizing use of rotating equipment.
- Continuous operating capability was optimized by installing redundant, 100% capacity, spares for all equipment expected to require periodic maintenance. This included the HEME, Filter Preheater, and Prefilter Assembly.
- The potential for failure of non-maintenance items, such as the vessel ventilation header, was minimized by requiring radiographic verification of the quality of 100% of the fabrication welds.

2.0 DESIGN DESCRIPTION

2.1 Summary

The In-Cell Vessel Ventilation and Off-Gas Treatment System includes all vessels, piping, valves, and associated equipment required to collect, treat, and transfer process gases and vapors from the melter and other in-cell equipment to the Out-of-Cell Off-Gas Treatment System.

To confine high radiation fields within the Vitrification Cell, prefilters were located inside the cell.

Redundant blowers in the Out-of-Cell Off-Gas Treatment System, and redundant off-gas trains, provide the means for the In-Cell Off-Gas Treatment System to remain operating during routine equipment maintenance.

The list of all the individual items is appended.

2.2 Unit Operations Descriptions

The major unit operations are as follows:

- Vessel Ventilation
- Quenching/Scrubbing
- High Efficiency Mist Elimination
- Filtration

2.2.1 Vessel Ventilation

Ventilation gases and vapors are collected into a single vessel vent header which directs the gases and vapors to a condenser. In the event that vacuum is lost in the SFCM, SFCM gases and vapors are also directed into the vessel vent header to re-establish the vacuum.

The gases and vapors from the vessel vent header are directed into the shell side of the condenser. Closed Loop Cooling Water is directed into the tubes, counterflow with the gases and vapors.

The condensate from the condenser flows by gravity through a calibrated weir, and a liquid seal, to a header which sends the liquid to tank 8D-3 for subsequent processing by the IRTS. Provisions are available to measure shell pressure, the shell side differential pressure across the tube bundle, and liquid depth at the wier.

The gases and uncondensed vapors are directed through a jumper to the In-Cell Off-Gas Treatment System.

2.2.2 Quenching/Scrubbing

A. Submerged Bed Scrubber

The SBS is designed for quenching and first stage scrubbing of melter off-gases, cooling and condensation of melter vapor emissions, and interim storage of condensed fluids and spent canister decontamination solution.

The SBS, shown schematically in Figure 2.2-1, uses water to remove particulate and to quench the off-gases. It functions by bubbling the off-gases through the water in a bed packed with ceramic spheres. The rising bubbles of off-gas cause the liquid to circulate up through the packing. This simultaneously causes downward flow in the annular space outside the packed bed as liquid from the annular space replaces the liquid which is rising through the bed. The packing breaks larger bubbles into smaller ones to increase the gas-to-water contacting surface, thereby increasing the particulate removal and heat transfer efficiencies. The liquid circulation helps to prevent a buildup of captured material in the bed by constantly washing the material away. As the off-gases cool, water vapor condenses and increases the liquid water inventory. The excess water spills into the receiver, thereby maintaining a constant liquid depth in the scrubber. Heat absorbed by the water from the off-gases is removed by the cooling coils as the water flows downward in the annular space.

Oxides of nitrogen, NO_x , arriving at the SBS are primarily in the form of nitric oxide (NO). As the off-gases are quenched, the NO tends to react with oxygen to form nitrogen dioxide (NO_2).



NO is not soluble in water, but the NO_2 can dissolve into the aqueous scrub according to the following chemical reaction.



Although the SBS was not specifically designed to remove oxides of nitrogen, it does remove about 3% of the amount entering with the off-gases.

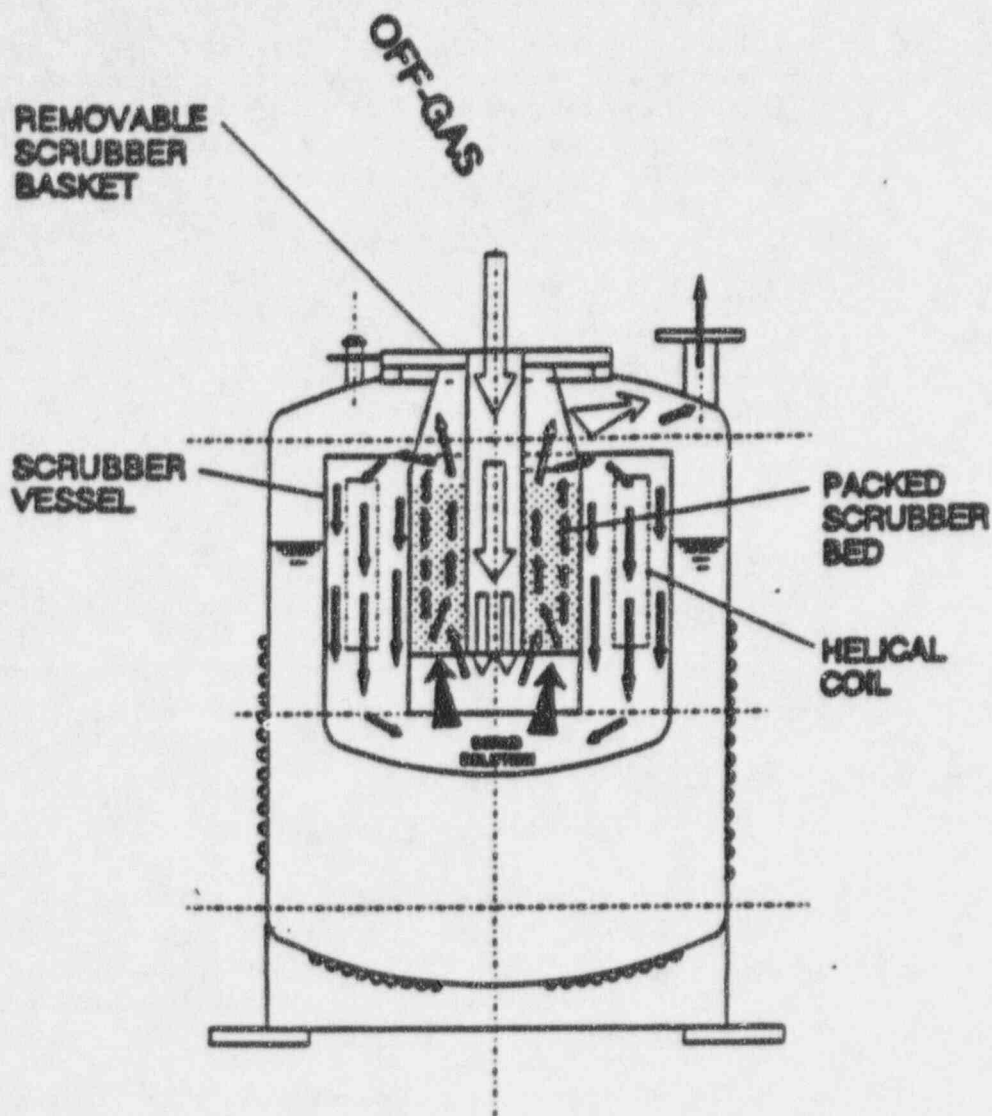


Figure 2.2-1: SBS Schematic

B. Mist Eliminator

The mist eliminator consists of a mesh pad in a housing mounted directly on the SBS off-gas exit nozzle flange, Flange Z, plus a jumper that provides demineralized spray water to flush the pad, and pressure differential measurement across the pad during operation.

Off-gases enter from below the pad and exit from above. The mist eliminator pad collects entrained droplets by impaction against the pad fibers where they adhere and coalesce. The coalesced liquid flows by gravity back into the SBS.

2.2.3 High Efficiency Mist Elimination

A. HEME Preheater

Energy is provided to the HEME Preheater as 480 V electricity. Electrical energy is converted to thermal energy in electric resistance elements, and the thermal energy is transferred to the off-gases by forced convective and radiative heat transfer.

Should the operations organization decide to employ the HEME as a dry filter, the HEME Preheater would be used to elevate the temperature of the off-gas above its dew point. The reference use for the HEME is mist elimination, and this preheating option is not expected to be routinely employed when treating radioactively contaminated off-gas.

B. High Efficiency Mist Eliminator

The HEME receives off-gases from the HEME preheater. It collects and coalesces entrained liquid droplets, and is 99.8 wt.% efficient for droplets 3 microns in diameter and larger. Simultaneously it removes submicron particulate from the gas.

Off-gas enters the center of the cylindrical pad from the top and passes through the pad to the outside. Because the pad is so large, the velocity of the gas through the pad is slow. Due to Brownian movement, droplets and particles contact the fibers of the pad where they collect and coalesce. Collected particulate is carried to the HEME drain lines by the gravity flow of the coalesced liquids.

NOTE: When the HEME Preheater is employed, the HEME pad functions as a dry filter, and the particulate would be carried to the HEME drain by the demineralized spray water used to flush the pad after the differential pressure becomes excessive.

The HEME vessels have drain lines which direct coalesced liquid and spray water to the SBS.

2.2.4 Prefiltration

A. Filter Preheaters

The Filter Preheaters operate by the same principles described for the HEME Preheater.

The filter preheaters are used to elevate the temperature of the off-gas above its dew point to assure that no condensation occurs on the prefilter elements downstream.

B. Prefilter Assemblies

The Prefilter Assemblies capture dry particulate to retain radioactive contamination inside the vitrification cell. This prevents significant contamination from reaching off-gas treatment equipment located downstream, outside the vitrification cell, thereby allowing hands-on maintenance there.

C. Heating

The original purpose of the "Postheater" was to elevate the temperature of the off-gases above the dew point sufficiently to assure that no condensation occurred in the duct from the vitrification cell to the 01-14 Building. An entrainment separator and reheaters located in the Out-of-Cell Off-Gas Treatment System to protect the HEPA filters there, made this heater redundant.

2.3 Equipment Performance Characteristics

2.3.1 Vessel Ventilation

Typical vessel ventilation condenser tube bundle performance is depicted in Figure 2.3-1. The curves are keyed to operation of the condenser with a clean tube bundle, while water is being boiled out of the CFMT at a rate of 18 L/min (5 gpm), and the condenser tubes are supplied with 380 L/min (100 gpm) of 16 °C (60 °F) cooling water. Significant changes in these parameters can alter the location and curvature of the lines in Figure 2.3-1.

The clean tubes of the condenser tube bundle have a surface area of about 100 m² (1100 ft²) and a demonstrated overall heat transfer coefficient (U_o) of about 780 kJ/h-m²-C° (38 Btu/hr-ft²-F°).

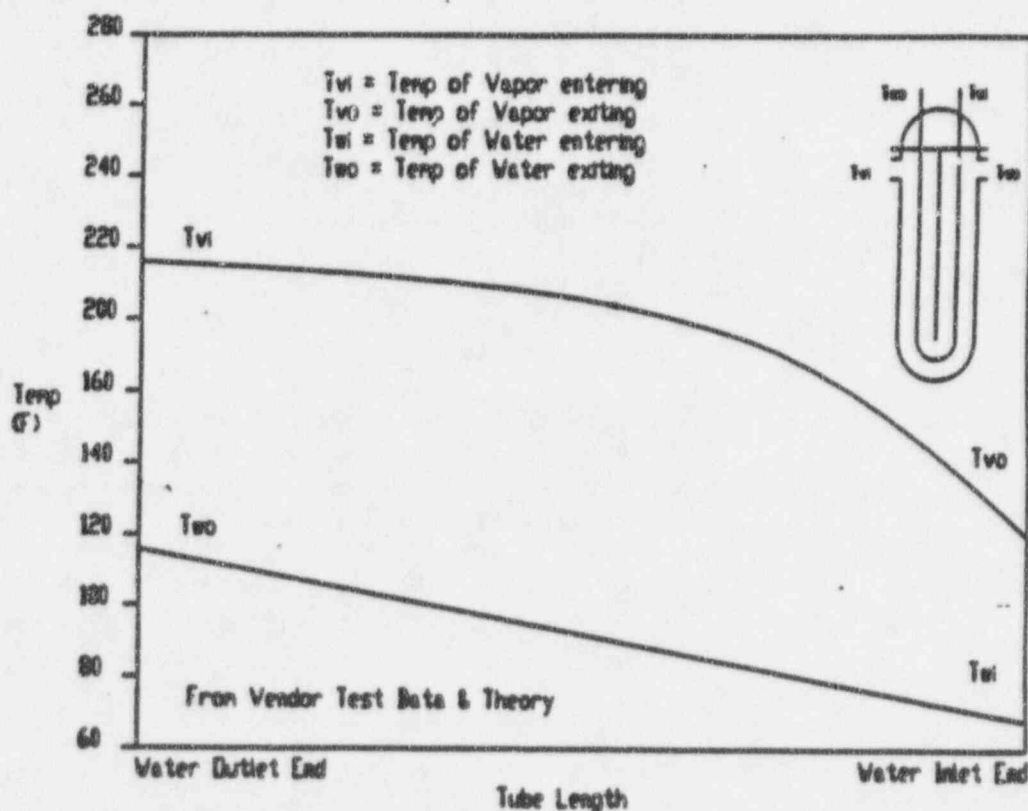


Figure 2.3-1: Vessel Ventilation Condenser Tube Bundle Performance

The condenser weir calibration, shell side pressure differentials, and tube side pressure differentials are given in Figures 2.3-2 through 2.3-4 respectively.

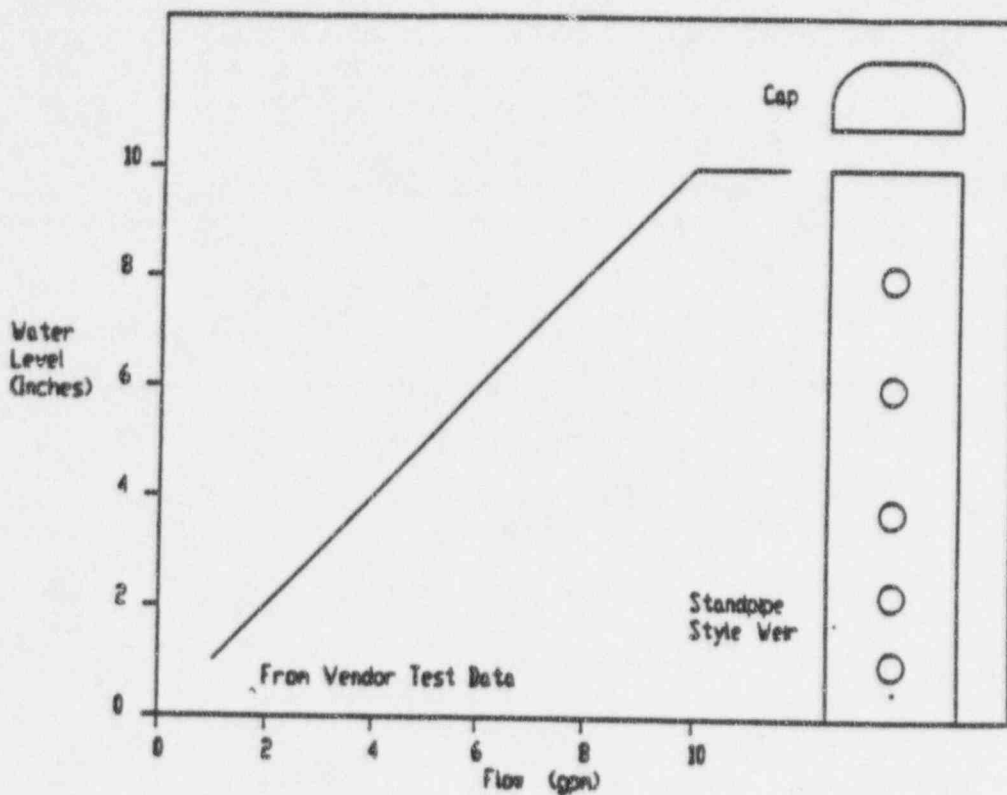


Figure 2.3-2: Condenser Weir Calibration Curve

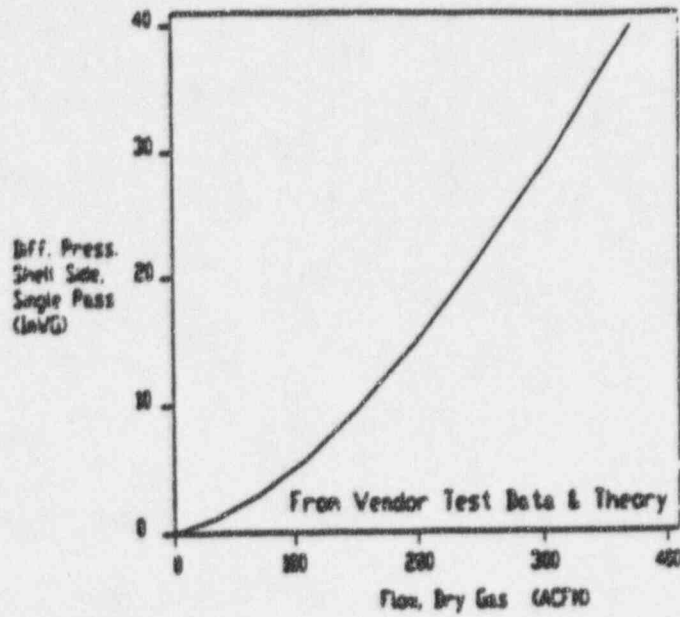


Figure 2.3-3: Vessel Ventilation Condenser Shell Side Pressure Differential

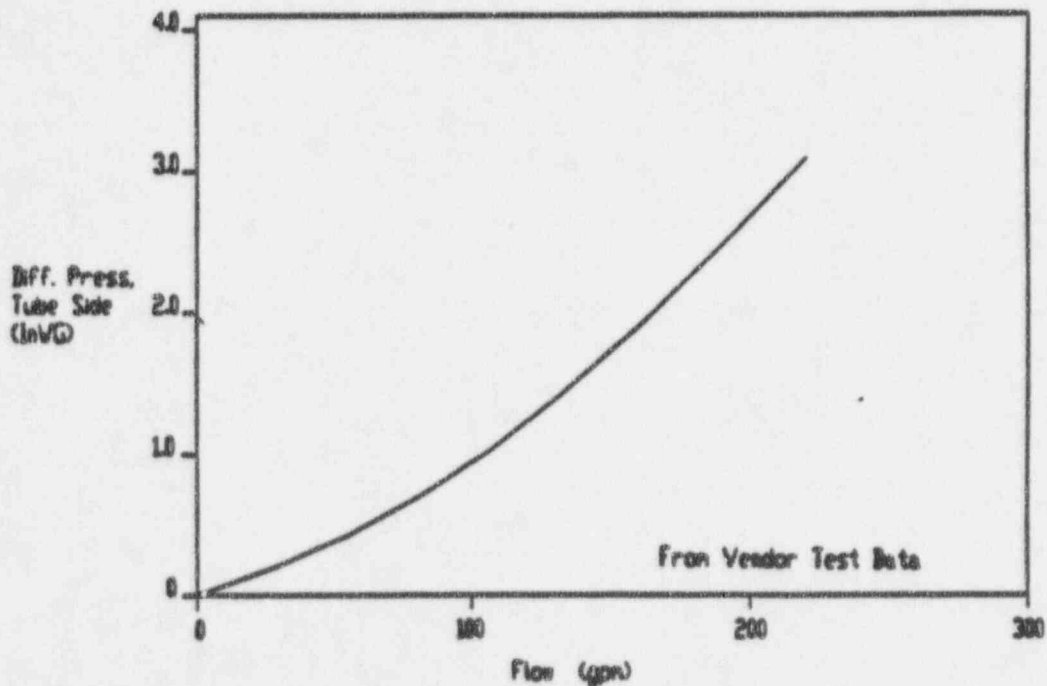


Figure 2.3-4: Vessel Ventilation Condenser Tube Side Pressure Differentials

2.3.2 Quenching Scrubbing

Based upon non-radioactive testing at the West Valley Demonstration Project, test run SF-10B, 99.4% (DF=160) of the primary radionuclide of concern, Cesium-137, entering the SBS is expected to be captured there. The variables affecting SBS scrubbing efficiency are summarized in Table 2.3-1.

The theoretical rate at which scrub solution will accumulate in the SBS with changes in bed temperature and melter operating rate is presented in Figure 2.3-5. The accumulation rate is also dependent upon the amount of inleakage into the SBS. The accumulation rate decreases as the amount of inleakage increases because additional water vapor is carried out with the additional effluent. The figure was developed assuming an inleakage rate of 24 mol/min (20 SCFM).

The theoretical cooling water flow rates required to maintain desired SBS bed temperatures during normal operation, for various cooling water temperatures, is presented in Figure 2.3-6. Actual cooling performance will change as fouling occurs on the coils. This figure assumes an overall heat transfer coefficient of 1.57 MJ/h-m²-K (71.8 Btu/hr-ft²-F°), which includes an allowance for some fouling, and a glass production rate at the melter of 30 kg/h (66 lb_m/hr).

The theoretical and measured closed loop cooling water pressure losses through the SBS bed cooling coils and SBS receiver half-pipe jacket are presented in Figures 2.3-7 and 2.3-8 respectively. The measured data are presented as discrete points; the theoretical data are presented as continuous curves.

The solids withdrawal equipment has been demonstrated to be capable of removing all but 0.1 liter (0.03 gal) of sludge from the bottom of a full scale scrubber section. The conditions under which the testing was performed are listed in Table 2.3-2. Deviations from these conditions could result in less efficient solids removal.

Table 2.3-1: Variables Influencing SBS Scrubbing Efficiency ⁽¹⁾		
No.	Variable	Effects
1.	Aerosol Solubility	Soluble aerosols are easily captured. Insoluble aerosols are not so easily wetted and can penetrate more easily.
2.	Aerosol Size	Experiments have shown that particles 0.3 to 0.7 microns are the most difficult to capture. For smaller particles collection efficiency probably increases due to effects of Brownian motion. For larger particles, collection efficiency probably increases due to effects of inertial impaction
3.	Aerosol Concentration	Soluble particle concentration at the outlet is independent of the concentration at the inlet. Thus, DFs for solubles are greater for higher inlet concentrations. For insoluble particles, higher inlet concentrations result in higher DFs, probably due to agglomeration into larger, easier to capture particles.
4.	Off-Gas Humidity	Increased steam with the entering off-gas increases collection efficiency. Steam condensing on aerosols cause particles to grow in size making them easier to capture. Steam condensing on insoluble particles should wet them making them easier to collect.
5.	Packing Shape	Spheres are considered less likely to plug than other packing shapes.
6.	Packing Size	For 10 mm (3/8") diameter packing, gas bubbles remain discrete. For smaller, 3 mm (1/8") packing, gas phase channels form in the bed which results in reduced scrubbing efficiencies.
7.	Packing Depth	Greater packing depths should always increase collection efficiencies, but would also produce increases in the pressure differential across the bed.

Table 2.3-1: Variables Influencing SBS Scrubbing Efficiency (Concluded)		
No.	Variable	Effects
8.	Superficial Velocity ⁽²⁾	Insoluble aerosol collection efficiency decreases with increases in superficial velocity, whereas soluble aerosol collection is not affected. Reentrainment increases for both soluble and insoluble aerosols as the superficial velocity increases. The superficial velocity should remain between 9 and 34 m/min (30 & 110 ft/min). ⁽³⁾
9.	Scrub Concentration	As the concentration of solubles in the scrub increases, the reentrainment of the solubles increase.
10.	Surfactant Additive	Laboratory studies by PNL suggested a defoamer can eliminate re-entrainment, but full scale testing at WVDP with surfactant concentrations of 0 to 8000 ppm indicated negligible changes. ⁽⁴⁾
(1)	PNL-5780, PNL-6035, PNL-6036	
(2)	Superficial velocity is defined as the volumetric flow rate at standard conditions of non-condensable gases divided by the cross-sectional area of the empty bed.	
(3)	At less than 9 m/min (30 ft/min) the recirculation characteristics become unstable. Studies haven't been performed for over 34 m/min (110 ft/min).	
(4)	D.E. Carl et. al., <u>West Valley Demonstration Project Vitrification Process Equipment Functional and Checkout Testing of Systems (FACTS)</u> , Draft Topical Report DOE/NE/44139-64, September 1990	

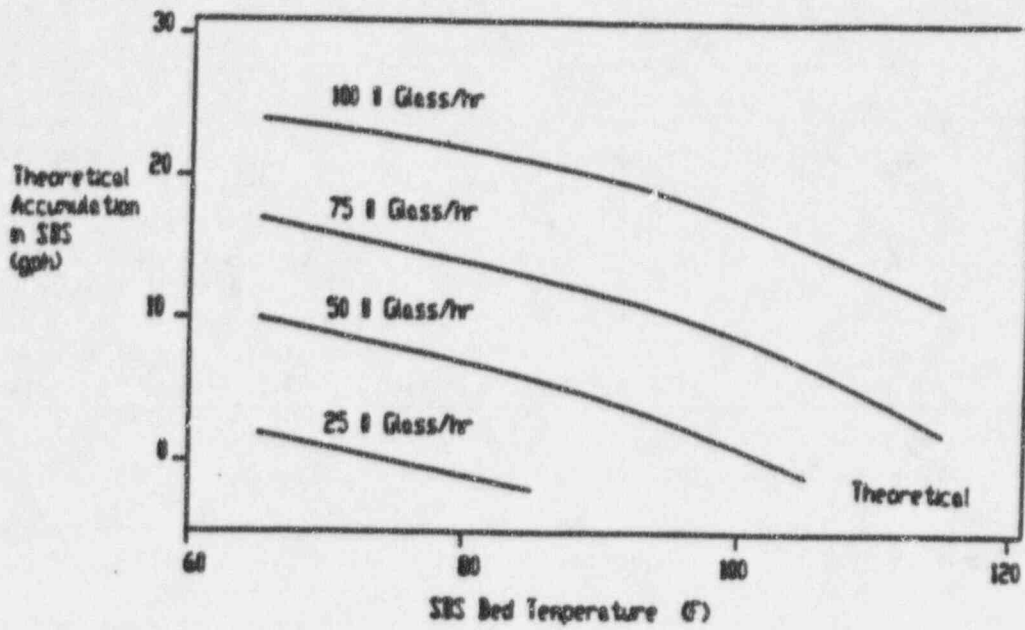


Figure 2.3-5: SBS Scrub Accumulation Rate

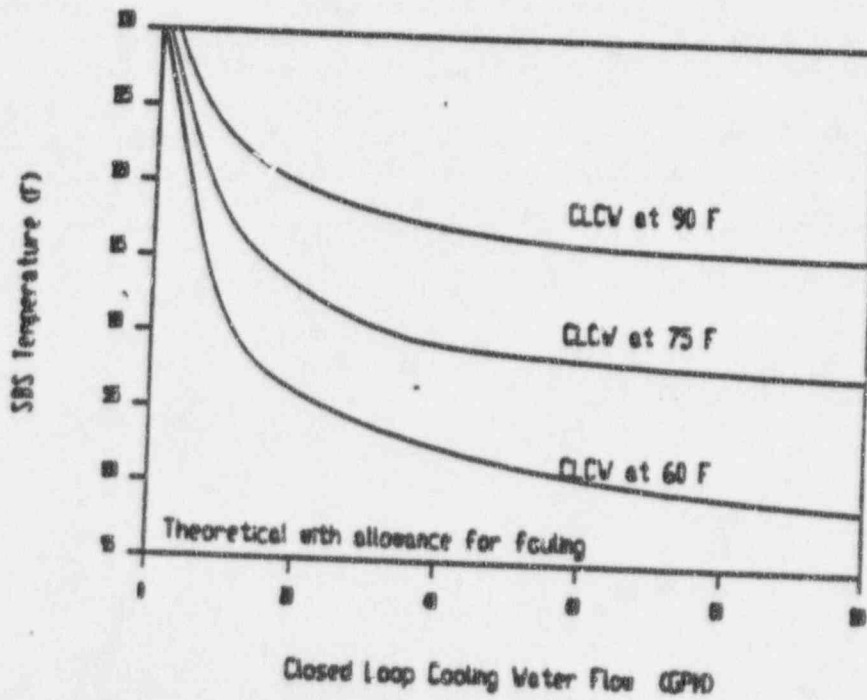


Figure 2.3-6: SBS Bed Cooling Coil Performance

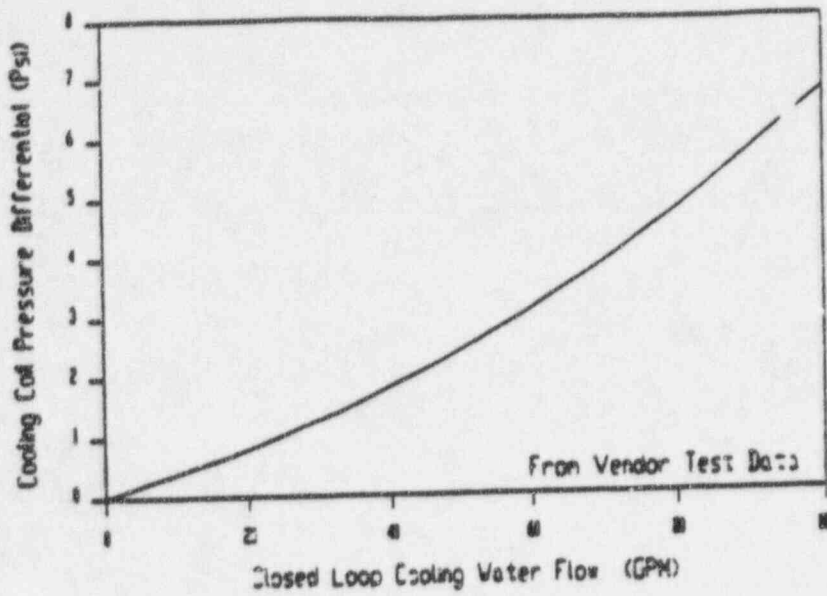


Figure 2.3-7: Closed Loop Cooling Water Pressure Loss through the SBS Bed Cooling Coil

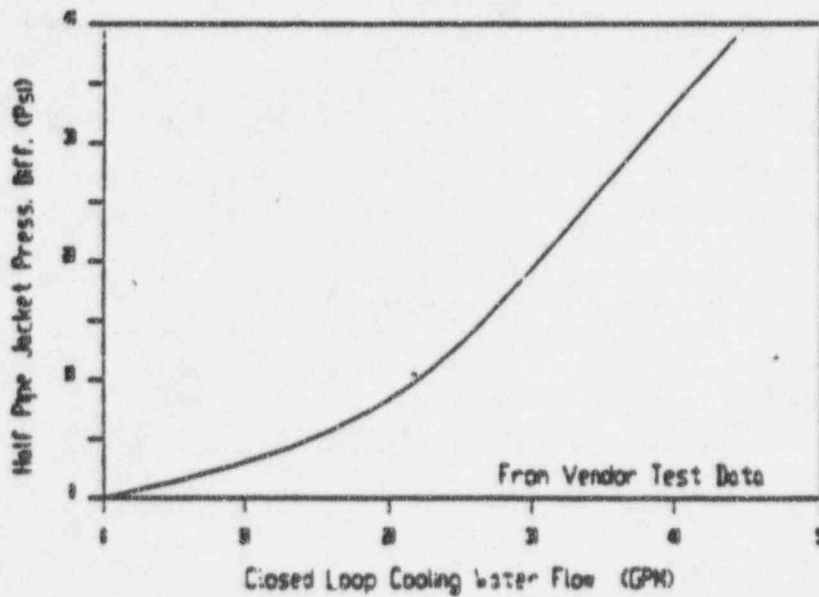


Figure 2.3.8: Closed Loop Cooling Water Pressure Loss through the SBS Receiver Half-Pipe Jacket

Table 2.3-2: Variables Influencing SBS Solids Removal Efficiency⁽¹⁾

No.	Variable	Effects
1	Centering Nozzle Configuration Number of nozzles Nozzle distance from wall Nozzle elevation Nozzle horizontal angle Nozzle vertical angle Nozzle opening	4 nozzles, evenly spaced. Use of only 3 is ineffective. 64 mm (2.5 in.) Even with bottom head flange 0.083 π rad (15°) right of center 0.11 π rad (20°) downward 7 mm (0.283 in.) diameter
2	Centering Nozzle Flow Rate	19 L/min (5.0 gpm) per nozzle
3	Centering Nozzle Operating Frequency	Withdrawal of solids is aided by intermittent centering flow. Prior to solids withdrawal, operation on a cycle of 10 minutes on and 10 minutes off for up to 16 hours is recommended. During withdrawal of solids, operation on a cycle of 5 minutes on and 5 minutes off is recommended. Effectiveness of other operating scenarios has not been determined.
4	Solids withdrawal head intake slot velocity	130 mm/s (5.5 in/sec) or greater. Lower velocities can result in failure to remove solids, or clogging of intake slots, or both.
5	Minimum withdrawal jet flow	45 L/min (12 gpm) minimum. Lower velocities can result in failure to remove solids, or clogging of intake slots, or both.

(1) Walter Vaux, Centering and Withdrawal of SBS Sludge in a Full-Scale, Transparent Test Scrubber, Test Report NWT-TR-078, Westinghouse Science and Technology Center, March 1993

2.3.3 High Efficiency Mist Elimination

A. HEME Preheater

Normally, no energy is expected to be directed to the HEME Preheater. When used, about 20 kW of energy will be required to maintain an exit temperature of 85 °C (185 °F) during steady state operation.

B. High Efficiency Mist Eliminators

Based upon non-radioactive testing at the West Valley Demonstration Project, test run SF-10B, 97% (DF-30) of the Cesium-137 entering the HEME is expected to be captured there.

Experimentally determined pressure differentials across the pad as a function of off-gas flow is given in Figure 2.3-9.

The variables affecting HEME performance are summarized in Table 2.3-3.

The HEME spray unit design was based upon 280 kPa (40 psig) demineralized water being delivered at 95 L/min (25 gpm).

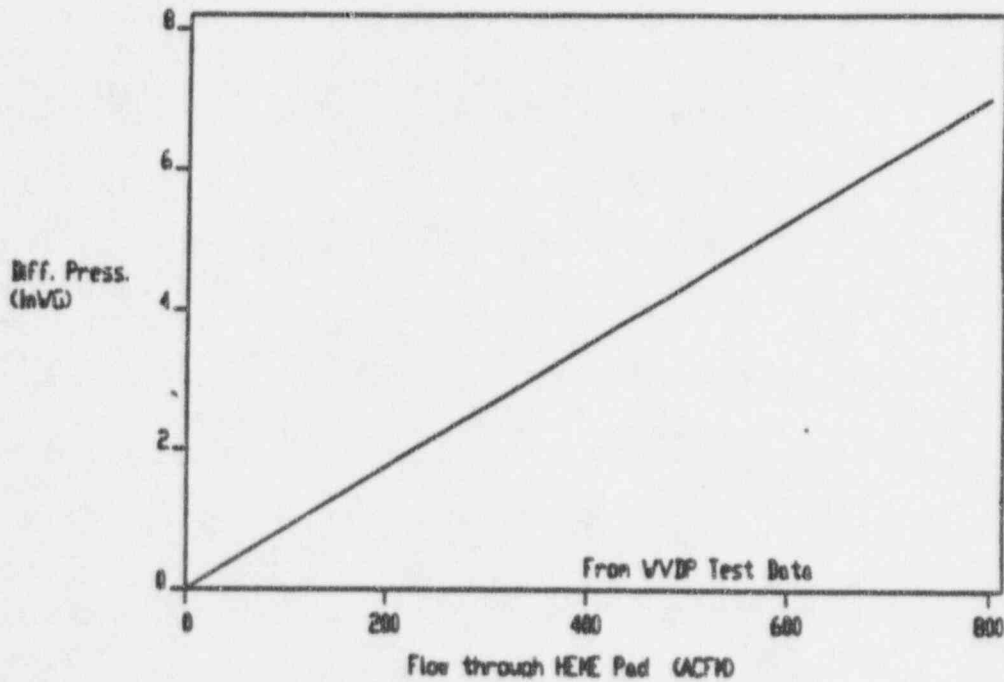


Figure 2.3-9: HEME Pad Differential Pressures with Off-Gas Flow

Table 2.3-3: Variables Influencing HEME Efficiency

No.	Variable	Effects
1.	Face Velocity	The recommended range is 1.5 to 12 m/min (5-40 ft/min). Higher face velocities will tend to strip droplets from the fibers causing reintraintment.
2.	NO _x ⁽¹⁾	Prolonged exposure to NO _x gas can significantly reduce water repellency of glass fibers, thereby increasing a tendency to become plugged from water droplets.
3.	Radiation ⁽¹⁾	Exposure to more than 350 kGy (35 x 10 ⁶ Rads) can significantly reduce water repellency of glass fibers thereby increasing a tendency to become plugged from water droplets.

(1) Burchsted, Fuller & Kahn, Nuclear Air Cleaning Handbook, ERDA-76-21, pp. 42-50

2.3.4 Prefiltration

A. Filter Preheaters

During normal steady state operation, about 20 kW of electrical energy will be required to maintain an exit temperature of 85 °C (185 °F).

B. Prefilters

The prefilter assemblies hold two HEPA filter elements in series, each 99.97% efficient for retaining particles 0.3 microns in diameter. For particles greater than 0.3 microns, capture is by impaction. For particles smaller than 0.1 micron, capture is by Brownian motion. For the intermediate sizes, 0.1 to 0.3 micron, the HEPA is least efficient.

The upstream element can collect approximately 2 kg (4 lb_m.) of fine granular dust.

NOTE: During FACTS testing, solids accumulated on the in-cell HEPA element at a rate of approximately 10 grams/day (0.02 lb_m/day). This suggests an assembly should be good for about 6 months of operation.

The differential pressure across a clean HEPA filter element will vary in direct proportion to the gas velocity through it.

Variables influencing HEPA filter element integrity are listed in Table 2.3-2.

C. Postheater

No energy needs to be delivered to the Postheater.

Table 2.3-4: Variables Influencing HEPA Filter⁽¹⁾ Integrity

No.	Variable	Effects
1.	Temperature ⁽²⁾	<ul style="list-style-type: none"> • 120 °C (250 °F) continuously will not diminish efficiency • 200 °C (392 °F) will gradually degrade Blu-Jel® seal properties • 340-400 °C (650-750 °F) for 15 min. will affect seals reducing efficiency no more than 3 % • 820 °C (1500 °F) can melt the fiberglass element
2.	Differential Pressure ⁽³⁾	<ul style="list-style-type: none"> • 250 Pa (1 InWG) expected at rated flow when clean • 2.5 kPa (10 InWG) continuously will not produce damage • 5.0 kPa (20 InWG) continuously should not produce damage • 17 kPa (2.5 psid) for 9 sec, more than a tornado should produce, should cause no damage • 19 kPa (2.7 psid) for 50 msec should be withstood • 26 kPa (3.7 psid) for 50 msec may burst pleats • 36 kPa (5.2 psid) for 50 msec produces extensive damage • 57 kPa (8.2 psid) for 50 msec produces blowout
3.	NO _x ⁽³⁾	Prolonged exposure to NO _x gases can significantly reduce water repellency of glass fibers thereby increasing tendency to become plugged from water droplets
4.	Radiation ⁽³⁾	Exposure to more than 35 x 10 ⁶ Rads can significantly reduce water repellency of glass fibers thereby increasing tendency to become plugged from water droplets

(1) 24" x 24" x 11.5" Elements with 4 by 4 mesh face guards
 (2) Flanders Nuclear Grade Hepa Filters, bulletin No. 812C
 (3) Burchsted, Fuller & Kahn, Nuclear Air Cleaning Handbook, ERDA-76-21, pp. 42-50

2.4 Equipment Arrangement

The In-Cell Vessel Ventilation and Off-Gas Treatment System components are arranged as shown in Figures 2.4-1 and 2.4-2. The equipment is arranged for ease of routine maintenance, and replacement of those components most likely to fail. The items requiring the most routine maintenance are the HEMEs and the prefilters. To permit flushing of a HEME pad, or replacement of a HEME pad, or replacement of a prefilter, without having to interrupt melter operations, redundant HEMEs and prefilters are installed in parallel trains that can be isolated by impact wrench operated isolation valves.

The off-gas equipment is arranged to provide overhead access to the isolation valves in the four off-gas jumpers and the two isolation valves in the HEME drain jumpers. This allows operation of these valves by the impact wrench suspended from a crane hook.

2.4.1 Vessel Ventilation

The in-cell equipment of the Vessel Ventilation System is assembled as shown in Figure 2.4-3. The information found in this figure is also found in P&ID drawing 900-E-705 sheet 19, Vessel Vent System.

The condenser is placed on the cell floor (Reference elevation 100'-0") so the seal loop in the condensate line can dip into the pit. This seal loop isolates the vessel ventilation system from the tank farm ventilation system.

Sufficient vertical clearance between the top of the shell and the high position of the crane hooks is provided to permit removal and replacement of the tube bundle.

Sufficient overhead access to the isolation valve in the condenser drain jumper is provided to allow operation of the valve by an impact wrench suspended from a crane hook.

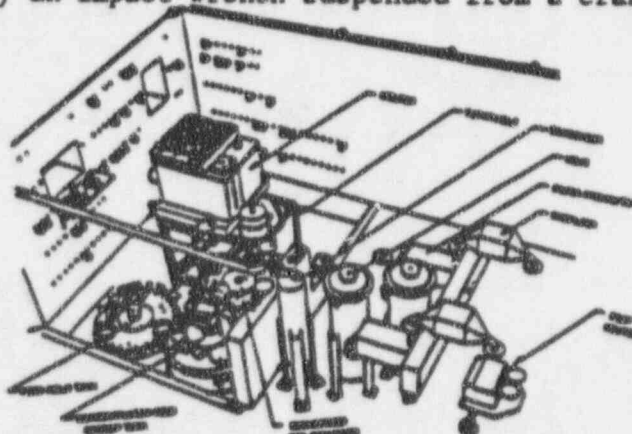


Figure 2.4-1: Off-Gas & Vessel Vent System Arrangement

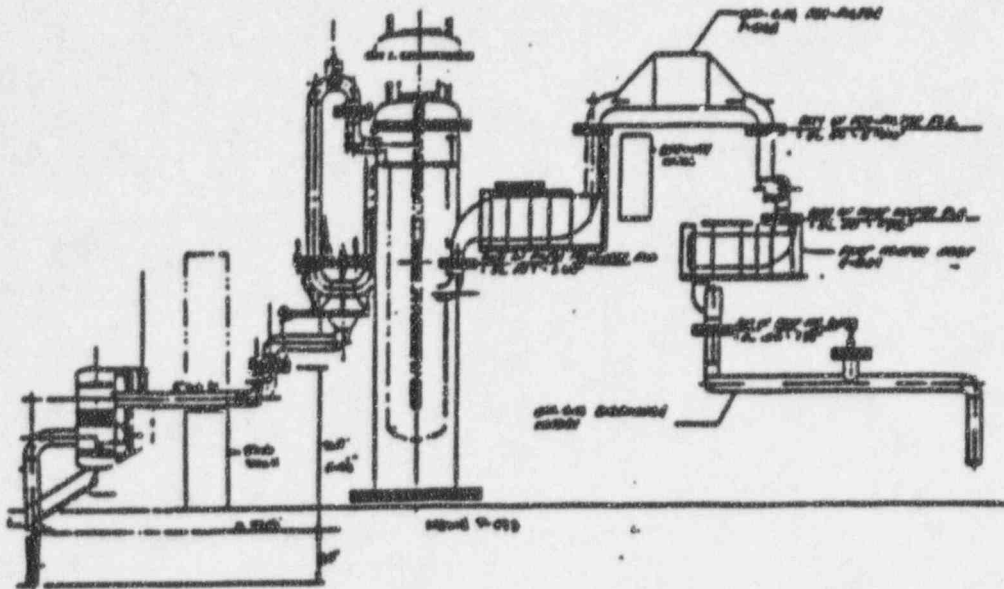


Figure 2.4-2: Off-Gas & Vessel Vent System Elevation View

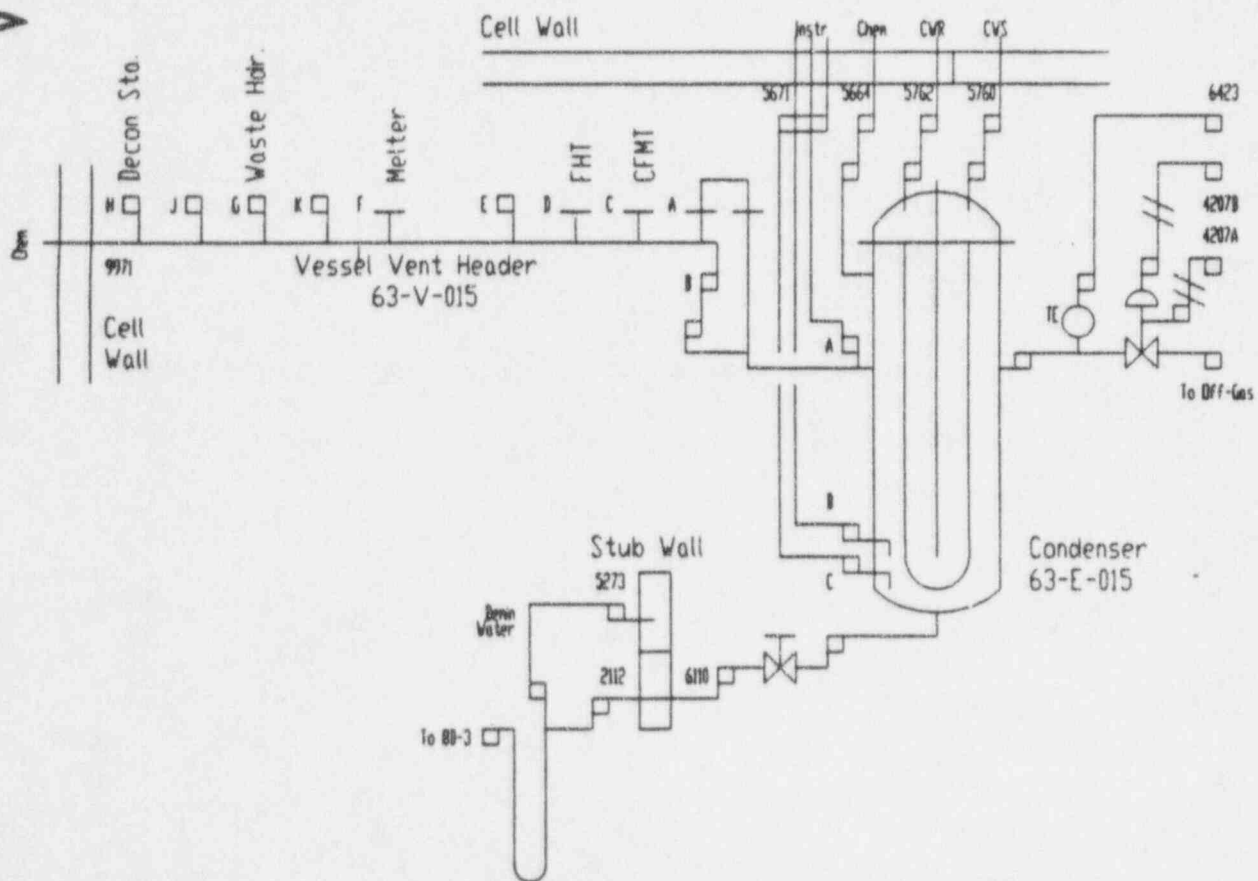


Figure 2.4-3: Vessel Ventilation Configuration

2.4.2 Quenching/Scrubbing

The Quenching/Scrubbing equipment located in-cell is assembled as shown in Figure 2.4-4. The information found in this figure is expanded in P&ID drawing 900-E-705, Sheet 14, Primary Scrubber, Scrub Section, and Sheet 15, Primary Scrubber, Receiver Tank.

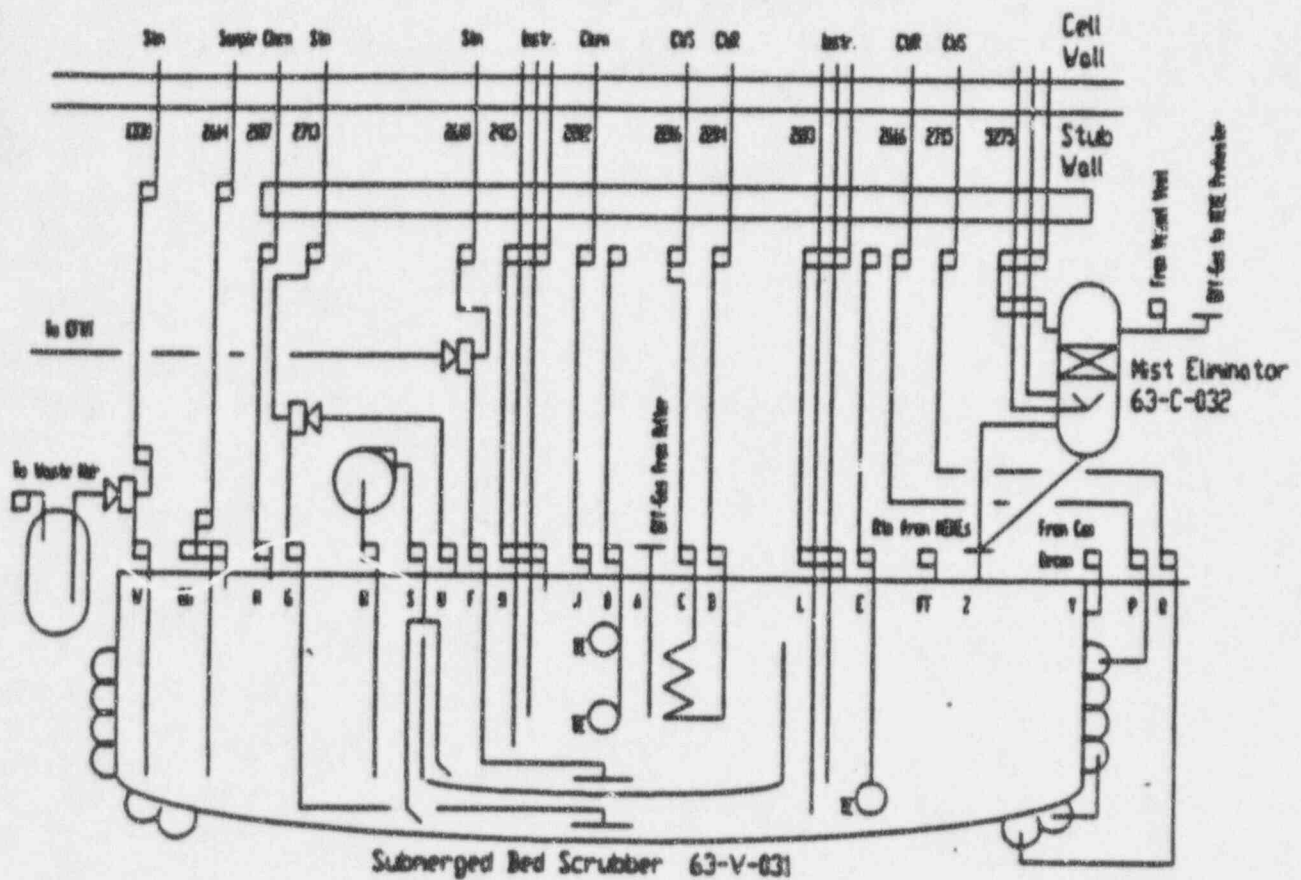


Figure 2.4-4: Quenching/Scrubbing Configuration

2.4.3 High Efficiency Mist Elimination

The High Efficiency Mist Elimination equipment located in-cell is assembled as shown in Figure 2.4-5. The information found in this figure is expanded in P&ID drawing 900-E-705, Sheet 21, Melter Off-Gas System, Pre-Heater and HEMEs P&ID.

Sufficient vertical clearance is provided between the tops of the HEME housings and the high position of the crane hooks to permit removal and replacement of the HEME pads.

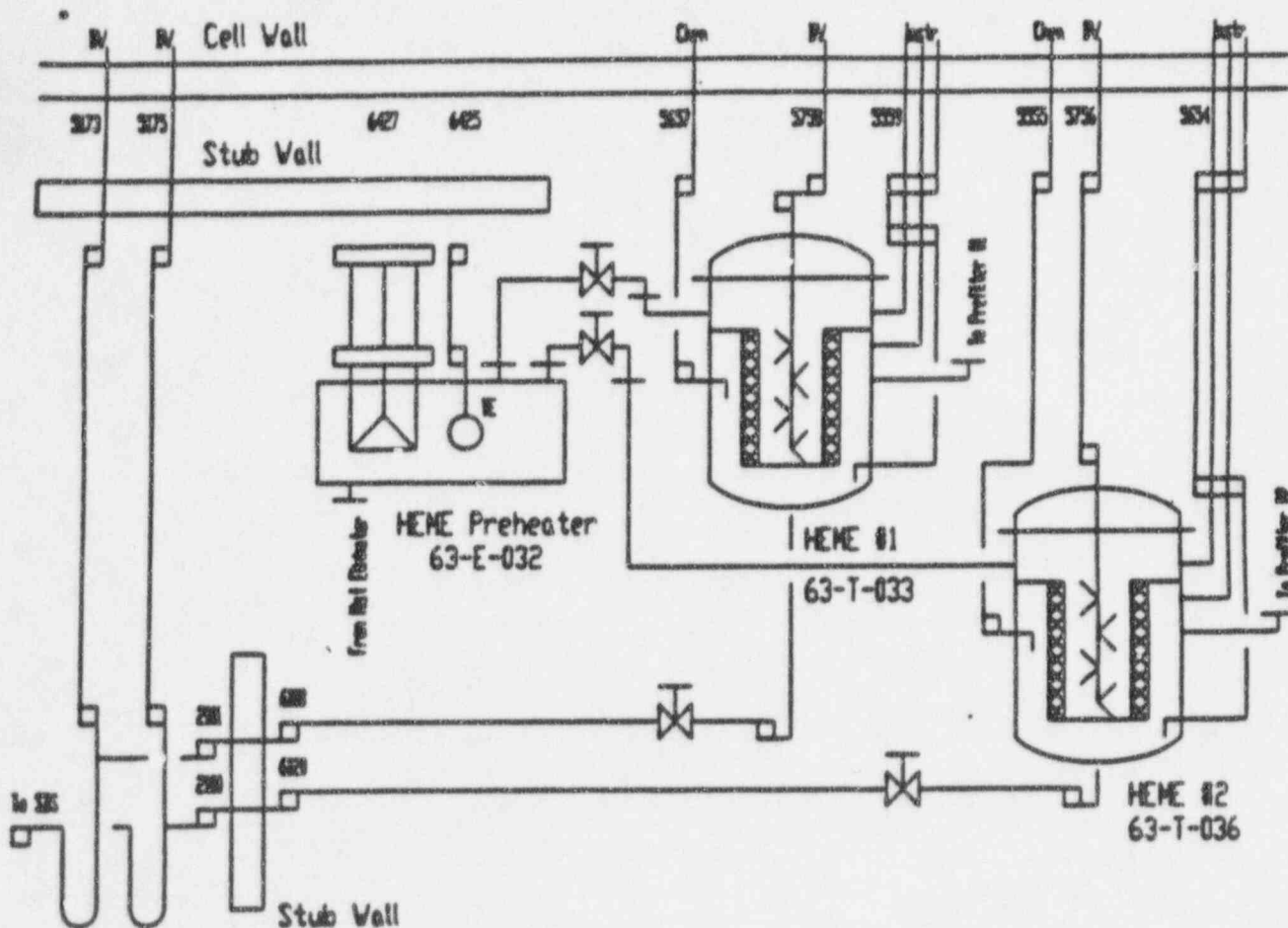


Figure 2.4-5: High Efficiency Mist Elimination Configuration

2.4.4 Prefiltration

The Prefiltration equipment located in-cell is assembled as shown in Figure 2.4-6. The information found in this figure is expanded in P&ID drawing 900-E-705, Sheet 22, Vessel Offgas Filters and Heaters Process and Instrument Diagram.

For ease of prefilter changeout, the prefilter assemblies are mounted over the equipment to which they connect. In addition, the jumpers that are used to monitor the differential pressure across the prefilter elements are attached to the adjacent pieces of equipment. This allows removal and replacement of the prefilter assemblies without having to remove other pieces of process equipment or instrumentation jumpers.

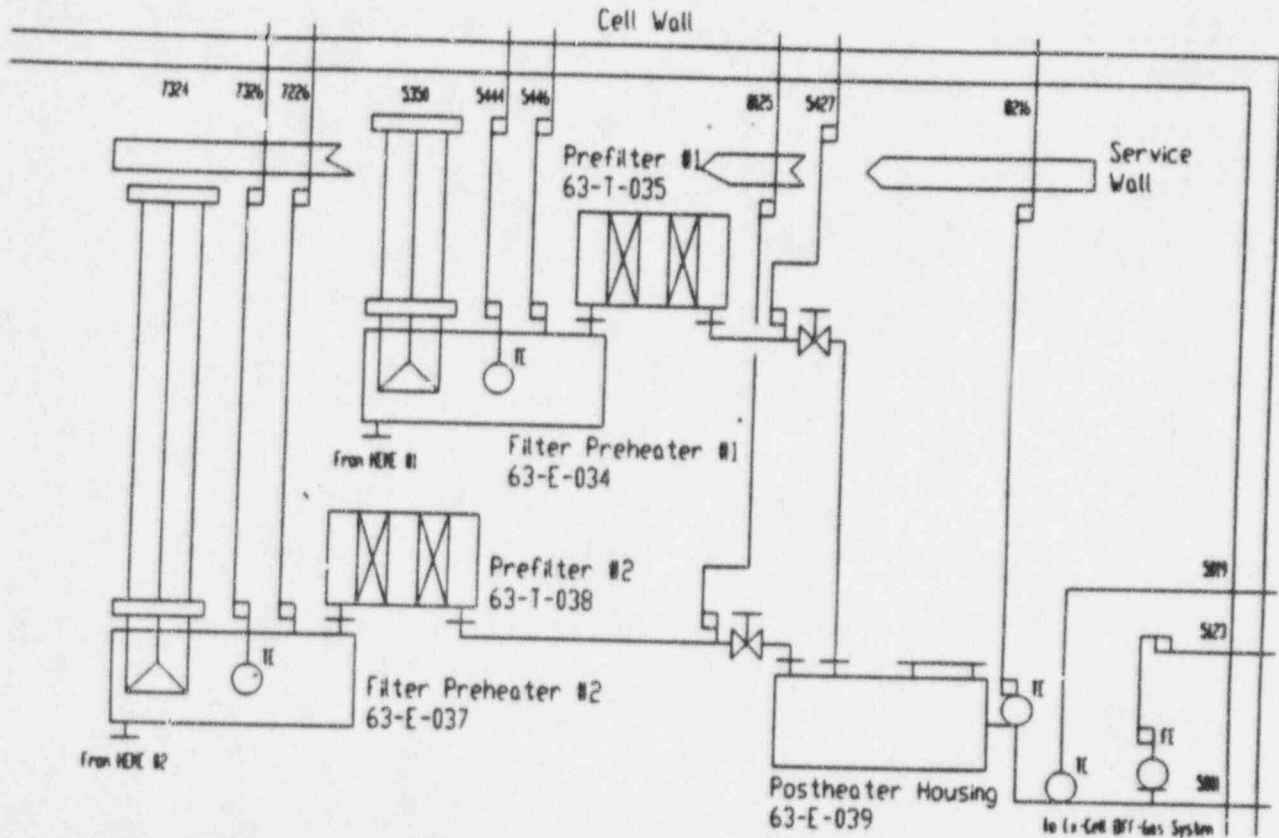


Figure 2.4-6: Prefiltration Configuration

2.5 Equipment Descriptions

For corrosion resistance against nitric acid fumes and solutions, the fabrication materials used for surfaces of equipment exposed to the vitrification cell environment, and to process fluids, is generally Type 304L SS. The structural supports are made from carbon steel painted with yellow Carboline Phenoline 305 primer and gray Carboline Phenoline 305 finish.

The structural supports rest on the vitrification cell apron floor embeds and are anchored with 27 mm (1-1/16") diameter studs.

To avoid galling of threaded stainless steel nuts, free nuts not directly exposed to the corrosive process environment are made from carbon steel (ASTM A194-84a). To assure the associated studs have yield properties greater than the nuts, and can withstand the torque from the impact wrench, they are made from carbon steel (ASTM A193-85b).

Many items are fastened together by the process and electrical Purex connectors shown in Figures 2.5-1 and 2.5-2.

An impact wrench is used to connect and disconnect the Purex connectors, and to open and close the isolation valves in the system. The wrench is suspended horizontally or vertically from a crane hook, employs a 51 mm (2") hexagonal socket, and applies 750 N-m (550 ft-lb_t) of torque.

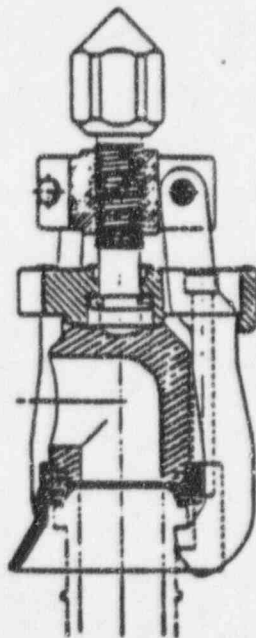


Figure 2.5-1: Purex Process Connector

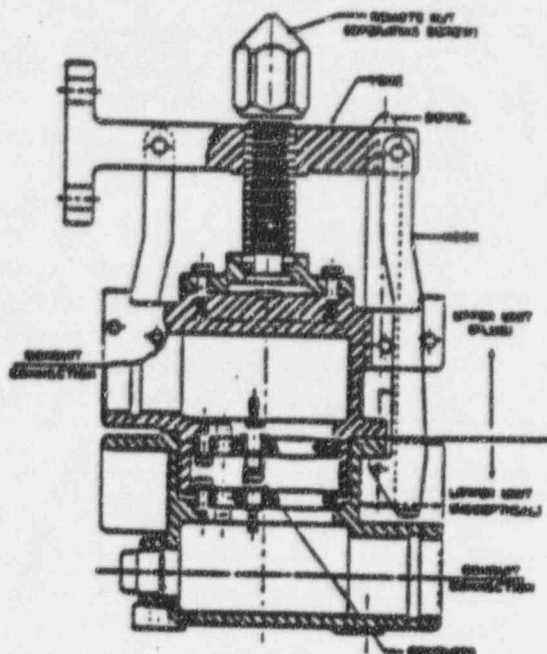


Figure 2.5-2: Purex Electrical Connector

2.5.1 Vessel Ventilation

The vessel ventilation components are identified in the appended equipment list.

A. Vessel Ventilation Header

The vessel ventilation header is located on a ledge below the crane rails near the top of the vitrification cell walls. It rests on adjustable supports that allowed installation at a slope of 10 mm/m (1/8 inch/ft) so liquids will drain to the condenser. There is no provision to remotely readjust the supports.

The header is made from seamless 150 mm (6" Sch 40), Type 304 SS pipe, with a corrosion allowance of 1.6 mm (1/16").

Stresses in the header due to thermal expansion and contraction over the design temperature range are accommodated by six, permanently installed expansion joints made from Type 304L SS. They are protected from physical abuse by external covers, and from accumulations of particulate by internal sleeves.

Provisions are made to monitor and control the pressure in the header. As required, it can be flushed by solutions from the cold chemical system.

The header is designed for the following conditons:

Temperature	13 to 260 °C	(55 - 500 °F)
Pressure	210 kPa	(30 psig)
Vacuum	30 kPa	(120 InWG)
Flow	45 m ³ /min	(1600 ACFM)

The header was fabricated to SMCI drawings 26901 through 26905. Hanford drawings H-11-7332 and H-11-7391 describe the spool pieces connecting the header to the condenser.

B. Condenser

The vessel ventilation condenser, shown schematically in Figure 2.5-3 is a vertical, 3 GJ/h (3,000,000 Btu/hr) shell and U-tube heat exchanger. The condenser shell was fabricated to SMCI drawings 29001 and 29002. Connecting service jumpers are described by Hanford drawings H-11-7443, H-11-7444, H-11-7445 and H-11-7446.

The shell is made of Type 304L SS with a corrosion allowance of 1.6 mm (1/16"), is 762 mm (2'-6") in diameter, is 3400 mm (11') high, and rests on a 1200 mm (4') skirt. The empty shell, with vessel head, weighs 1.8 Mg (3980 lb_m).

The condenser is self supporting on a circular, 1.32 m (4'-4") diameter lower base plate made from 51 mm (2") Type 304L SS plate. There are guide pins and studs in the lower base plate to facilitate remote installation and fastening of the condenser. The lower base plate is welded to a floor embed.

The shell is ASME "U" stamped, and is designed for the following conditons.

Temperature	185 °C	(365 °F)
Pressure	210 kPa	(30 psig)
Vacuum	30 kPa	(120 InWG)
Pressure Diff. (max.)	7 kPa	(1 psid)
Flow (inlet)	45 m ³ /min	(1600 ACFM)

Section 2

The tube bundle is described by JFD Tube & Coil Products drawing 89169. It consists of 343, Type 304L SS, 19 mm (3/4") diameter, 1.2 mm thick (18 BWG), tubes in a "U" configuration extending 2390 mm (7'-10") down from the top flange of the condenser shell. The drained tube bundle weighs 1.28 Mg (2830 lb_m). When filled with water it weighs 1.63 Mg (3585 lb_m). Two lifting bails are provided on the top of the tube sheet for handling.

The tube bundle head is ASME "U" stamped, and the bundle is designed for the following conditions.

Temperature	185 °C	(365 °F)
Pressure	690 kPa	(100 psig)
Pressure Diff. (max.)	34 kPa	(5 psid)
Flow (max.)	490 L/min	(130 gpm)

C. Non-Condensibles Jumper

The non-condensibles jumper is 100 mm (4") in diameter, is made from Type 304L SS, and has a corrosion allowance of 1.6 mm (1/16"). It holds an air operated, butterfly, pressure control valve and an RTD for temperature indication and condenser control. It rests on Condenser Nozzle B and Mist Eliminator Nozzle C.

The jumper is described by Hanford drawing H-11-7442 and is designed for the following conditions.

Temperature	177 °C	(350 °F)
Pressure	207 kPa	(30 psig)
Vacuum	30 kPa	(120 InWG)
Flow	20 m ³ /min	(700 ACFM)

> Service jumpers from the Stub Wall for the RTD and pressure control valve are described by Hanford drawings H-11-7437 and 900D-6563 respectively.

D. Condensate Drain

The condensate drain includes the jumper from the bottom of the condenser to the stub wall, the penetration through the stub wall, the seal loop jumper, and the demineralized water jumper to the seal loop. The sections which carry condensate are made from seamless 76 mm (3" Sch 40), Type 304 SS pipe.

The jumper from the condenser to the stub wall has an isolation valve which is operated from overhead by the impact wrench, and is described by Hanford drawing H-11-7441.

The seal loop jumper, which provides a liquid seal of 10 kPa (40 InWG) between the condenser and tank 8D-3 to isolate the condenser from the tank farm ventilation system, is described by Hanford drawing H-11-7385. It has a demineralized water inlet to allow flushing toward tank 8D-3 when the isolation valve is closed.

The demineralized water jumper to the loop seal is described by Hanford drawing H-11-7386.

The condensate drain is designed for the following conditions.

Temperature	170 °C	(338 °F)
Pressure	690 kPa	(100 psig)
Flow	1100 L/h	(300 gph)

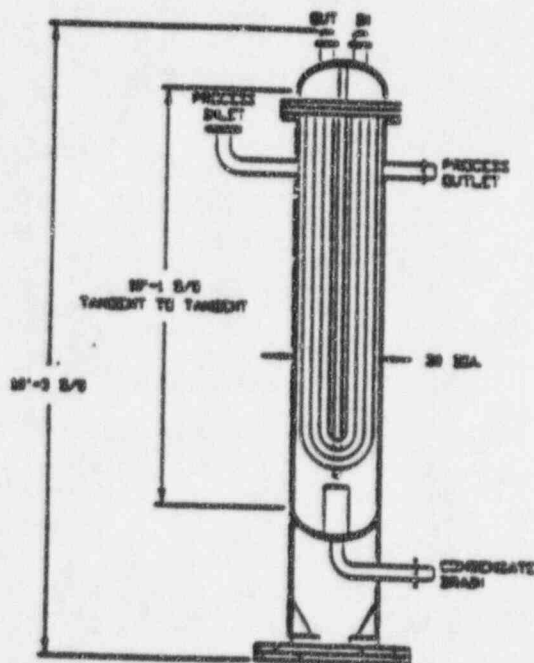


Figure 2.5-3: Condenser

Section 2

2.5.2 Quenching/Scrubbing

Quenching and initial scrubbing is accomplished by the SBS, shown in Figure 2.5-4. It is comprised of a scrubber vessel and a receiver vessel which completely envelopes the scrubber vessel. It stands on four 610 mm by 610 mm (24" x 24") rectangular support pads which rest on, and are bolted to, a steel platform that is bolted to the floor of the vitrification cell pit.

When empty the SBS weighs about 6.89 Mg (15,200 lb_m), and when filled with water about 17.5 Mg (38,600 lb_m). Jumpers provide solution transfer capabilities and access to instrumentation and utility services.

The SBS was designed for the following conditions, is ASME code stamped, and is described in Westinghouse Electric Corp. drawings 1990E31 through 1990E46.

Temperature		300 °C	(572 °F)
Pressure	(Vessel)	40 kPa	(6 psig)
	(Exchangers)	550 kPa	(80 psig)
Vacuum		25 kPa	(100 InWG)

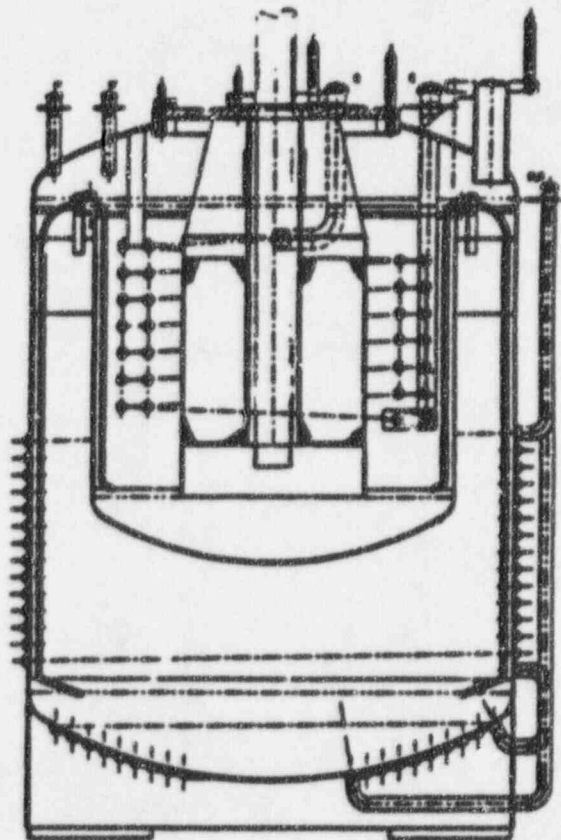


Figure 2.5-4: Submerged Bed Scrubber

A. The SBS Scrubber Vessel

The scrubber consists of two concentric right cylindrical vessels made from 9.5 mm (3/8") Hastelloy C-22 with 1.6 mm (1/16") corrosion allowances. (Hastelloy C-22 was selected to resist corrosion from the scrub solution which may contain a small amount of mercury, received as vapor from the melter.)

The inner vessel contains the bed, is 1200 mm (4') tall, 910 mm (3') in diameter, and is constantly flooded with the water contained by the outer vessel. An Inconel 690 bed support/gas distributor plate forms the bottom. (Inconel 690 was selected for corrosion resistance to the high temperature off-gases.) It houses a 510 L (18 ft³) bed of 9.5 mm (3/8") diameter ceramic sphere packing. A packing hold-down screen is located at the open top. Off-gases are introduced through a 250 mm (10") diameter Inconel 690 downcomer entering from the top and discharging at the bottom of the bed. The bed is remotely removable through the large flanged head in the receiver vessel.

The outer vessel is 1640 mm (5'-4") tall and 1830 mm (6') in diameter with a capacity of 3.3 m³ (880 gal) when the bed is installed. The solid bottom is dished to facilitate near complete evacuation by jet transfer. It is open at the top, and is kept filled with water.

The scrubber contains cooling coils, in the annular space outside the bed, having a design heat load of about 250 MJ/h (237,000 Btu/hr).

A system is provided to withdraw water from the receiver, then re-inject it through nozzles near the bottom of the scrubber to scour undissolved solids from the bottom and to create a swirling motion. The swirling motion is designed to draw the undissolved solids to the center of the bottom dished head. A jet, with its suction head located over the center of the bottom head, is designed to transfer both liquid and accumulated solids to the CFMT in the Primary Process System (System 63I).

Instrumentation to measure temperature, vapor space pressure, liquid specific gravity and liquid depth are provided.

B. The SBS Receiver Vessel

The maximum operating volume of the receiver is 5.5 m³ (1450 gal), enough to hold all condensation anticipated for one melter waste feed preparation cycle. It is a right cylindrical vessel, 2440 mm (8') in diameter and 3350 mm (11') tall, with a dished bottom to allow near complete evacuation by jet transfer. It is fabricated from Hastelloy C-22, and has a corrosion allowance of 1.6 mm (1/16"). (Hastelloy C-22 was used to preclude pitting and crevice attack from the small amount of mercury which may be in the waste and which could collect in the SBS.)

The vessel includes a half-pipe jacket to cool the fluid below 40 °C (104 °F) before jet transfer. The half-pipe jacket has a design duty of about 71 MJ/h (67,500 Btu/hr).

A system is provided to withdraw water from the receiver, then re-inject it through nozzles near the bottom of the receiver to scour any undissolved solids from the bottom and to create a swirling motion. The swirling motion is designed to draw the undissolved solids to the center of the bottom dished head. A jet, with its suction head located over the center of the bottom head, is designed to transfer both liquid and any accumulated solids back to the scrubber.

Instrumentation is provided to measure temperature, vapor space pressure, liquid specific gravity and liquid depth.

C. SBS Service Jumpers

The jumper that directs cooling water to the cooling coils in the scrubber is made from 76 mm (3" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7421 for 550 kPa (80 psig) and 43 °C (110 °F).

The jumper that returns water from the cooling coils in the scrubber is made from 76 mm (3" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7384 for 690 kPa (100 psig) and 35 °C (95 °F).

The jumper that provides the scrubber temperature sensing is made from 25 mm (1" Sch 40S), and 12 mm (1/2" Sch 80S), Type 304L SS pipe, flex hose, and a thermocouple wire which extends into the SBS at nozzle D. It was designed as shown in Handord drawing H-11-7422.

The jumper that provides taps to monitor scrub solution specific gravity and depth in the scrubber is made from 13 mm (1/2" Sch 80S), Type 304L SS pipes. It was designed as shown in Hanford drawing H-11-7426 for 345 kPa (50 psig) and 35 °C (95 °F).

NOTE: As the result of a scrubber bottom redesign, the lower dip tube was shortened to enable installation of the jumper. Hence, the vertical separation of the ends of the two immersed tubes is only 180 mm (7"), as opposed to the customary 250 mm (10").

The jumper that holds the pump and motor for the SBS solids centering equipment is made using 38 mm (1-1/2" Sch 40S) Type 304L stainless steel pipe for fluid transfer service. The pump is a 150 L/min (40 gpm), self-priming centrifugal pump with Type 316 stainless steel casing and impeller. The motor is a 1.1 kW (1-1/2 hp) 1800 rpm, 460 volt, 3 phase, 60 Hz, electrical induction motor. The jumper was designed as shown in WVNS drawing 900D-5737.

The jumper that provides electrical service to the motor for the solids centering equipment uses 50 mm (2") flex hose and 50 mm (2" Sch 40) Type 304L stainless steel pipe for conduit. It was designed as shown in WVNS drawing 900D-5738.

The chemical addition jumper to the scrubber is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7418 for 550 kPa (80 psig) and 102 °C (216 °F).

The receiver to scrubber jet assembly is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It was designed to transfer 95 L/min (25 gpm nominal). It was designed as shown in Hanford drawing H-11-7336 for 690 kPa (100 psig) and 170 °C (338 °F).

The jumper that directs steam to the receiver-to-scrubber jet is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7429 for 690 kPa (100 psig) and 170 °C (338 °F).

The jumper assembly that directs the liquid drain from the HEMEs into the SBS receiver vessel is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It includes two separate 2000 mm (80") seal loops, one for each HEME drain, and two separate connectors for adding demineralized water to flush the two seal loops. It was designed as shown in Hanford drawing H-11-7431 for 550 kPa (80 psig) and 43 °C (110 °F).

The jumper that delivers demineralized water to flush the seal loop in the drain from HEME #1 is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7432 for 550 kPa (80 psig) and 102 °C (215 °F).

The jumper that delivers demineralized water to flush the seal loop in the drain from HEME #2 is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7433 for 550 kPa (80 psig) and 102 °C (215 °F).

The jumper that directs water to the receiver half-pipe jacket is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7427 for 550 kPa (80 psig) and 43 °C (110 °F).

The jumper that returns water from the receiver half-pipe jacket is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7428 for 550 kPa (80 psig) and 43 °C (110 °F).

The jumper that provides receiver temperature sensing is made from flex hose, 25 mm (1" Sch 40S) pipe and thermocouple wire that extends into the SBS at nozzle E. It was designed as shown in Hanford drawing H-11-7417 for 35 °C (95 °F).

The jumper that provides taps to monitor solution specific gravity and depth in the SBS Receiver is made from 13 mm (1/2" Sch 40S), Type 304L SS pipes. It was designed as shown in Hanford drawing H-11-7419 for 345 kPa (50 psig) and 35 °C (95 °F).

The chemical addition jumper to the receiver and is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7424 for 550 kPa (80 psig) and 99 °C (210 °F).

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The jet assembly that transfers liquid from the SBS receiver to the waste header has a seal pot on the discharge end. The jumper is made from 51 mm (2" Sch 40S), Type 304L SS pipe, and the seal pot is made from 208 mm (8" Sch 40S), Type 304L SS pipe and pipe caps. It was sized to transfer 95 L/min (25 gpm nominal), and was designed as shown in Hanford drawing H-11-7389 for 690 kPa (100 psig) and 170 °C (338 °F).

The jumper that delivers steam to the SBS receiver to waste header jet is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7395 for 690 kPa (100 psig) and 170 °C (338 °F).

The SBS Receiver Sampler was designed as shown in PNL drawings 288-01, 288-02, 289-01 and 289-02, and Hanford drawing H-11-7425. The jumper providing utility service to the sampler is described by Hanford drawing H-11-7655.

D. Mist Eliminator Housing and Element

The mist eliminator housing, shown in Figure 2.5-5, is made from Type 304L SS pipe which includes a corrosion allowance of 1.6 mm (1/16"), and weighs 515 kg (1135 lb_m). The body is made from 460 mm (18" Sch 40S) pipe, and the inlet and outlet ducting is from 150 mm (6" Sch 40S) pipe.

The liquid return line is 25 mm (1") pipe that is sloped downward from the bottom of the housing into the SBS, and is equipped with a liquid seal at the end inside the SBS. Gases and vapors from the vessel ventilation condenser are accepted into the mist eliminator discharge through a 102 mm (4") Purex connector.

The pad is a 152 mm (6") thick, knitted mesh pad with a 356 mm (14") diameter exposed face. It is made from Type 304L stainless steel wire and structurals. The pad is designed to minimize fouling, and consists of four pads in series with each successive pad having a greater packing density. The packing densities are 53, 80, 144 and 173 kg/m³ (3.3, 5.0, 9.0 & 10.8 lb_m/ft³) respectively. The design face velocity is 2.4 m/s (8 ft/sec). The minimum and maximum acceptable face velocities are 1.5 and 3.4 m/s (5 & 11.3 ft/sec) respectively.

The spray nozzle is a wide angle, full cone nozzle fabricated from Type 304 SS. Vendor literature describing the spray nozzle is appended.

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The mist eliminator meets the requirements of ANSI/ASME N509-1980, bears an ASME "U" stamp, and is designed for the following conditions:

Flow (pad)	13 m ³ /min	(466 ACFM)
(housing)	28 m ³ /min	(1000 ACFM)
Pressure	207 kPa	(30 psig)
Vacuum	30 kPa	(120 InWG)
Temperature	121 °C	(250 °F)
Density (off-gas)	1 kg/m ³	(0.06 lb _m /ft ³)
Rel. Humidity (off-gas)	100 %	
Entrained Moisture	64 g/min	(0.14 lb _m /min)
Particulate	340 g/h	(0.74 lb _m /hr)
Efficiency (5 μm)	93+%	
Life Dose	26 kGy	(2.6 10 ⁴ Rads)
Press Diff. (clean)	250 Pa	(1 InWG)
Housing Leak Rate	2.6 mol/min-m ²	(0.2 SCFM/ft ²)
(max. at 2.5 kPa (10 InWG))		

The mist eliminator was fabricated to SMCI drawing 27101, and it rests directly on the Type 304L SS flange of SBS Nozzle Z, and the discharge rests in a Type 304L SS "pipe saddle" on the stub wall.

E. Spray and Pressure Tap Jumper

The jumper that delivers demineralized water to the spray nozzle, and that monitors the pressure differential across the mist eliminator pad, is made from 13 mm (1/2" Sch 40S), Type 304L SS pipes. It was designed as shown in Hanford drawing H-11-7434 for 690 kPa (100 psig) and 35 °C (95 °F).

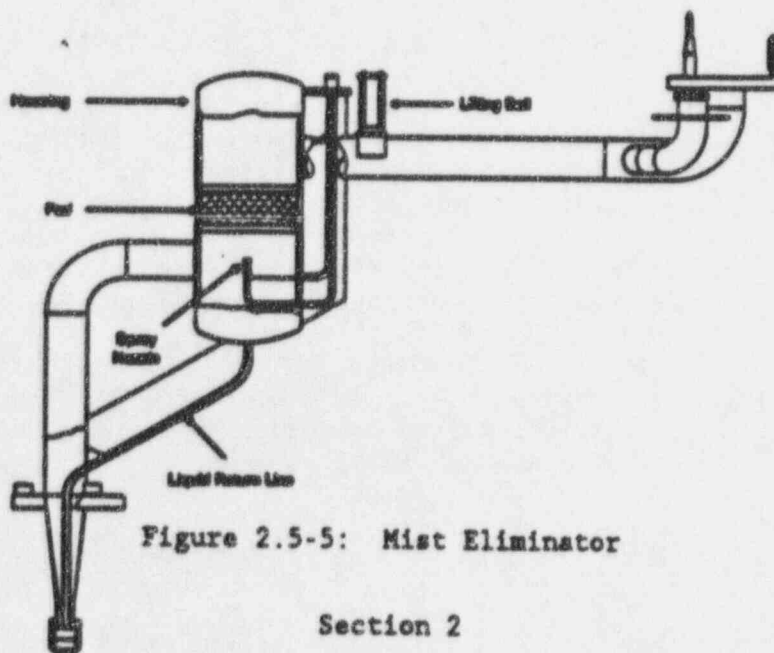


Figure 2.5-5: Mist Eliminator

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2.5.3 High Efficiency Mist Elimination

A. HEME Preheater

The HEME preheater includes the housing with heating element bundle, a jumper to provide electrical energy, and a jumper to provide temperature measurement.

• HEME Preheater Housing and Element Bundle

The HEME Preheater housing is made from Type 304L SS, has a corrosion allowance of 1.6 mm (1/16") and weighs 805 kg (1775 lb_m) without the element. A blind flange can be used to remotely seal the housing to operate the system without the heating element installed.

The HEME preheater housing meets the requirements of ANSI/ASME N509-1980, bears an ASME "U" stamp, and is designed for the conditions below.

Flow	37 m ³ /min	(1300 ACFM)
Pressure	207 kPa	(30 psig)
Vacuum	30 kPa	(120 InWG)
Temperature	121 °C	(250 °F)
Density	1 kg/m ³	(0.06 lb _m /ft ³)
Rel. Humidity	100 %	
Entrained moisture	180 g/min	(0.39 lb _m /min)
Particulate	18 g/h	(0.04 lb _m /hr)
Life Dose	26 kGy	(2.6 10 ⁶ Rads)
Press. Diff. (max.)	250 Pa	(1 InWG)
Housing Leak Rate	2.6 mol/min-m ²	(0.2 SCFM/ft ²)
	(max. at 2.5 kPa (10 InWG))	

The HEME Preheater was fabricated to Hunter drawing 27401 and it rests on its own steel structural support.

The interchangeable, 50 kW, electrical resistance heating element bundle weighs 238 kg (525 lb_m), is operated with 480 V, 3 phase, electrical energy, and is sheathed in Incoloy for high temperature corrosion resistance. The element bundle can be remotely removed from the housing, and replaced. It is balanced to maintain a vertical orientation of ±13 mm (±1/2") with the vertical centerline when suspended by its bail. The element bundle assembly is detailed in SMCI drawings 27801 and 27802. Vendor literature describing the heating element bundle is appended.

• Service Jumpers

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The jumper that delivers electrical energy to the HEME preheater heating element bundle is made from 51 mm (2") flex hose. It was designed as shown in Hanford drawing H-11-7435.

The jumper that provides temperature sensing is made from 1020 mm (40") of 76 mm (3") flex hose, and a thermowell that extends down through nozzle D about 380 mm (15"). It was designed as shown in Hanford drawing H-11-7436.

• Support Assembly

The HEME Preheater support weights 494 kg (1090 lb_a) and provides direct support for the HEME preheater only. The assembly was fabricated to SMCI drawings 29701 through 29707.

B. Off-Gas Jumper to HEME #1

The off-gas jumper from HEME preheater flange B1 weighs 320 kg (706 lb_a), and spans 1120 mm (3'-8") to flange A of HEME #1. It is made from seamless 150 mm (6" Sch 40S), Type 304L SS pipe, and a 150 mm (6"), 1.0 MPa (150#), full port ball valve. The valve is fabricated from Type 316L SS and radiation resistant PEEK seats & bearings, and Grafoil packing. It was modified for operation from overhead by the impact wrench. Vendor literature describing the valve is appended.

The jumper is designed to the following conditions, and fabricated to SMCI drawing 27201.

Temperature	121 °C	(250 °F)
Pressure	280 kPa	(40 psig)
Vacuum	30 kPa	(120 InWG)
Flow	37 m ³ /min	(1300 ACFM)

The jumper is supported by HEME Preheater Nozzle B1 and HEME nozzle A.

C. Off-Gas Jumper to HEME #2

The off-gas jumper from HEME preheater flange B2 weighs 322 kg (710 lb_a) and spans 1190 mm (3'-11") to flange A of HEME #2. It is made from the same materials, and to the same specifications, as the off-gas jumper to HEME #1. It is supported by HEME Preheater Nozzle B2 and HEME Nozzle A.

D. High Efficiency Mist Eliminator 63-T-033

The HEME is depicted schematically in Figure 2.5-6.

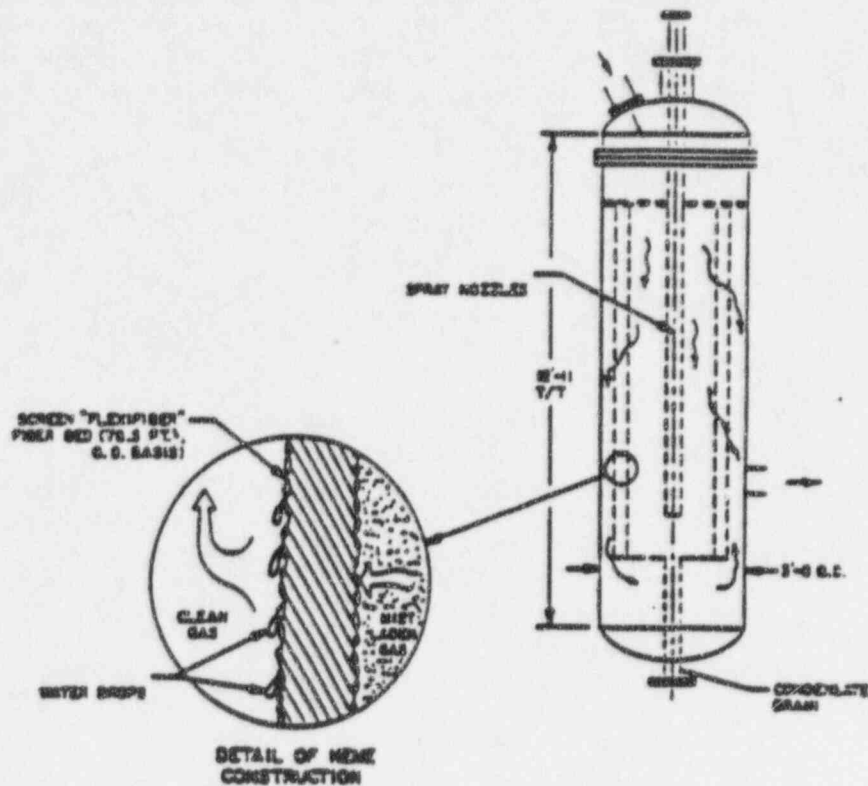


Figure 2.5-6: High Efficiency Mist Eliminator

• HEME Vessel, Element and Spray Unit

The HEME vessel; a cylindrical vessel 1070 mm (3'-6") in diameter, 4060 mm (13'-4") tall, with a base 610 mm (2') high; was fabricated to SMC drawings 27301 through 27303. Made from Type 304L SS with a corrosion allowance of 1.6 mm (1/16"), it weighs 2.75 Mg (6,160 lb_m) empty and 3.90 Mg (8,590 lb_m) assembled excluding water. The volume to the top of the element is about 2.8 m³ (750 gal). The total vessel volume is about 3.3 m³ (860 gal).

The vessel is self supporting, resting on a circular, 1680 mm (5'-6") diameter, lower base plate made from 51 mm (2") Type 304L SS plate which distributes the weight onto the floor embeds.

The HEME pad is 760 mm (2'-6") diameter, 3050 mm (10') tall, with a woven wire screen and wound glass fiber element. The pad is enclosed by a woven screen of Type 316L SS. The pad assembly can be remotely removed and replaced. The pad is detailed in Koch drawing 32053-A-00-01 which is appended.

The spray unit is a 3660 mm (12') vertical lance made from a 51 mm (2" Sch 40S), Type 304L SS pipe. It holds 15 stainless steel, wide angle, full cone, spray nozzles positioned to deliver a spray of droplets to the inside surface of the HEME pad. Vendor literature describing these nozzles is appended.

The HEME vessel meets the requirements of ANSI/ASME N509-1980, bears an ASME "U" stamp, and is designed for the following conditions.

Flow (vessel)	37 m ³ /min	(1300 ACFM)
(element)	23 m ³ /min	(818 ACFM)
Pressure	280 kPa	(40 psig)
Vacuum	30 kPa	(120 InWG)
Temperature	121 °C	(250 °F)
Density	1 kg/m ³	(0.06 lb _m /ft ³)
Rel. Humidity	100 %	
Entrained moisture	180 g/min	(0.39 lb _m /min)
Particulate	18 g/h	(0.04 lb _m /hr)
Life Dose	26 kGy	(2.6 10 ⁻⁶ Rads)
Pressure Diff. (pad saturated)	2.5 kPa	(10 InWG)

• Service Jumpers

The jumper to the taps that monitor differential pressure across the pad, and the liquid level in the bottom of the vessel, is made from 13 mm (1/2" Sch 40S), Type 304L SS pipes. It was designed as shown in Hanford drawing H-11-7447 for 207 kPa (30 psig) and 121 °C (250 °F).

The jumper that directs demineralized water to the spray unit is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7448 for 550 kPa (80 psig) and 100 °C (212 °F).

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The jumper that directs chemical solutions to the HEME vessel is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7449 for 550 kPa (80 psig) and 100 °C (212 °F).

The drain jumper from the bottom of the HEME vessel to the stub wall includes an isolation valve. The jumper is made from 51 mm (2" Sch 40S), Type 304L SS pipe. The valve is a 51 mm (2"), SS, full port, ball valve with polyethylene seats and seals, which is designed to be operated using the impact wrench. The jumper was designed as shown in Hanford drawing H-11-7439 for 207 kPa (30 psig) and 121 °C (250 °F).

E. High Efficiency Mist Eliminator 63-T-036

• HEME Vessel and Element

The description and design specifications for HEME 63-T-036 are the same as for HEME 63-T-033.

• Service Jumpers

The jumper to the taps that monitor the differential pressure across the pad and the liquid level in the bottom of the vessel is made from 13 mm (1/2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7452 for 207 kPa (30 psig) and 121 °C (250 °F).

The jumper that directs demineralized water to the spray unit is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7450 for 550 kPa (80 psig) and 100 °C (212 °F).

The jumper that directs chemical solutions to the HEME vessel is made from 51 mm (2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7451 for 550 kPa (80 psig) and 100 °C (212 °F).

The drain jumper from the bottom of the HEME vessel to the stub wall includes an isolation valve. The jumper is made from 51 mm (2" Sch 40S), Type 304L SS pipe. The valve is a 51 mm (2"), SS, full port, ball valve with polyethylene seats and seals, which was modified to be operated using the impact wrench. The jumper was designed as shown in Hanford drawing H-11-7438 for 207 kPa (30 psig) and 121 °C (250 °F).

2.5.4 Prefiltration

A. Filter Preheater 63-E-034

The filter preheater consists of a housing and element bundle, a jumper providing electrical energy to the element bundle, a jumper to monitor the pressure upstream from the prefilter, and a jumper with temperature instrumentation.

The filter preheater is shown schematically in Figure 2.5-7.

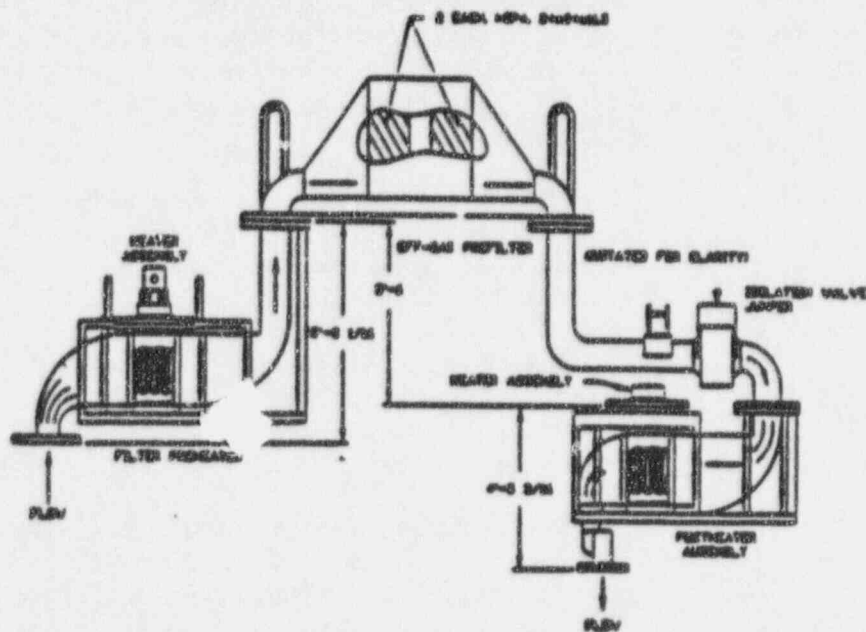


Figure 2.5-7: Filter Preheater, Prefilter, Off-Gas Jumper to Postheater, and Postheater

• Filter Preheater Housing and Element Bundle

The housing, made from Type 304L SS, has a corrosion allowance of 1.6 mm (1/16") and weighs 712 kg (1570 lb_m). It meets the requirements of ANSI/ASME N509-1980, bears an ASME "U" stamp, and is designed for the conditions below.

Flow	42 m ³ /min	(1500 ACFM)
Pressure	280 kPa	(40 psig)
Vacuum	30 kPa	(120 InWG)
Temperature	121 °C	(250 °F)
Density	1 kg/m ³	(0.06 lb _m /ft ³)
Rel. Humidity	100 %	
Entrained Moisture	36 g/min	(0.08 lb _m /min)
Particulate	680 mg/h	(1.5 10 ⁻³ lb _m /h)
Life Dose	26 kGy	(2.6 10 ⁻⁶ Rads)
Press. Diff. (max)	250 Pa	(1 InWG)
Housing Leak Rate	2.6 mol/min-m ²	(0.2 SCFM/ft ²)
	(max. at 2.5 kPa (10 InWG))	

The filter preheater housing was fabricated to SMC I drawing 27501 and is supported by the same structural assembly that supports the service wall.

The heating element bundle is the same as, and interchangeable with, those of the HEME preheater and the other filter preheater.

• Service Jumpers

The jumper directing energy to the element bundle is made from flex hose and was designed as shown in Hanford drawing H-11-7453.

The jumper for monitoring the pressure upstream from Prefilter 63-T-035 is made from 13 mm (1/2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7454 for 207 kPa (30 psig) and 121 °C (250 °F).

The jumper used to measure the temperature of the off-gases downstream from the heating element holds an RTD which extends 460 mm (1'-6") into the housing. The jumper was designed as shown in Hanford drawing H-11-7455.

B. Filter Preheater 63-E-037

• Filter Preheater Housing and Element Bundle

The description and specifications for Filter Preheater 63-E-037 housing is the same as for Filter Preheater 63-E-034 housing, except that it weighs 753 kg (1660 lb_m).

The heating element bundle is the same as, and interchangeable with, those of the HEME preheater and the other filter preheater.

• Service Jumpers

The jumper directing energy to the element bundle is made from flex hose and was designed as shown in Hanford drawing H-11-7458.

The jumper for monitoring the pressure upstream from Prefilter 63-T-038 is made from 13 mm (1/2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7457 for 207 kPa (30 psig) and 121 °C (250 °F).

The jumper used to measure the temperature of the off-gases downstream from the element holds an RTD which extends 460 mm (1'-6") into the housing. The jumper was designed as shown in Hanford drawing H-11-7456.

C. Prefilter 63-T-035

The prefilter assembly, without elements, weighs 803 kg (1770 lb_m). It consists of a housing made from Type 304L SS with no corrosion allowance, a perforated flow straightening baffle, and two HEPA filter elements in series. The baffle is rectangular sheet of 3 mm (11 Gauge) Type 304L SS with about 390 uniformly spaced 19 mm (3/4") diameter holes. The elements are fiberglass with 1.9 mm (14 Gauge) Type 304 SS frame, silicone fluid sealer, and urethane solid sealant. The elements are secured in place, upstream and downstream, with stainless steel face guards of screens having square 6 mm openings (4 X 4 mesh). Vendor literature describing the sealant is appended.

For traceability, the housings are marked on both sides with black serial numbers 32 mm (1-1/4") tall.

Provision is made in adjacent equipment to measure the differential pressure across the filter elements to measure filter plugging.

Replacement prefilter assemblies are DOP tested prior to introduction into the vitrification cell to assure that no perforations are in the filter media, and that no breaks are in the seal between the filter elements and the housing. Anti-tampering seals are installed on the housings following the successful DOP tests to assure that the filter seals have remained untouched.

The prefilter assemblies meet ANSI/ASME N509 requirements, bear ASME "U" stamps, and are designed for the conditions below.

Flow	42 m ³ /min	(1500 ACFM)
Pressure	280 kPa	(40 psig)
Vacuum	30 kPa	(120 InWG)
Temperature	121 °C	(250 °F)
Density	1 kg/m ³	(0.06 lb _m /ft ³)
Rel. Humidity	10 %	
Entrained Moisture	0	
Particulate	680 mg/h	(1.5 10 ⁻³ lb _m /hr)
DF	(0.3 μm)	3333
Life Dose	26 kGy	(2.6 10 ⁻⁶ Rads)
Press. Differential		
(max. when clean)	500 Pa	(2 InWG)
Housing Leak Rate	2.6 mol/min-m ²	(0.2 SCFM/ft ²)
(max. at 2.5 kPa (10 InWG))		

The prefilter assembly was fabricated to SMCI drawing 27601, and is shown schematically and conceptually in Figures 2.5-7 and 2.5-8.

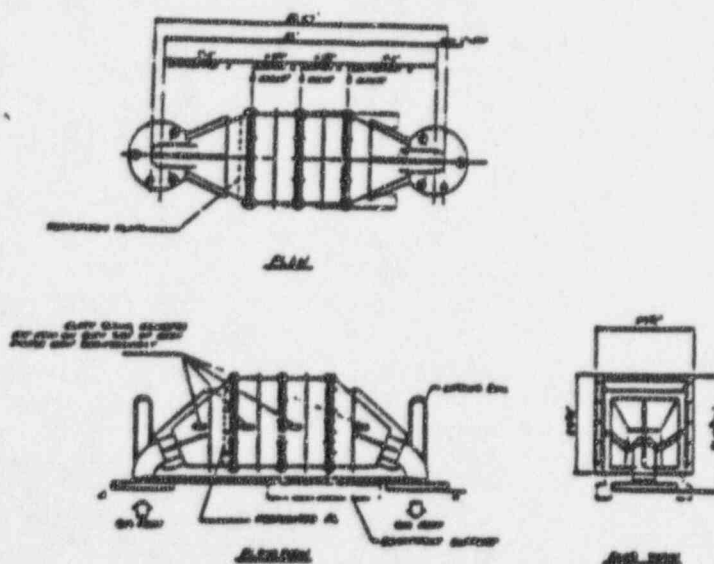


Figure 2.5-8: Prefilter Assembly

Section 2

D. Prefilter 63-T-038

The descriptions of Prefilter 63-T-038 housing and elements are the same as for Prefilter 63-T-035.

E. Off-Gas Jumper from Prefilter 63-T-035 to Postheater Housing

The off-gas jumper assembly consists of the off-gas jumper and a pressure tap jumper.

The off-gas jumper to the postheater is depicted schematically in Figure 2.5-7.

• Off-Gas Jumper

The off-gas jumper is "L" shaped, spans 1630 mm (5'-4"), is 1070 mm (3'-6") tall, holds a valve, and weighs 298 kg (657 lb_m). The jumper is made from seamless 150 mm (6" Sch 40), Type 304 SS pipe. It is supported by brackets on the structural supports.

The valve is a 150 mm (6"), 1 MPa (150"), full port ball valve, made from Type 316L SS and radiation resistant PEEK seat & bearings, and Grafoil packing. It was modified for operation from overhead by the impact wrench. Vendor literature describing the valve is appended.

The jumper was designed for the following conditions, and fabricated to SMC drawing 28001.

Flow	42 m ³ /min	(1500 ACFM)
Pressure	280 kPa	(40 psig)
Vacuum	30 kPa	(120 InWG)
Temperature	121 °C	(250 °F)

• Pressure Tap Jumper

The jumper used to monitor the pressure downstream from Prefilter 63-T-035 made from 13 mm (1/2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7464 for 345 kPa (50 psig) and 35 °C (95 °F).

F. Off-Gas Jumper from Prefilter 63-T-038 to Postheater Housing

The off-gas jumper assembly consists of the off-gas jumper and a pressure tap jumper.

- Off Gas Jumper

The description and specifications for the off-gas jumper from Prefilter 63-T-038 is the same as for the off-gas jumper from Prefilter 63-T-035, except it spans only 1120 mm (3'-8") and weighs 347 kg (766 lb_m). It was fabricated to SMC drawing 28101.

- Pressure Tap Jumper

The jumper for monitoring the pressure downstream from Prefilter 63-T-038 is made from 13 mm (1/2" Sch 40S), Type 304L SS pipe. It was designed as shown in Hanford drawing H-11-7460 for 345 kPa (50 psig) and 35 °C (95 °F).

G. Postheater Housing

The postheater housing assembly consists of a housing, a support assembly, and a temperature instrumentation jumper. The postheater housing is depicted schematically in Figure 2.5-7.

- Housing

The postheater housing is made from Type 304L SS with a corrosion allowance of 1.6 mm (1/16"), and weighs 1.34 Mg (2960 lb_m). It was designed for the conditions below, was fabricated to SMC drawing 27701, meets the requirements of ANSI/ASME N509-1980, bears an ASME "U" stamp, and rests on its own structural steel supports.

Flow	42 m ³ /min	(1500 ACFM)
Pressure	207 kPa	(30 psig)
Vacuum	30 kPa	(120 InWG)
Temperature	185 °C	(365 °F)
Density	800 g/m ³	(0.05 lb _m /ft ³)
Rel. Humidity	0	
Entrained Moist.	0	
Particulate	0	
Life Dose	26 kGy	(2.6 10 ⁻⁶ Rads)
Press. Diff. (max.)	250 Pa	(1 InWG)
Housing Leak Rate	2.6 mol/min-m ²	(0.2 SCFM/ft ²)
	(max. at 2.5 kPa (10 InWG))	

NOTE: Although designed and analyzed for 185 °C (365 °F), paragraph 5.5.1 of ANSI/ASME N509 limits the temp. to 107 °C (225 °F).

- Temperature Instrumentation Jumper

The jumper used to measure the temperature of the off-gases is made from flex hose and includes an RTD which extends 300 mm (1') down into the housing. It was designed as shown in Hanford drawing H-11-7462.

- Postheater Housing Support

The Postheater Housing Support assembly was fabricated to SMC drawings 29701 through 29707, and weighs 925 kg (2040 lb_m).

H. Discharge Header

The discharge header consists of a duct with an installed mass flowmeter, and an instrumentation jumper that services the flowmeter.

- Discharge Header

The discharge header is made from seamless 200 mm (8" Sch 40), Type 304L SS pipe. It holds a flowmeter made from Type 316 SS, and was fabricated to SMC drawings 29201 and 29202 for the following conditions.

Flow	42 m ³ /min	(1500 ACFM)
Pressure	207 kPa	(30 psig)
Vacuum	30 kPa	(120 InWG)
Temperature	185 °C	(365 °F)

- Flow Instrumentation Jumper

The flowmeter service jumper was fabricated to Hanford drawing H-11-7465 and is made with 25 mm (1") flex hose.

2.6 Instrumentation and Control

The instruments and controls are given in Tables 2.6-1 through 2.6-6.

Table 2.6-1: Temperature and Temperature Differential Instrumentation

Parameter	Instrument	Nominal	Control Range
Condenser Exit	TT-1502	45 °C (113 °F)	88 to 45 °C (190 to 113 °F)
Condenser Cooling Water Supply	TI-1508	20 °C (68 °F)	na
Condenser Cooling Water Return	TE-1509	47 °C (116 °F)	na
SBS Plenum	TT-3102	45 °C (113 °F)	30 to 45 °C (86 to 113 °F)
SBS Bed	TT-3103		
SBS Bed Cooling Water Return	TI-3104	42 °C (107 °F)	na
SBS Receiver Cooling Water Rtn	TI-3117	32 °C (90 °F)	na
SBS Receiver	TT-3118	35 °C (95 °F)	≤40 °C (≤104 °F)
HEME Preheater	TT-3212	45°C ⁽¹⁾ (113°F)	na ⁽¹⁾
		85°C ⁽²⁾ (185°F)	82 to 88°C ⁽²⁾ (180 to 190°F)
Preheater E-034	TT-3408	85°C (185°F)	82 to 88°C (180 to 190°F)
Preheater E-037	TT-3709		
Postheater Exit	TT-3914	85°C (185°F)	⁽³⁾
	TT-3915		na

(1) Usual operation with HEME Preheater off
(2) Unusual operation with HEME Preheater on
(3) The Postheater should not be used to control temperature.

The condenser exit temperature (TT-1502) is deliberately kept slightly higher than the SBS plenum temperature because off-gases from the SBS will always be 100% humid. Contacting humid off-gases with cooler air from the vessel vent system will produce condensation. Condensation will cycle back into the process instead of being expelled to the stack as vapor, as desired.

Table 2.6-2: Pressure and Differential Pressure Instrumentation

Parameter	Instrument	Nominal	Control Range
Vessel Vent Header	PT-1505	-2 kPa (-7 InWG)	-2 to -0.5 kPa (-9 to -2 InWG)
Condenser Shell ⁽¹⁾	PDT-1505	2.5 kPa (0.36 psid)	na
Condenser Cooling Water	PT-1508	340 kPa (50 psig)	na
SBS Bed	PDT-3101	10 kPa (42 InWG)	na
SBS Scrubber Jet	PT-3105	0 - 690 kPa (0 - 100 psig)	na
Mist Eliminator	PDT-3211	500 Pa (2.0 InWG)	na
HEME T-033	PT-3315	-14 kPa (-55 InWG)	na
HEME T-033	PDT-3315	1.25 kPa (5.0 InWG)	na
Preheater E-034	PT-3408	-16 kPa (-62 InWG)	na
Prefilter T-035	PDT-3506	0.5 - 2.25 kPa (2 - 9 InWG)	na
HEME T-036	PT-3621	-14 kPa (-55 InWG)	na
HEME T-036	PDT-3621	1.25 kPa (5.0 InWG)	na
Preheater E-037	PT-3702	-16 kPa (-62 InWG)	na
Prefilter T-035	PDT-3810	0.5 - 2.25 kPa (2 - 9 InWG)	na

(1) The measured differential pressure across the tube bundle is from top to bottom. Because this measures only one of two passes the gases make across the tube bundle, the measured value must be multiplied by two to estimate the total differential pressure across the condenser.

Table 2.6-3: Flow Instrumentation

Parameter	Instrument	Nominal	Control Range
Purge, Condenser Bottom P Tap	FIC-1504	0.6 mol/h (0.5 SCFH)	na
Purge, Condenser Inlet P Tap	FIC-1505		
Purge, Condenser Level Tap	FIC-1506		
Cooling Water, Condenser	FE-1508	Varies	0 - 490 L/min (0 - 130 gpm)
Purge, SBS Bed Reference P Tap	FIC-3102	0.6 mol/h (0.5 SCFH)	na
Purge, SBS Bed SpGr Tap	FIC-3103		
Purge, SBS Bed Level Tap	FIC-3104		
Purge, SBS Receiver Level Tap	FIC-3111		
Purge, SBS Receiver SpGr Tap	FIC-3112		
Purge, SBS Receiver Ref. P Tap	FIC-3113		
Cooling Water Supp, SBS Receiver	FT-3118		
Cooling Water Supp, SBS Bed	FT-3121	190 L/min (50 gpm)	na
Purge, Mist Elim. Exit P Tap	FIC-3211	0.6 mol/h (0.5 SCFH)	na
Purge, Mist Elim. Entrance P Tap	FIC-3212		

Table 2.6-3: Flow Instrumentation (Concluded)			
Parameter	Instrument	Nominal	Control Range
Spray, HEME	FT-3314	95 L/min (25 gpm)	na
Purge, HEME T-033 P Tap	FIC-3315	0.6 mol/h (0.5 SCFH)	na
Purge, HEME T-033 DP Tap	FIC-3316		
Purge, HEME T-033 L Tap	FIC-3317		
Purge, Preheater E-034 P Tap	FIC-3408		
Purge, Prefilter T-035 P Tap	FIC-3506		
Purge, HEME T-036 P Tap	FIC-3620		
Purge, HEME T-036 DP Tap	FIC-3621		
Purge, HEME T-036 L Tap	FIC-3622		
Purge, Preheater E-037 P Tap	FIC-3702		
Purge, Prefilter T-038 P Tap	FIC-3810		
Postheater Exit	FT-3916	850 mol/min (710 SCFM)	na

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Table 2.6-4: Level Instrumentation			
Parameter	Instrument	Nominal	Control Range
Condenser	LT-1506	130 mm (5 in.)	na
SBS Scrubber	LT-3101	1400 mm (55 in.)	na
SBS Receiver	LT-3111	300 - 2800 mm (12 - 110 in.)	na
HEME T-033	LT-3317	0	na
HEME T-036	LT-3622		

Table 2.6-5: Density Instrumentation			
Parameter	Instrument	Nominal	Control Range
SBS Scrubber	DT-3101	1.00 kg/L (SpGr = 1.00) ⁽¹⁾	na
SBS Receiver	DT-3112	1.02 kg/L (SpGr = 1.02) ⁽²⁾	na
(1) Corresponds to 10.0 InWG differential pressure at DT-3101			
(2) Corresponds to 10.2 InWG differential pressure at DT-3112			

Table 2.6-6: Electrical Current Instrumentation			
Parameter	Instrument	Nominal	Control Range
SBS Pump Motor	IT-3130	2 amps	na

2.6.1 Vessel Ventilation

A. Vessel Vent Header

The vessel vent header has no instrumentation. The pressure in the vessel vent header is controlled by modulating the diaphragm operated pressure control valve in the non-condensibles jumper while monitoring the pressure at the condenser shell inlet. (Alternatively, pressure monitoring may be performed at the FHT, or in the CFMT.)

B. Condenser

The condenser is equipped with pressure taps to monitor the shell side inlet pressure, the pressure differential across the tube bundle, and the depth of the liquid condensate in the bottom of the condenser shell. The cooling water flow to the condenser tubes is automatically modulated to maintain a target temperature at the probe in the non-condensibles jumper. An excessive liquid depth in the shell is indicative of a plug in the drain line. The shell side inlet pressure tap is used to control the pressure in the vessel vent header by modulation of the pressure control valve in the non-condensibles jumper.

C. Non-Condensibles Jumper

The non-condensibles jumper is equipped with a temperature probe and a butterfly style pressure control valve. The temperature probe provides input for the control of the condenser cooling water flow rate. The pressure control valve is automatically adjusted to maintain a target pressure (vacuum) in the vessels to which the header is connected.

2.6.2 Quenching/Scrubbing

A. Submerged Bed Scrubber

The SBS bed is equipped with instruments to monitor the temperatures in and above the bed, the pressure above the bed, the liquid specific gravity, and the liquid level. The temperature and pressure above the bed provide an indication of the water vapor content in the off-gas leaving the SBS. The temperature in the bed is used as a basis for automatic control of the cooling water flow rate to the cooling coils in the bed. The liquid specific gravity provides a measure of scrubbing efficiency in the SBS. The liquid level indicates whether the scrub liquid is evaporating at a greater rate than it is being replaced, an undesirable condition because it would ultimately lead to loss of scrubbing efficiency.

The SBS receiver is equipped with instruments to monitor the temperature in the receiver, the liquid specific gravity and the liquid level. The temperature of the scrub determines whether the scrub can be jetted from the vessel, or if it must first be cooled by use of the cooling coils. The specific gravity is needed to be able to accurately measure the liquid level, and the liquid level measurement provides an indication of when the vessel must be emptied.

B. Mist Eliminator

The pressure differential across the mist eliminator pad is continuously monitored by pressure taps on either side of the pad. When the pressure differential increases, a demineralized water spray can be manually activated momentarily to clear the restriction. The maximum pressure differential expected across the pad is 500 Pa (2 InWG).

2.6.3 High Efficiency Mist Elimination

A. HEME Preheater

Performance of the HEME preheater is monitored by a temperature probe located downstream from the heating element. Electrical energy directed to the heating element is automatically modulated to control the downstream temperature.

An interlock prevents the heating elements from being energized when there is no gas flow detected at the flowmeter in the discharge header.

B. Jumpers to the HEMEs

The valves in the jumpers to the HEMEs are used to isolate, or place into service, the parallel off-gas trains. The valves are used in conjunction with the valves in the jumpers from the prefilters to the postheater.

C. HEMEs

The pressure differential across the HEME pad in service is continuously monitored by pressure taps on either side of the pad. When the pressure differential increases, a demineralized water spray can be manually activated momentarily to clear the restriction.

2.6.4 Prefiltration

A. Filter Preheaters

Performance of the filter preheater is monitored by a temperature probe downstream from the heating element. Electrical energy directed to the heating element is automatically modulated to control the temperature.

An interlock prevents the heating elements from being energized when there is no gas flow detected at the flowmeter in the discharge header.

An interlock suspends energy delivery to the heating elements when a high temperature is sensed in the housing. This assures that no energy is directed to the heating element in the off-gas train which has been valved out-of-service.

B. Prefilters

The pressure differential across the prefilters is continuously monitored by pressure taps located upstream at the filter preheaters and downstream in the jumpers to the postheater. The prefilters are replaced when the pressure differential across the elements exceeds 2 kPa (7 InWG), an indication that the element has become loaded.

The prefilter elements are also replaced when the pressure differential is less than 100 Pa (0.5 InWG), an indication that a seal, or a prefilter element, has breached.

NOTE: The clean, intact, elements should produce a pressure differential of about 250 Pa (1.0 InWG) during normal flow.

C. Jumpers to the Postheater Housing

The valves in the jumpers to the Postheater Housing are used to isolate, or place into service, the parallel off-gas trains. The valves are used in conjunction with the valves in the jumpers to the HEMEs.

D. Postheater Housing

A check of the off-gas temperature exiting the vitrification cell is provided by a temperature probe.

E. Discharge Header

The flowmeter in the discharge header monitors the off-gas flow rate. If no flow is detected then an interlock prevents operation of the heaters in the In-Cell Off-Gas Treatment System.

2.7 System Interfaces

The In-Cell Vessel Ventilation and Off-Gas Treatment Systems (System 63H) interface with the systems identified in Table 2.7-1. The Vessel Ventilation, Scrubbing/Quenching, High Efficiency Mist Elimination, Prefiltration, and Heating interfaces are itemized in the appendices.

Table 2.7-1: List of Interfacing Systems	
Number	System
55	Waste Mobilization and Transfer
63F	Cell Walls and Ex-Cell Arrangement
63G	Waste Header System
63I	Primary Process System
63J	Canister Decontamination, Swipe & Welding Stations
63K	In-Cell Remote Handling, Maintenance & Viewing
63DW	VF Deionized Water
63ED	VF Electrical Power Distribution
63IA	VF Instrument Air
63SC	VF Steam and Condensate System
64	VF Ex-Cell Off-Gas System
65	VF Cold Chemical System
66	VF Closed Loop Cooling Water System
69A	VF Sampling and Sample Transfer System
200A	VF Instrumentation and Control Hardware

The interfaces with the instrumentation and controls (System 200A) are typically more complex with other systems because in many instances, information sent to one interface requires a corresponding control response to a different interface. The nature of these interfaces are described in Section 3.0, "Operation," under the headings labeled "Initiate."

3.0 OPERATION

3.1 Introduction

The following outline procedures describe how the Off-Gas and Vessel Vent System equipment is operated. Information is limited within the system boundaries of System 63H as described in Section 2.0. The information in these procedures must be combined with the operating procedures of interfacing equipment, and made consistent with appropriate WVNS policies and procedures to develop the approved procedures from which the equipment will actually be operated.

3.2 Vessel Ventilation

3.2.1 Initiate

- A. Assure the DCS is configured to control the condenser outlet temperature (TE-1502) by modulating the position of the cooling water flow valve (TV-1508), and enter into the DCS the desired condenser outlet temperature. (See Section 2.6.1 for guidance in establishing the desired temperature.
- B. Assure the DCS is configured to control the vessel ventilation header vacuum (PT-1505) by modulating the position of the pressure control valve (PV-1502) in the noncondensibles jumper, and enter into the DCS the desired vacuum at the condenser inlet.

NOTE: During special situations, operations may control the vacuum at different locations. During CFMT boiling, the pressure in the CFMT may be substituted for PT-1505, and during melter venting the pressure in the melter may be substituted for PT-1505.

- C. Open the condenser drain valve, 63-V-1503.
- D. Open the isolation valve, IA-GL-009, to provide instrument air to the pressure control valve.
- E. Open condenser cooling water source pressure tap isolation valve, 66-GV-648.
- F. Open valve DW-H-028 and introduce at least 8 L (2 gal) to establish the liquid seal in the condenser drain.
- G. Close valve DW-H-028.

3.2.2 Startup

- A. Assure that one of the off-gas blowers in the Out-of-Cell Off-Gas System (System 64) is operating.
- B. Open condenser instrumentation isolation valves IA-GA-836, IA-GA-839 and IA-GA-842, and assure the related instrumentation is functioning properly.
- C. Open condenser cooling water return isolation valve 66-GL-046.
- D. Open condenser cooling water source isolation valve 66-GL-632.
- E. Open condenser cooling water source isolation valve 66-H-631.
- F. Open condenser cooling water source isolation valve 66-H-630 to initiate flow of cooling water.
- G. Verify cooling water flow on flow element FE-1508, and on temperature indicator TI-1508 which will change from ambient temperature to the cooling water temperature.

3.2.3 Normal Operation

Normal operation is automatic. Pressure control valve 63-PV-1502 will automatically modulate to maintain the desired vacuum entered into the DCS. Temperature control valve TV-1508 will automatically modulate cooling water flow to maintain the condenser outlet temperature entered into the DCS. Condensate will be drawn by gravity through the drain valve to the tank farm.

3.2.4 Shutdown

NOTE: The vessel ventilation system condenser must not be shutdown while steam is being received from the CFMT.

- A. Stop cooling water flow from the cooling water supply by closing valve 66-GL-632.
- B. Isolate the condenser from the cooling water system by closing valve 66-GL-046.

3.2.5 Draining

- A. The condenser shell will be passively drained by gravity. Check level indicator to assure all liquid has drained. If a liquid level is indicated, assure drain valve 63-V-1503 is open. If the valve is open and a liquid level is indicated, maintenance is required.
- B. The condenser tubes can remain filled unless maintenance is required. Draining of the tubes is a maintenance procedure.

3.3 Quenching/Scrubbing

3.3.1 Initiate

- A. Assure the DCS is configured to prevent operation of the jet from the scrubber to the CFMT (J-3114 in System 63I) unless the jet from the receiver to the scrubber, J-3105, is operating.
- B. Assure the DCS is configured to control the temperature in the SBS bed (TT-3103) by modulating the position of the valve (TY-3121) which controls the flow of cooling water to the SBS Scrubber heat exchanger. (TT-3103, the scrub solution temperature, may be substituted for TT-3102.)
- C. Assure the DCS is configured to control the receiver liquid temperature (TT-3118) by modulating the position of the valve (TY-3118) which controls the flow of cooling water to the SBS Receiver heat exchanger.

3.3.2 Initial Fill

- A. Assure that purge air is flowing through FIC-3102, FIC-3103 and FIC-3104, and that the associated SBS Scrubber instruments (PDT-3101, and DT-3101 LT-3101) are functioning properly.
- B. Assure that purge air is flowing through FIC-3111, FIC-3112 and FIC-3113, and that the associated SBS Receiver instruments (LT-3111 and DT-3112) are functioning properly.
- C. Introduce demineralized water through line CH-1 1/2-3106 into the SBS Scrubber until the scrubber is filled. This will require about 3.3 m³ (880 gal).
- D. Open isolation valve CH-H-930.

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- E. Accept delivery of the demineralized water, verifying receipt by watching the SBS Scrubber and Receiver level indicators (LT-3101 and LT-3111).
- F. Close isolation valve CH-H-930.
- G. Open mist eliminator spray isolation valve CH-H-959 and introduce about 4 L (1 gal) of demineralized water to establish the liquid seal in the mist eliminator drain.
- H. Close isolation valve CH-H-959.

3.3.3 Startup

- A. Assure that the SBS has been filled by checking the scrubber level indicator (LT-3101) and the receiver level indicator (LT-3111).
- B. Assure the scrubber cooling water return valve 66-GL-057, and cooling water source valves 66-GL-626 and 66-GT-625 are open.
- C. Open valve 66-GT-624 to initiate scrubber cooling water flow. Verify cooling water is flowing by checking FT-3121.
- D. Assure the receiver cooling water return valve 66-GL-058 and cooling water source valves 66-GL-623, and 66-GT-622 are open.
- E. Open valve 66-GT-621 to initiate receiver cooling water flow. Verify cooling water is flowing by checking flow element FE-3118.
- F. Assure that isolation valves IA-GA-878 and IA-GA-881 are open, and that the associated mist eliminator pad differential pressure indicator is functioning properly.

3.3.4 Normal Operation

> NOTE: Sampling is not normally required because no routine operating decisions require SBS sample analysis results.

- A. For one hour during each operating shift, run the solids suspension system pump. As a minimum the pump should be operated for one hour on a 12-hour cycle. This is necessary to maintain the looseness of accumulated solids.

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- B. Should the receiver become filled to its high level alarm set-point level, melter feed operation should be suspended until after the contents of the receiver are jettied.
- C. During periods when melter feed has been suspended, condensation of moisture will not occur in the scrubber, and the dry off-gases from the melter will tend to evaporate the water from the bed. To counter this, operate the solids mobilization pump, which will transfer water from the receiver section to the scrubber section. Should the receiver contents become diminished to the minimum liquid level, additional water can be added to either the scrubber or receiver section, from the Cold Chemical System.

3.3.5 Shutdown

- A. Stop cooling water flow to the scrubber coils by closing valve 66-GL-626.
- B. Isolate the scrubber coils by closing valve 66-GL-057.
- C. Stop cooling water flow to the receiver coils by closing valve 66-GL-623.
- D. Isolate the receiver coils by closing valve 66-GL-058.

3.3.6 Refilling the Scrubber

- A. Assure the off-gas system is ventilating the SBS.
- B. Arrange for the necessary amount of make-up demineralized water to be delivered to the SBS Scrubber.
- C. Open isolation valve CH-H-930.
- D. Accept delivery of the demineralized water, verifying receipt by watching the SBS Scrubber level indicator (LT-3101).
- E. Close isolation valve CH-H-930.

3.3.7 Receiver Sampling

NOTE: When the sampler is removed from the SBS, the receiver will be temporarily opened to the cell and ventilation of the melter will likely be lost.

- A. Assure the melter is in idle mode and ventilated through the vessel vent header.
- B. Open isolation valve UA-GL-036.
- C. Obtain sample of liquid from the receiver per sampling system (System 69) instructions.
- D. Close isolation valve UA-GL-036.

3.3.8 Jet to CFMUT

- A. For a minimum of one hour prior to transferring SBS contents, operate the solids mobilization system pump on a cycle of 10 minutes on and 10 minutes off.
- B. Observe readout from TT-3118 to assure the liquid temperature is no warmer than 40 °C (104 °F). If not, reconfigure the DCS to modulate temperature control valve TV-3118 to provide a temperature of 40 °C (104 °F) at TT-3118.
- C. Open isolation valve SH-GL-647 to enable operation of jet J-3105 from the receiver to the scrubber.
- D. Immediately prior to initiating the transfer, change the solids mobilization system pump operating cycle to 5 minutes on and 5 minutes off.
- E. Direct steam to jet J-3105 by opening HV-3105F (HV-3105G to the vent header simultaneously closes) and HV-3105D.
- F. Operate the SBS to CFMT jet (J-3114 in System 63I).

NOTE: The jet from the receiver to the scrubber, J-3105, is designed to transfer about 0.14 m³/min (37 gpm), whereas the jet from the scrubber to the CFMT (J-3114 in System 63I) is designed to transfer only about 0.12 m³/min (31 gpm). Therefore, throughout the transfer process, the scrubber will remain filled and the level in the receiver will steadily decrease.

- G. Observe the liquid level sensor, LT-3111, in the receiver. As soon as the level sensor indicates the minimum liquid level has been reached, stop operation of the SBS to CFMT jet and of jet J-3105 by closing HV-3114D and HV-3105D.

NOTE: The minimum liquid level in the receiver coincides with the suction inlet for the solids mobilization system pump. This level is to be maintained throughout normal operation to assure the solids can be periodically "mobilization."

- H. Stop operation of the solids mobilization system pump.
I. Close isolation valve SH-GL-647.

NOTE: See WVNS-SD-63I for more details regarding transfers to the CFMT

3.3.9 Jet to Waste Header

NOTE: The reason for the 40°C (104°F) limit is to assure the jet will prime. Operations may attempt to jet with the liquid at a higher temperature, but the success of the procedure cannot be guaranteed.

- A. Observe readout from TT-3118 to assure the liquid temperature is no warmer than 40 °C (104 °F). If not, reconfigure the DCS to modulate temperature control valve TV-3118 to provide a temperature of 40 °C (104 °F) at TT-3118.

- B. Open isolation valve, SH-GL-638, between the steam supply and jet J-3124.
- C. Direct steam to jet J-3124 while observing the liquid level sensor (LT-3111) in the receiver. (The associated steam supply, utility air supply, and the ventilation controls are described in the system description for System 63I.)
- D. As soon as the level sensor indicates the receiver has been emptied, discontinue the steam.

NOTE: The controls for operating this jet are shared with jets used in System 63I. The details for the operating these controls are found in the system description for System 63I.

- E. Close isolation valve SH-GL-638.

3.4 High Efficiency Mist Elimination and Prefiltration

3.4.1 Initiate

- A. Assure that the HEME Preheater (63-E-032), and the filter preheaters (63-E-034 & 63-E-037), are connected to operate with site power, and that the breakers in System 63ED, which would connect the preheaters to stand-by power, are open.
- B. Assure the DCS is configured to modulate power to the HEME Preheater, 63-E-032, based upon readings from temperature transmitter TT-3212.
- C. Assure the DCS is configured to modulate power to Filter Preheater 63-E-034 based upon readings from temperature transmitter TT-3408.
- D. Assure the DCS is configured to modulate power to Filter Preheater 63-E-037 based upon readings from temperature transmitter TT-3709.
- E. Open demineralized water isolation valves DW-GL-021 and DW-GT-030 and introduce 11 L (3 gal) to establish the liquid seal between HEME 63-T-033 and the SBS.
- F. Close valves DW-GL-021 and DW-GT-030.

- G. Open demineralized water isolation valves DW-GL-022 and DW-GT-016 and introduce 11 L (3 gal) to establish the liquid seal between HEME 63-T-036 and the SBS.
- H. Close valves DW-GL-022 and DW-GT-016.
- I. Assure that off-gas jumper valve 63-V-3902 from Prefilter 63-T-038 is open.
- J. Assure that off-gas jumper valve 63-V-3901 from Prefilter 63-T-035 is open.
- K. Assure purge air is flowing through FIC-3316, FIC-3315 and FIC-3317, and that the associated instruments (PT-3315, PDT-3315 and LT-3317) are functioning properly.
- L. Assure purge air is flowing through FIC-3620, FIC-3621 and FIC-3622, and that the associated instruments (PT-3621, PDT-3621 and LT-3622) are functioning properly.
- M. Assure purge air is flowing through FIC-3408 and FIC-3506, and that the associated instruments (PT-3408 and PDT-3506) are functioning properly.
- N. Assure purge air is flowing through FIC-3702 and FIC-3810, and that the associated instruments (PT-3702 and PDT-3810) are functioning properly.

3.4.2 Startup

NOTE: Startup is described for off-gas train 1 (HEME 63-T-033, Filter Preheater 63-E-034, and Prefilter 63-T-035). Switching from off-gas train 1 to train 2 is described in a subsequent paragraph.

- A. Assure that off-gas jumper valve 63-V-3206 to HEME 63-T-033 is open.
- B. Assure that off-gas jumper valve 63-V-3901 from Prefilter 63-T-035 is open.
- C. Assure that off-gas jumper valve 63-V-3207 to HEME 63-T-036 is closed.
- D. Assure that off-gas jumper valve 63-V-3902 from Prefilter 63-T-038 is open.
- E. Assure that drain valve 63-V-3318 from HEME 63-T-033 is open.

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- F. Assure that drain valve 63-V-3619 from HEME 63-T-036 is closed.
- G. After off-gas has begun to flow, initiate electrical energy to Filter Preheater 63-E-034.

3.4.3 Normal Operation

The HEMEs, Filter Preheaters and Prefilter assemblies require no active involvement other than monitoring and maintenance of HEME and Prefilter differential pressures.

3.4.4 Shutdown

Before off-gas has ceased flowing, terminate electrical energy to whichever heater(s) is (are) functioning.

3.4.5 Draining - See Maintenance Section

3.4.6 Refilling - See Maintenance Section

3.4.7 Redirect flow from train 1 to train 2

- A. Assure that valve 63-V-3902 in the off-gas jumper from Prefilter 63-T-038 is open.
- B. Assure that valve 63-V-3619 in the drain from HEME 63-T-036 is open.
- C. Initiate power to the HEME Preheater and wait until it is providing the off-gas heating load. This is verified by observing when TT-3212 has reached its set-point temperature.
- D. Terminate power to Filter Preheater 63-E-034.
- E. Open valve 63-V-3207 in the off-gas jumper to HEME 63-T-036.
- F. Close valve 63-V-3206 in the off-gas jumper to HEME 63-T-033.
- G. Initiate power to Filter Preheater 63-E-037.
- H. Terminate power to the HEME Preheater.

3.4.8 Redirect flow from train 2 to train 1

- A. Assure that valve 63-V-3901 in the off-gas jumper from Prefilter 63-T-035 is open.
- B. Assure that valve 63-V-3318 in the drain from HEME 63-T-033 is open.
- C. Initiate power to the HEME Preheater and wait until it is providing the off-gas heating load. This is verified by observing when TT-3212 has reached its set-point temperature.
- D. Terminate power to Filter Preheater 63-E-037.
- E. Open valve 63-V-3206 in the off-gas jumper to HEME 63-T-033.
- F. Close valve 63-V-3207 in the off-gas jumper to HEME 63-T-036.
- G. Initiate power to Filter Preheater 63-E-034.
- H. Terminate power to the HEME Preheater.

3.5 Postheater

The Postheater is not to be operated.

3.6 Valve Position Table

Normal valve positions are identified in Table 3.5.

Table 3.5: Operational Valve Position Table

Valve Number	Valve Nomenclature	Normal Position
63-GL-246	Block, Spare	Closed
63-H-081	Block, Spare	Closed
63-H-177	Block, Spare	Closed
63-H-178	Block, Spare	Closed
63-H-179	Block, Spare	Closed
63-H-190	Block, Spare	Closed
63-H-191	Block, Spare	Closed
63-H-192	Block, Spare	Closed
63-H-193	Block, Spare	Closed
63-H-211	Block, Spare	Closed
63-H-212	Block, Spare	Closed
63-H-217	Block, Spare	Closed
63-H-218	Block, Spare	Closed
63-PV-1502	Control, Vessel Vent Pressure	Automatic
63-V-1503	Shut-Off, Condenser Drain Valve	Open
63-V-3206	Iso., Off-Gas Train #1 Inlet	Open
63-V-3207	Iso., Off-Gas Train #2 Inlet	Closed
63-V-3318	Shut-off, HEME 63-T-033 Drain	Open
63-V-3619	Shut-off, HEME 63-T-036 Drain	Open
63-V-3901	Iso., Off-Gas Train #1 Exit	Open
63-V-3902	Iso., Off-Gas Train #2 Exit	Open
66-GL-046	Block, Condenser Cooling Water Return	Open
66-GL-057	Block, SBS Scrubber Cooling Water Return	Open
66-GL-058	Block, SBS Receiver Cooling Water Return	Open

Table 3.5: Operational Valve Position Table (Continued)

Valve Number	Valve Nomenclature	Normal Position
65-GL-623	Block, SBS Receiver Cooling Water Supply	Open
66-GL-626	Block, SBS Scrubber Cooling Water Supply	Open
66-GL-632	Block, Condenser Cooling Water Supply	Open
66-GT-621	Iso., SBS Receiver Cooling Water Supply	Open
66-GT-622	Iso., SBS Receiver Cooling Water Supply	Open
66-GT-624	Iso., SBS Scrubber Cooling Water Supply	Open
66-GT-625	Iso., SBS Scrubber Cooling Water Supply	Open
66-GV-648	Iso., Condenser Cooling Water Supply P Tap	Open
66-H-630	Iso., Condenser Cooling Water Supply	Open
66-H-631	Iso., Condenser Cooling Water Supply	Open
CH-H-927	Block, SBS Receiver Chemical Addition	Closed
CH-H-930	Block, SBS Scrubber Chemical Addition	Closed
CH-H-947	Block, Vessel Vent Header Chemical Addition	Closed
CH-H-950	Block, HEME 63-T-036 Chemical Addition	Closed
CH-H-953	Block, HEME 63-T-033 Chemical Addition	Closed
CH-H-956	Block, Condenser Chemical Addition	Closed
CH-H-959	Block, Mist Eliminator Flush	Open
DW-GL-021	Block, HEME 63-T-033 Drain Flush	Closed
DW-GL-022	Block, HEME 63-T-036 Drain Flush	Closed
DW-GL-033	Block, Demin Water to Condenser Drain	Closed
DW-GL-662	Block, Flush to HEME 63-T-033	Closed
DW-GL-664	Block, Flush to HEME 63-T-036	Closed
DW-H-660	Iso., HEME Flush	Open
DW-H-661	Iso., HEME 63-T-033 Flush	Open
DW-H-663	Iso., HEME 63-T-036 Flush	Open

Table 3.5: Operational Valve Position Table (Continued)

Valve Number	Valve Nomenclature	Normal Position
HV-3105D	Iso., SBS Receiver to Scrubber Jet Steam	Closed
HV-3105E	Iso., SBS Receiver to Scrubber Jet Purge	Closed
HV-3105F	Iso., SBS Receiver to Scrubber Jet Steam	Closed
HV-3105G	Iso., SBS Receiver to Scrubber Jet Vent	Open
HV-3124	Iso., SBS to Waste Jet	Closed
HV-3314	Iso., HEME 63-T-033 Flush	Closed
HV-3623	Iso., HEME 63-T-036 Flush	Closed
IA-G-703	Iso., Prefilter PDT-3506 HP Tap	Open
IA-G-704	Iso., Preheater PT-3408 LP Tap	Open
IA-G-708	Iso., Prefilter PDT-3506 LP Tap	Open
IA-G-732	Iso., SBS Receiver LT-3111 LP Tap	Open
IA-G-733	Iso., SBS Receiver LT-3111 HP Tap	Open
IA-G-734	Iso., SBS Receiver DT-3112 LP Tap	Open
IA-G-735	Iso., SBS Receiver DT-3112 HP Tap	Open
IA-G-874	Iso., Mist Eliminator PDT-3211 LP Tap	Open
IA-G-875	Iso., Mist Eliminator PDT-3211 HP Tap	Open
IA-G-888	Iso., Prefilter PDT-3810 HP Tap	Open
IA-G-889	Iso., Prefilter PDT-3810 LP Tap	Open
IA-G-890	Iso., Preheater 63-E-037 PT-3702 LP Tap	Open
IA-G-908	Iso., HEME 63-T-033 PDT-3315 HP Tap	Open
IA-G-909	Iso., HEME 63-T-033 PDT-3315 LP Tap	Open
IA-G-910	Iso., HEME 63-T-033 LT-3317 LP Tap	Open

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Table 3.5: Operational Valve Position Table (Continued)

Valve Number	Valve Nomenclature	Normal Position
IA-G-911	Iso., HEME 63-T-033 LT-3317 HP Tap	Open
IA-G-913	Iso., HEME 63-T-033 PT-3315 LP Tap	Open
IA-G-914	Iso., HEME 63-T-036 LT-3622 HP Tap	Open
IA-G-915	Iso., HEME 63-T-036 LT-3622 LP Tap	Open
IA-G-916	Iso., HEME 63-T-036 PDT-3621 HP Tap	Open
IA-G-917	Iso., HEME 63-T-036 PDT-3621 LP Tap	Open
IA-G-918	Iso., HEME 63-T-036 PDT-3621 LP Tap	Open
IA-G-920	Iso., Condenser Inlet P to PDT-1505	Open
IA-G-921	Iso., Condenser Bottom P to PDT-1505	Open
IA-G-922	Iso., Condenser Inlet P to LT-1506	Open
IA-G-923	Iso., Condenser Level P to LT-1506	Open
IA-G-924	Iso., Condenser Inlet P to PT-1505	Open
IA-G-940	Iso., SBS Scrubber LT-3101 HP Tap	Open
IA-G-941	Iso., SBS Scrubber LT-3101 LP Tap	Open
IA-G-942	Iso., SBS Scrubber PDT-3101 LP Tap	Open
IA-G-943	Iso., SBS Scrubber PDT-3101 HP Tap	Open
IA-G-944	Iso., SBS Scrubber DT-3101 HP Tap	Open
IA-G-945	Iso., SBS Scrubber DT-3101 LP Tap	Open
IA-GA-706	Block, Preheater 63-E-034 Pressure Tap	Open
IA-GA-710	Block, Prefilter 63-T-035 Exit Pressure Tap	Open
IA-GA-725	Block, SBS Receiver Level Tap	Open
IA-GA-728	Block, SBS Receiver Sp.Gr. Tap	Open
IA-GA-731	Block, SBS Receiver Ref. Pressure Tap	Open
IA-GA-818	Block, HEME 63-T-033 Inlet Pressure Tap	Open

Table 3.5: Operational Valve Position Table (Continued)

Valve Number	Valve Nomenclature	Normal Position
IA-GA-821	Block, HEME 63-T-033 Exit Pressure Tap	Open
IA-GA-824	Block, HEME 63-T-033 Level Tap	Open
IA-GA-827	Block, HEME 63-T-036 Outlet Pressure Tap	Open
IA-GA-830	Block, HEME 63-T-036 Inlet Pressure Tap	Open
IA-GA-833	Block, HEME 63-T-036 Liquid Level Tap	Open
IA-GA-836	Block, Condenser Bottom Pressure Tap	Open
IA-GA-839	Block, Condenser Inlet Pressure Tap	Open
IA-GA-842	Block, Condenser Liquid Level Tap	Open
IA-GA-878	Block, Mist Eliminator Exit Press. Tap	Open
IA-GA-881	Block, Mist Eliminator Inlet Press. Tap	Open
IA-GA-884	Block, Preheater 63-E-037 Pressure Tap	Open
IA-GA-887	Block, Prefilter 63-T-038 Exit P Tap	Open
IA-GA-933	Block, SBS Scrubber Level Tap	Open
IA-GA-936	Block, SBS Scrubber SpGr Tap	Open
IA-GA-939	Block, SBS Scrubber Reference Pressure Tap	Open
DELETED		
IA-H-162	Block, Air to PCV-1502 Actuator	Open
IA-H-163	Block, Air to PCV-1502 Actuator	Open
IA-H-164	Block, Exhaust from PCV-1502 Actuator	Open
IA-H-705	Iso., Preheater 63-E-034 Pressure Tap	Open
IA-H-709	Iso., Prefilter 63-T-035 Pressure Tap	Open
IA-H-724	Iso., SBS Receiver Level Tap	Open
IA-H-727	Iso., SBS Receiver Sp.Gr. Tap	Open
IA-H-730	Iso., SBS Receiver Reference Pressure Tap	Open
IA-H-817	Iso., HEME 63-T-033 Pressure Tap	Open
IA-H-820	Iso., HEME 63-T-033 Diff. Pressure Tap	Open
IA-H-823	Iso., HEME 63-T-033 Level Tap	Open
IA-H-826	Iso., HEME 63-T-033 Diff. Pressure Tap	Open

Table 3.5: Operational Valve Position Table (Concluded)

Valve Number	Valve Nomenclature	Normal Position
IA-H-829	Iso., HEME 63-T-036 Pressure Tap	Open
IA-H-832	Iso., HEME 63-T-036 Level Tap	Open
IA-H-835	Iso., Condenser Bottom Pressure Tap	Open
IA-H-838	Iso., Condenser Inlet Pressure Tap	Open
IA-H-841	Iso., Condenser Level Tap	Open
IA-H-877	Iso., Mist Eliminator Downstream Press. Tap	Open
IA-H-880	Iso., Mist Eliminator Upstream Pressure Tap	Open
IA-H-883	Iso., Preheater 63-E-037 Pressure Tap	Open
IA-H-886	Iso., Prefilter 63-E-038 Pressure Tap	Open
IA-H-932	Iso., SBS Scrubber Level Tap	Open
IA-H-935	Iso., SBS Scrubber Sp.Gr. Tap	Open
IA-H-938	Iso., SBS Scrubber Reference Pressure Tap	Open
SH-GH-638	Block, SBS to Waste Header Jet Steam	Closed
SH-GL-647	Block, SBS Receiver to Scrubber Jet Steam	Closed
SH-GL-649	Iso., SBS Receiver to Scrubber Jet System PT	Open
SH-H-637	Iso., SBS to Waste Header Jet PT Isolation	Open
SH-H-646	Iso., SBS Receiver to Scrubber Jet Steam	Open
TV-1508	Control, Condenser Temperature	Automatic
TV-3118	Control, SBS Receiver Temperature	Automatic
TV-3121	Control, SBS Scrubber Temperature	Automatic
UA-GL-036	Block, SBS Receiver Sampler	Closed

3.7 Alarm Response Outline

NOTE: For any pressure alarm, or differential pressure alarm, operators can verify validity of the related instrument reading by checking the other system pressures and differential pressures for consistency.

3.7.1 Ventilation Header Pressure Alarm High

- A. Validate alarm by observing if reading from PT-1505 exceeds the alarm set point. Also check for loss of vacuum in the CFMT and FHT.
- B. Possible causes of a sustained alarm include excessive steam generation from the CFMT, plugging of the ventilation header with solids, and plugging of the condenser tube bundle by solids from turbulent boiling in the CFMT. (A temporary alarm could result from a pressure excursion in the melter accompanied by automatic opening of the valve isolating the ventilation header from the melter.)
- C. Loss of vacuum in the ventilation header can result in loss of in-cell contamination control at the CFMT, FHT and melter.
- D. Consider reducing the amount of steam entering the header from the CFMT by reducing the boiling rate.
- E. Troubleshoot and correct the root cause of the alarm.

3.7.2 Condenser Temperature Alarm High

- A. Validate alarm by observing if the reading from TT-1502 exceeds the alarm set point.
- B. Possible causes include loss of cooling to the condenser, excessing fouling of the condenser tube bundle, or venting of the melter into the vessel ventilation system without suspending melter feed operations.
- C. Inability of the condenser to cool the ventilation gases can result in delivery of steam from the CFMT directly into the off-gas system. In the off-gas system the steam could wet and damage the Prefilter elements.

- D. Assure cooling water flow is not interrupted. If the melter is venting to the vessel ventilation header, assure that feed operations have been suspended.
- E. Troubleshoot and correct the root cause for the alarm.

3.7.3 Condenser Condensate Level Alarm High

- A. Validate alarm by observing if the reading from LT-1506 indicates a level above the alarm set point.
- B. Possible causes include a closed drain valve, pluggage in the condensate drain line, and gross failure of one or more tubes of the tube bundle.
- C. Pluggage of the condensate drain line prevents removal of the condensate from the vitrification cell thereby requiring cessation of CFMT boiling operations. Failure of the tube bundle results in contamination of large quantities of clean water requiring subsequent processing.
- D. Discontinue CFMT boiling operations and condenser cooling water flow.
- E. Troubleshoot and correct the root cause for the alarm.

3.7.4 SBS Scrubber Level Alarm Low

- A. Validate alarm by observing if the reading from LT-3101 indicates a level below the alarm set point. Also check the differential pressure reading across the bed from PDT-3101, because a reduced level should also produce a reduced bed differential pressure.
- B. Possible causes include reduced feed rate to the melter and loss of cooling to the scrubber, either of which could result in a net evaporation from the scrubber, rather than condensation in the scrubber.
- C. Loss of scrubber level could result in loss of quenching and scrubbing by the SBS. Loss of quenching could produce thermal damage to the HEME pad and Prefilter elements. Loss of scrubbing could result in pluggage of the HEME pad and premature loading of the Prefilter elements.

- D. If a liquid inventory is present in the receiver, transfer liquid from the receiver to the scrubber by activating the solids suspension system pump, or by activating the receiver to scrubber jet, J-3105. If an insufficient amount of liquid is in the receiver, add demineralized water from the Cold Chemical System through valve CH-H-930 until the scrubber is filled.
- E. Consider reducing scrub temperature to reduce the evaporation rate.

3.7.5 SBS Receiver Level Alarm Low

- A. Validate alarm by observing if the reading from LT-3111 indicates a level less than the alarm setpoint.
- B. Possible causes include excessive transfers to the CFMT or waste header.
- C. A low level in the receiver can present proper operation of the solids mobilization system.
- D. Discontinue transfer from the SBS.

3.7.6 SBS Receiver Level Alarm High

- A. Validate alarm by observing if the reading from LT-3111 exceeds the alarm set point.
- B. Possible causes include accumulation of condensation over an excessive period of time before jetting the contents of the receiver, and inadvertant transfer of rinse water from the canister decontamination station.
- C. An excessive level in the receiver can produce an excessive differential pressure across the scrubber, and ultimately loss of vacuum at the melter.
- D. If the CFMT is ready to accept the contents of the SBS Receiver, transfer it there. Otherwise, jet it to the waste header with jet J-3124, or suspend feed to the melter until after the receiver has been jetted.

3.7.7 SBS Scrubber Temperature Alarm High

- A. Validate alarm by observing if reading from TT-3103 exceeds the set point temperature.

- B. Possible causes include loss of cooling to the scrubber, fouled surfaces on the heat transfer surfaces, or a reduced melter feed rate (A reduced melter feed rate would generate less water vapor to condense, which would produce a net evaporation rate from the scrubber, which could expose the temperature sensor to hot off-gases.).
- C. An excessive scrub temperature will ultimately result in evaporation of the scrub solution, with subsequent loss of quenching and scrubbing. Loss of quenching could result in thermal damage to the HEME pad and Prefilter elements. Loss of scrubbing could result in plugging of the HEME pad and premature loading of the Prefilter elements.
- D. Pay close attention to the scrubber level from LT-3101, and if necessary maintain the level by transfer from the receiver, or adding water from the Cold Chemical System through line CH-3106.
- E. Troubleshoot and correct the root cause for the alarm.

3.7.8 SBS Scrubber Temperature Alarm Low

- A. Validate alarm by observing if reading from TT-3103 is below the alarm set point.
- B. A possible cause is failure of cooling water control valve TV-3121 (It fails in the open position.).
- C. A low scrub temperature increases the rate that water vapor is condensed from the melter off-gas, which could result in filling of the receiver before the CFMUT is available to accept the contents of the receiver.
- D. Consider reducing the melter feed rate to reduce the rate that water vapor is delivered to the SBS.
- E. Troubleshoot and correct the root cause for the alarm.

3.7.9 Mist Eliminator Differential Pressure High

- A. Validate alarm by observing if the reading from PDT-3211 exceeds the alarm set point.
- B. The probable cause is build-up of solids in the mist eliminator pad.

- C. An excessive differential pressure across the mist eliminator pad can result in loss of vacuum at the melter.
- D. Flush the mist eliminator pad by momentarily directing water through line CH-2-3210. Repeat as necessary.

3.7.10 HEME Preheater Temperature Alarm High

- A. Validate alarm by observing if the reading from TT-3212 exceeds the alarm set point.
- B. Possible causes include venting of the melter to the vessel ventilation system without suspension of feed operation, delivery of excessive power to the HEME Preheater element, or continued delivery of power to the HEME Preheater element when off-gas flow has been interrupted.
- C. Off-gas temperatures above 121 °C (250 °F) can cause thermal damage to the HEME pad and Prefilter elements. Continued delivery of energy to the HEME Preheater elements after off-gas flow has been interrupted can result in permanent damage to the Preheater element and housing.
- D. De-energize the HEME Preheater. If off-gas is continuing to flow through the system, activate the Filter Preheater in the off-gas train being used.
- E. Troubleshoot and correct the root cause of the alarm.

3.7.11 DELETED

3.7.12 HEME 63-T-033 Pressure Differential Alarm High

- A. Validate alarm by observing if the reading from PDT-3315 is greater than the alarm set point.
- B. The probable cause is build-up of solids in the HEME pad.
- C. An excessive differential pressure across the HEME pad can result in failure of the pad, or loss of vacuum in the melter.
- D. Flush the HEME pad with demineralized water through valve DW-GL-662.

- E. If flushing does not reduce the excessive differential pressure, switch off-gas trains to place HEME 63-T-036 into service, then troubleshoot and correct the root cause of the alarm.

3.7.13 HEME 63-T-033 Level Alarm High

- A. Validate alarm by observing if the reading from LT-3317 is greater than the alarm set point.
- B. Possible causes include a closed drain valve, pluggage in the drain loop seal caused by accumulation of undissolved solids there, and a disconnected drain jumper (A disconnected drain jumper could allow the partial vacuum in the HEME to support a column of water in the bottom of the vessel.).
- C. Standing water in the HEME can result in loss of particulate removal efficiency and entrained liquid entering the off-gas stream.
- D. Assure that HEME drain jumper is properly connected and that drain valve V-3318 is open. If they are, and the liquid level remains high, flush the drain from HEME 63-T-033 by closing drain valve V-3318, momentarily introducing demineralized water through valve DW-GL-021, then re-opening the valve.

3.7.14 HEME 63-T-036 Pressure Differential Alarm High

- A. Validate alarm by observing if the reading from PDT-3621 is greater than the alarm set point.
- B. The probable cause is build-up of solids in the HEME pad.
- C. An excessive differential pressure across the HEME pad can result in failure of the pad, or loss of vacuum in the melter.
- D. Flush the HEME pad with demineralized water through valve DW-GL-664.
- E. If flushing does not reduce the excessive differential pressure, switch off-gas trains to place HEME 63-T-033 into service, then troubleshoot and correct the root cause of the alarm.

3.7.15 HEME 63-T-036 Level Alarm High

- A. Validate alarm by observing if the reading from LT-3622 is greater than the alarm set point.
- B. Possible causes include a closed drain valve, and pluggage in the drain loop seal caused by accumulation of undissolved solids there, and a disconnected drain jumper (A disconnected drain jumper could allow the partial vacuum in the HEME to support a column of water in the bottom of the vessel.).
- C. Standing water in the HEME can result in loss of particulate removal efficiency and entrained liquid entering the off-gas stream.
- D. Assure that HEME drain jumper is properly connected and that drain valve V-3619 is open. If they are, and the liquid level remains high, flush the drain from HEME 63-T-036 by closing drain valve V-3619, momentarily introducing demineralized water through valve DW-GL-022, then re-opening valve V-3619.

3.7.16 Filter Preheater 63-E-034 Temp. Alarm Low

- A. Validate alarm by observing if the reading from TT-3408 is less than the alarm set point.
- B. Possible causes include failure of the heating elements, and failure of the power distribution system to deliver power to the heating elements.
- C. Failure of the Filter Preheater to maintain the off-gases above the dew point could result in wetting and subsequent damage to the Prefilter elements.
- D. Energize the HEME Preheater. If the off-gas is still flowing, re-establish a backup heater by switching off-gas trains.
- E. Troubleshoot and correct the root cause of the alarm.

3.7.17 Filter Preheater 63-E-034 Temp. Alarm High

- A. Validate alarm by observing if the reading from TT-3408 exceeds the alarm set point.

- B. Possible causes include venting of the melter to the vessel ventilation system without suspension of feed operation, delivery of excessive power to the Filter Preheater element, and continued operation after off-gas flow has been interrupted.
- C. Off-Gas temperatures above 121 °C (250 °F) can cause thermal damage to the Prefilter elements. Continued delivery of energy to the Filter Preheater elements after off-gas flow has been interrupted can result in permanent damage to the preheater elements and housing.
- D. De-energize the Filter Preheater. If off-gas is still flowing, energize the HEME Preheater, then re-establish a back-up heater by switching off-gas trains.
- E. Troubleshoot and correct the cause of the alarm.

3.7.18 Filter Preheater E-037 Temperature Alarm Low

- A. Validate alarm by observing if the reading from TT-3709 is less than the alarm set point.
- B. Possible causes include failure of the heating elements, and failure of the power distribution system to deliver power to the heating elements.
- C. Failure of the Filter Preheater to maintain the off-gases above the dew point could result in wetting and subsequent damage to the Prefilter elements.
- D. Energize the HEME Preheater. If the off-gas is still flowing, re-establish a backup heater by switching off-gas trains.
- E. Troubleshoot and correct the root cause of the alarm.

3.7.19 Filter Preheater 63-E-037 Temp. Alarm High

- A. Validate alarm by observing if the reading from TT-3709 exceeds the alarm set point.
- B. Possible causes include venting of the melter to the vessel ventilation system without suspension of feed operation, delivery of excessive power to the Filter Preheater element, and continued operation after off-gas flow has been interrupted.

- C. Off-Gas temperatures above 121 °C (250 °F) can cause thermal damage to the Prefilter elements. Continued delivery of energy to the Filter Preheater elements after off-gas flow has been interrupted can result in permanent damage to the Preheater elements and housing.
- D. De-energize the Filter Preheater. If off-gas is still flowing, energize the HEME Preheater, then re-establish a back-up heater by switching off-gas trains.
- E. Troubleshoot and correct the root cause of the alarm.

3.7.20 Prefilter 63-T-035 Press. Diff. Alarm Low

- A. Validate alarm by observing if the reading from PDT-3506 is below the alarm set point.
- B. Possible causes are loss of off-gas flow through the elements, and tearing of a prefilter element(s).
- C. Failure of the prefilter elements could result in transfer of some of the radioactive materials from the prefilter elements to the HEPA filters located outside the vitrification cell.
- D. Switch off-gas trains to place Prefilter 63-T-038 into service.
- E. Troubleshoot and correct the root cause of the alarm.

3.7.21 Prefilter 63-T-035 Press. Diff. Alarm High

- A. Validate alarm by observing if the reading from PDT-3506 is greater than the alarm set point.
- B. Possible causes are build-up of particulate on the element(s), wetting of the element(s), and failure of an element(s) against its retaining screen.
- C. High differential pressure across an unfailed element is an indication that continued operation may result in failure of the element(s). High differential pressure across a failed element could result in loss of vacuum at the melter.
- D. Switch off-gas trains to place Prefilter 63-T-038 into service.
- E. Troubleshoot and correct the root cause of the alarm.

3.7.22 Prefilter 63-T-038 Press. Diff. Alarm Low

- A. Validate alarm by observing if the reading from PDT-3810 is below the alarm set point.
- B. Possible causes are loss of off-gas flow through the elements, and tearing of a prefilter element(s).
- C. Failure of the prefilter elements could result in transfer of some of the radioactive material from the prefilter elements to the HEPA filters located outside the vitrification cell.
- D. Switch off-gas trains to place Prefilter 63-T-035 into service.
- E. Troubleshoot and correct the root cause of the alarm.

3.7.23 Prefilter 63-T-038 Press. Diff. Alarm High

- A. Validate alarm by observing if the reading from PDT-3810 is greater than the alarm set point.
- B. Possible causes are build-up of particulate on the element(s), wetting of the element(s), and failure of an element(s) against its retaining screen.
- C. High differential pressure across an unfailed element is an indication that continued operation may result in failure of the element(s). High differential pressure across a failed element could result in loss of vacuum at the melter.
- D. Switch off-gas trains to place Prefilter 63-T-035 into service.
- E. Troubleshoot and correct the root cause of the alarm.

3.7.24 Postheater Housing Temperature High

- A. Validate alarm by observing if the readings from TT-3914 and TT-3915 are greater than the alarm set point.
- B. Possible causes include venting of the melter to the vessel ventilation system without suspension of feed operation, overheating by one of the heaters upstream.

- C. Excessive off-gas temperatures threaten thermal damage to the Postheater housing, to the mass flowmeter FE-3916, to the duct in the trench leading to the 01-14 building.
- D. (With no heating element in the housing, the high temperature would result from other sources which would trigger alarms leading to corrective actions.)
- E. Troubleshoot and correct the root cause of the alarm.

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3.7.25 DELETED

4.0 SYSTEM LIMITATIONS, SET-POINTS AND PRECAUTIONS

The instrumentation limits, set points, alarms and interlocks are listed in Tables 4-1 through 4-4.

Table 4-1: Temperature Limits, Set-Points, Alarms, Events & Interlocks

Parameter	Instrument	Limits	Set-Points	Alarms, Events, & Interlocks
Condenser Outlet	TT-1502	107 °C (225 °F)	102 °C (215 °F)	Alarm High
SBS Bed	TT-3103	Not Established	Deviation of 10 C° (18 F°) from setpoint	Alarm High
		Not Established	Deviation of -10 C° (-18 F°) from setpoint	Alarm Low
HEME Preheater	TT-3212	107 °C (225 °F)	95 °C (205 °F)	Alarm High
			107 °C (225 °F)	Event Hi Hi Stop Power Stop Feed
Preheater E-034	TT-3408	Off-Gas Dew Point	60 °C (140 °F)	Alarm Low
			107 °C (225 °F)	Alarm High
			107 °C (225 °F)	Event Hi Hi Stop Power Stop Feed
Preheater E-037	TT-3709	Same as TT-3408	Same as TT-3408	Same as TT-3408
Postheater	TT-3914	107 °C (225 °F)	104 °C (220 °F)	Alarm High
			107 °C (225 °F)	Event Hi Hi Stop Power Stop Feed

The limit on the condenser outlet coincides with the maximum allowable temperature at the prefilter elements located downstream, consistent with ANSI-N509. The high temperature alarm set-point is set below the limit to warn the operators before the limit is reached.

The SBS bed low temperature limit is that temperature at which the condensation rate in the SBS bed is such that the receiver will become overfilled before the CFMT will be ready to accept the condensate from the receiver. Because this limit will change with changes in operating conditions (e.g. melter feed rate), a specific value for the limit cannot be firmly established. The suggested low temperature alarm set-point is well below normally anticipated operating temperatures and is intended to alert the operator to excessive cooling which could result in over accumulation of liquid in the receiver.

The SBS bed high temperature limit is that temperature which establishes an off-gas dew point sufficiently high that condensation will occur in the ducting located in the trench between the Vitrification Cell and the 01-14 Building. Because this limit will change with changes in operating conditions (e.g. trench temperature) a specific value for the limit cannot be firmly established. The suggested high temperature alarm set-point is slightly above off-gas temperature which might be expected to result in condensation in the off-gas duct in the trench. Operating experience, and changes in atmospheric temperatures with changes in season, may dictate changes in the set-point.

The HEME Preheater temperature limit is established by ANSI/ASME-N509. The interlock is set at the limit to terminate power to the HEME Preheater should the system, for any reason, reach the limit temperature and thereby threaten to exceed it. The high temperature alarm is set between the control point and the maximum allowable temperature to indicate that the temperature is rising and give the operator time to respond before the power is automatically cut off by the interlock. Simultaneously, it also interrupts feed to the melter because the efficiency of the off-gas system will be temporarily compromised. Because the temperature sensor is located in the heater housing, it also serves to protect the heating elements from self-destruction.

The prefilter low temperature limit is the dew point of the off-gases. At the dew point and below, condensation would be expected to form on the prefilter elements. Because the off-gas dew point can change with changes in the operating conditions (e.g. SBS bed temperature and vessel ventilation gas temperature), a firm low temperature limit cannot be established. The low temperature alarm set-point is established at a temperature greater than the SBS bed is ever expected to operate because the SBS bed operating temperature should generally control the minimum possible dew point.

The prefilter high temperature limit is established by ANSI/ASME-N509. The high temperature alarms are to annunciate above the set point temperature, but below the temperature limit, to allow the operator time to respond before the interlock takes control from the operator. The temperature interlock interrupts electrical power to the heater element should the temperature reach the limit. Simultaneously, it also interrupts feed to the melter because the efficiency of the off-gas system will be temporarily compromised. Because the temperature sensors are located in the heater housings, the interlock also serves to protect the heating elements from self-destruction.

The Postheater temperature limit is established by ANSI/ASME-N509. The Postheater became redundant equipment when ANSI/ASME-N509 was imposed because it could no longer provide service beyond that provided by filter preheaters 63-E-034 and 63-E-037. Therefore, the high temperature alarm and interlock serve as back-ups to the alarms and interlocks of filter preheaters 63-E-034 and 63-E-037, and are programmed to be the same.

Table 4-2: Pressure and Differential Pressure Limits, Set-Points, & Alarms/Events				
Parameter	Instrument	Limits	Set-Points	Alarms/Limits
Vent Header	PT-1505	0 gage	-0.5 kPa (-2 InWG)	Alarm High Stop Steam to CFMT
Mist Eliminator	PDT-3211	Not Estab'd.	750 Pa (3 InWG)	Alarm High
HEME T-033	PDT-3315	5 kPa (20 InWG)	4 kPa (16 InWG)	Alarm High
Prefilter T-035	PDT-3506	Not Established	200 Pa (0.75 InWG) Suggested Initial See Note 1	Alarm Low
		2.4 kPa (9.5 InWC) See Note 2	2.1 kPa (8.5 InWC) See Note 2	Alarm High
HEME T-036	PDT-3621	5 kPa (20 InWG)	4 kPa (16 InWG)	Alarm High
Prefilter T-038	PDT-3810	Not Established	200 Pa (0.75 InWC) Suggested Initial See Note 1	Alarm Low
		2.4 kPa (9.5 InWC) See Note 2	2.1 kPa (8.5 InWC) See Note 2	Alarm High
Note 1 -	Set within 150 Pa (3. InWC) below the operating differential pressure, after the operating differential pressure has exceeded 1.5 kPa (6 InWC).			
Note 2 -	Consistent with "Vitrification Facility Ventilation of Off-Gas System Requirements". Preliminary Process Safety Requirement 12, Rev. 0, Draft, allowing InWC for second element in the housing.			

The vent header pressure limit is zero gage pressure because pressurization of the ventilation system, relative to the vitrification cell, will result in contamination of the cell from the CFMT and FHT, and from the melter if it is being ventilated to the header. The alarm is set between the desired operating pressure and the limit, at a point such that any further deterioration in the vacuum would clearly compromise the ability of the ventilation system to perform its mission.

The differential pressure across the mist eliminator pad is alarmed to alert the operator when the mist eliminator pad requires flushing. Testing experience has indicated that the pad should not plug, and there is no means to replace the pad without replacing the entire housing, so the pad should be flushed whenever any restriction is detected. So long as mist eliminator restrictions do not prevent establishment of a slight vacuum in the melter, feed operation can continue regardless of the differential pressure measurement.

The limiting differential pressure across the HEME pads was established by the pad vendor, and the alarms were set below the limits to alert the operator of a pending need to flush the pads.

No prefilter pressure differential low limit is established because the minimum acceptable differential pressure varies with the changes in process conditions, specifically the volumetric flow rate through the elements. The prefilter pressure differential low alarm is set below the differential pressure expected during normal operation when the prefilter elements are clean, and is used to detect prefilter element tearing. This is only a suggested alarm point. Operations may periodically increase this alarm set-point as the pressure differential increases due to buildup of material on the elements.

The prefilter pressure differential high limit is based upon published literature indicating that single HEPA elements are commonly used until the differential pressure reaches 2 kPa (8 InWC). Therefore, a differential pressure across the first element of 2 kPa (8 InWC), plus an allowance for 250 Pa (1 InWC) across the second element, which should remain relatively clean, is allowed. The pressure differential alarm high is set slightly below the limit to alert the operator in advance of a pending need to replace the prefilters.

> DELETED - Table 4.3: Flow Limit, Set-Points, Events and Interlocks

Table 4-3: Level Limits, Set-Points, Alarms, Events & Interlocks

Parameter	Instrument	Limits	Set-Points	Alarms, Events & Interlocks
Condenser Condensate	LT-1506	250 mm (10 InWC)	230 mm (9 InWC)	Alarm High
SBS Scrubber	LT-3101	1240 mm (49 InWC)	1300 mm (51 InWC)	Alarm Low
			1240 mm (49 InWC)	Event lo lo stop feed
SBS Receiver	LT-3111	1960 mm (77 InWC)	1350 mm (53 InWC)	Alarm High
			230 mm (9 in)	Alarm Low
			180 mm (7 in)	Event Lo Lo Stop Pump
HEME T-033	LT-3317	Detectable Level	50 mm (2 InWC)	Alarm High
HEME T-036	LT-3622	Detectable Level	50 mm (2 InWC)	Alarm High

The liquid level limit in the condenser shell is the level of the opening of the reference pressure tap at the lower end of the condenser shell. Should the level increase above this point, level readings will no longer be accurate.

The weir in the standpipe is designed to measure condensate flow rate from normal CFMT boiling about 130 mm (5") up the standpipe. Therefore, a water level significantly higher than 130 mm (5") up the standpipe height would be indicative of a restriction in the condensate drain line. The alarm point is set well above the expected nominal level during CFMT boiling, but below the limit, to alert the operator to the existence of a possible restriction.

The SBS Scrubber must always be filled to assure proper quenching and particulate removal. The low level limit is the level of the upper lip of the bed section. Below this level, liquid will no longer be able to circulate from the top of the bed and down over the cooling coils. The level low alarm is set just above this lip to assure that the operator is alerted to a diminishing scrubber level while he/she will still has the capability of responding to the dropping liquid level, for example, by increasing the amount

of cooling and thereby increasing the amount of condensation occurring in the scrubber, or by direct water additions to the scrubber.

The SBS Receiver high level limit corresponds to the maximum liquid inventory for which the SBS Receiver was designed to accept, 6.824 m³ (1803 gal.), which includes a 5.651 m³ (1493 gal) working volume plus a 1.173 m³ (310 gal) heel. The SBS Receiver high level alarm is established at a level corresponding to the top of the half-pipe jacket, and notifies the operator that the Receiver has only 1.25 m³ (330 gal) of available space remaining. This corresponds to about 20% of the available working volume and should allow sufficient time for operations to determine whether or not some of the contents should be jetted to the waste header to assure that the Receiver won't become overfilled before the CFMT will be available to accept liquid from the SBS Receiver.

The SBS Receiver level low alarm is set to indicate when the liquid level is approaching the minimum liquid level to assure the suction for the solids suspension system pump remains covered so that solids suspension operations are not needlessly interrupted. Should the liquid level go below the minimum liquid level, the pump will no longer be able to withdraw liquid from the SBS Receiver, and the solids suspension will no longer function, so the power to the recirculation pump motor will be interrupted to protect the recirculation system from self-destruction.

The liquid level limit in an operating HEME corresponds to the bottom of the HEME pad. Should a liquid level be detected during operation, the HEME efficiency could become compromised. The level probe is located at the bottom of the pad, and the level high alarm is set to annunciate after a liquid level is clearly established.

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Table 4-4: Electrical Current Limit, Set-Point, & Alarm				
Parameter	Instrument	Limit	Set-Point	Alarm
SBS Pump Motor	IT-3130	0	0.5 amp when operating	Alarm Low

> The electrical current low alarm for the SBS solids mobilization pump motor is set well below the nominal current expected to be drawn when the motor is running, to indicate the pump is not running when it is expected to be running.

4.1 Vessel Ventilation

The condenser tube bundle was designed for a maximum differential pressure of 7 kPa (1 psid). This was done to leave a sufficient differential pressure requirement at the control valve so that the pressure in the system could be modulated. The instrumentation measures only one of two passes of the ventilation gases across the tube bundle, therefore the maximum differential the instrumentation should measure is 3.4 kPa (0.5 psid, 14 InWG). No alarm is required on

this measurement because an excess differential pressure across the tube bundle will result in an insufficient vacuum in the vent header which will initiate an alarm.

Assure that cooling water block valves 66-GL-046 and 66-GL-632 are open whenever a possibility exists for CFMT boiling, or opening of the valve between a thermally hot melter and the vessel vent header. This is because the water in the condenser tubes could vaporize and over pressurize the equipment.

4.2 Quenching/Scrubbing

The nominal SBS bed temperature should be selected to establish the maximum expulsion of water vapor from the SBS, without producing condensation in the trench between the vitrification cell and the 01-14 building.

The SBS receiver temperature is set below the maximum limit. At temperatures in excess of the limit, the jets used to discharge the contents of the receiver, may not function. Above the limit, the vacuum produced in the jet suction may vaporize the scrub, thereby preventing priming of the jet with liquid. The alarm is set at the limit to alert the operator as soon as the operability of the jets has become compromised.

4.3 Prefiltration

The temperature set point for the operating filter preheater must be below the mandatory limit, and well above the normally expected off-gas dew point. An operating set-point temperature of 85 °C (185 °F) is recommended.

5.0 CASUALTY EVENTS AND RECOVERY PROCEDURES

This section identifies the casualty events that could affect the system, and the protection provided against those casualties by the system design. It also outlines the system design features and recovery procedures which will mitigate the consequences of the casualties and restore the system to a known and confirmed safe condition.

5.1 Casualty Events

Following is a list of the casualty events considered. This list is not intended to be all inclusive.

- Loss of Cooling
- Loss of Site Power
- Loss of Steam
- Loss of Utility Air
- Loss of Instrument Air
- Failure of Vessel Vent Pressure Control Valve
- Failure of Condenser Tube Bundle
- Failure of HEME Preheater Element
- Malfunction of HEME Preheater Element - Overheating
- Failure of HEME Pad
- Failure of Filter Preheater Element
- Malfunction of Filter Preheater Element - Overheating
- Failure of Prefilter Elements
- Failure of Postheater Element
- Malfunction of Postheater Element - Overheating
- Failure or Malfunction of Off-Gas Flowmeter
- Tornado
- Earthquake

5.2 Design Features to Mitigate Effects of Casualty Events

This subsection briefly outlines the design features which provide protection from casualty events and mitigate the effects of such events.

5.2.1 Loss of Cooling

Closed loop cooling water provides process cooling services to three locations in the In-Cell Off-Gas system; the Vessel Vent Condenser, the SBS Receiver, and the SBS Scrubber.

Should closed loop cooling water flow be lost while the condenser is being used to condense the steam produced from CFMUT operation, the steam will pass through the condenser, and the pressure control valve in the non-condensibles jumper, before entering the off-gas stream. The steam will remain in a vapor state because the off-gas system will be at a significantly lower pressure than the condenser. The steam will place a significantly larger energy demand on the filter preheater in use. The heating elements have considerable excess capacity and will draw additional electrical energy to maintain the set-point temperature, thereby protecting the prefilter elements from becoming wetted. The increased flow rate in the off-gas train will produce increased pressure differentials through the processing equipment, and the air inbleed valve in the out-of-cell off-gas system will automatically respond by reducing the amount of air entering the system at the blower suction. With this action, a vacuum will likely be retained in the system, but most if not all of the flexibility in the pressure control system will have been used, and the vacuum may not be as significant as desired. Should the detected vacuum be less than the interlock point, the steam to the CFMUT and waste feed to the melter will automatically be interrupted. After the steam flow to the CFMUT is interrupted, steam flow into the vessel vent condenser will cease, and the pressure control logic will automatically restore the set-point vacuum.

Should closed loop cooling water flow be lost to the SBS Receiver, the temperature of the liquid stored there may rise thereby compromising the ability to operate the steam jets which are used to drain the receiver. This could create a delay in the schedule for jetting the receiver, and could require interruption of melter feed operations after the receiver becomes filled with condensate.

Should closed loop cooling water flow be lost to the SBS Scrubber, the temperature in the scrubber would rise, greater amounts of water vapor would be expelled from the scrubber with the off-gases, the liquid inventory in the scrubber would become depleted, and eventually, the ability to quench and scrub the off-gases would gradually be lost.

Of the three closed loop cooling water applications, only one is necessarily in continuous use, the cooling of the SBS Scrubber.

To establish whether cooling water flow is lost, FE-3314, the SBS Scrubber cooling water flow element, should be checked. After cooling is lost, the temperature of the scrub will rise above the set-point and the temperature control valve will automatically move to a fully open position trying to re-establish the set-point temperature. Therefore, to verify that no cooling water is flowing to the SBS Scrubber, check the temperature of the scrub solution, TE-3103, and the position of the scrubber temperature control valve, TV-3121. The SBS Receiver cooling water flow element, FE-3118, and the condenser cooling water flow element, FE-1508, should be checked to establish if cooling water is being supplied elsewhere in the system.

5.2.2 Loss of Site Power

Upon loss of site power, melter feed operations should automatically cease and one of the off-gas blowers in the out-of-cell off-gas system will continue to operate on an alternate energy source. Therefore, flow would continue through the in-cell off-gas equipment but the amount of contamination released into the off-gases from the melter would steadily decrease. Alternate energy will also be provided for the preheaters, so operation can continue without undue risk of wetting the prefilter elements.

5.2.3 Loss of Steam

Upon loss of plant steam, the ability to make liquid transfers from the SBS Scrubber and SBS Receiver will be lost. Loss of ability to transfer liquid from the SBS would eventually result in a filled SBS Receiver which would require interruption of melter feed operations.

To verify the presence, or absence, of steam, check steam pressure at PT-3105 when valve HV-3105 to jet J-3105 is open.

5.2.4 Loss of Utility Air

Upon loss of utility air, the ability to purge the steam jets used to transfer liquids from the SBS will be lost. Because purging of the jets is necessary to prevent condensing steam from creating a vacuum that could suck contaminated liquid back through the vitrification cell wall, the steam jets must not be used when utility air is not available.

5.2.5 Loss of Instrument Air

Upon loss of instrument air, proper operation of control valves and pressure taps will be lost. The system will continue to be maintained under a vacuum by the operating off-gas blower, but control of system pressures, differential pressures and liquid levels will be lost, so liquid transfer operations must be suspended.

5.2.6 Failure of Vessel Vent Pressure Control Valve

Failure of the Vessel Ventilation Pressure Control Valve, PV-1502, would result in the valve moving to the fully open position. The degree of vacuum in the system may increase somewhat, and the ability to hold the equipment at a constant vacuum may be lost. However, the equipment will remain under a vacuum relative to the cell pressure, containment of contamination by ventilation will continue, and equipment attached to the vessel ventilation system will remain operable.

To establish whether PV-1505 has failed, first check the pressure in the vessel ventilation header, PT-1505, for a vacuum greater than the set point (an absolute pressure lower than the set point). If the vacuum is greater than the set point, the possibility of failure is indicated, and the operation of the valve should be tested. Test the valve by changing the set-point while observing PV-1505 to determine whether the control valve responds to the change. Lack of responsiveness is indicative of failure.

5.2.7 Failure of Condenser Tube Bundle

Failure of the tube bundle in the condenser will result in compromised cooling efficiency, but more importantly, will result in large quantities of clean water being added to the contaminated water inventory.

To establish whether the tube bundle has failed, check the liquid level at the weir in the bottom of the condenser vessel on LT-1506. An unusually high level while condensing steam from CFMUT operation, is suggestive of tube failure. Any positive level when condensate is not being produced from CFMUT operation while the condenser drain valve, V-1503, is open, is also indicative of tube failure.

5.2.8 Failure of HEME Preheater Element

Failure of the HEME Preheater element would be of no consequence to the HEME itself because it would passively begin functioning as a mist eliminator rather than as a particulate filter. The Prefilter, however, would be exposed to moist off-gas, and the deleterious effects that would pose.

To detect failure of the element verify that the HEME Preheater power has not been switched off, and determine the HEME Preheater outlet temperature on TE-3212. If the activated heater cannot maintain the set-point temperature, the element has probably failed.

5.2.9 Malfunction of HEME Preheater Element - Overheating

Overheating of the HEME Preheater threatens thermal damage to the HEME element, the prefilter elements, and the HEME Preheater housing itself.

Overheating of the HEME Preheater is detected by TE-3212 which is alarmed and interlocked for high temperature.

5.2.10 Failure of HEME Pad

Failure of the HEME pad in service, or of the HEME pad seal, would result in reduced collection efficiency of the HEME, and an increased burden being placed upon the prefilter elements downstream.

A noticeable decrease in the differential pressure across the HEME pad in service, observed on PDT-3315 for HEME 63-T-033 or on PDT-3621 for HEME 63-T-036, compared to the established steady state differential pressure reading, is an indication that the HEME element, or HEME element seal, may have failed.

5.2.11 Failure of Filter Preheater Element

Failure of the filter preheater element in service would result in exposure of the prefilter to moist off-gas and the deleterious effects that would pose.

To detect failure of the element, verify that the filter preheater power has not been switched off, and determine the Filter Preheater outlet temperature on TE-3407 for Filter Preheater 63-E-034, or on TE-3709 for Filter Preheater 63-E-037. If the activated heater cannot maintain the set-point temperature, the element has probably failed.

5.2.12 Malfunction of Filter Preheater Element - Overheating

Overheating of the filter preheater element in service threatens thermal damage to the prefilter elements, and to the filter preheater housing itself.

Overheating of the filter preheater is detected by TE-3408 for Preheater 63-E-034, or by TE-3709 for Preheater 63-E-037. These sensors are alarmed and interlocked for high temperature.

5.2.13 Failure of Prefilter Elements

Failure of the prefilter elements in service could result in transfer of radioactively contaminated material into the off-gas duct in the trench between the Vitrification Cell and Building 01-14, and onto the HEPA filters in the 01-Cell. This would subject maintenance and decommissioning workers to increased radiation exposures.

A considerable decrease in the differential pressure across the prefilter assembly in service, observed on PDT-3506 for Prefilter 63-T-035, or on PDT-3810 for Prefilter 63-T-038, compared to the established steady state differential pressure reading, is an indication that the prefilter element or elements, has or have failed.

5.2.14 Failure Postheater Element

The Postheater is not required for proper system operation. Therefore, neither the absence nor the failure of the Postheater element is of concern.

5.2.15 Malfunction of Postheater Element - Overheating

Overheating by the Postheater element would violate the constraints placed upon the heater by ANSI/ASME-N509, would threaten the duct between the Vitrification Cell and 01-14 Building with thermal stresses, and would threaten the final HEPA filters in the 01-14 Building with thermal damage. Because the Postheater is not to be placed into service (The heating element and associated service jumper are not to be installed.), malfunction of the Postheater is of no concern.

5.2.16 Failure or Malfunction of Off-Gas Flowmeter

Failure or malfunction of the off-gas flowmeter, FE-3916, should trigger an interlock sequence which will interrupt feed to the melter and de-energize the operating heater element(s).

5.2.17 Tornado

The Vitrification Cell which contains the In-Cell Off-Gas System is designed to withstand a design basis tornado. The prefilter elements are HEPA elements which, according to the Nuclear Air Cleaning Handbook (ERDA-76-21), should withstand a pressure pulse caused by a tornado across off-gas system filter elements. Therefore, a tornado would not be expected to release significant amounts of radioactive materials from the off-gas system.

5.2.18 Earthquake

The off-gas system has been designed to remain standing, but not necessarily functioning, following a design basis earthquake. The Vitrification Cell and associated ventilation system have been designed to survive such an earthquake, thereby effectively containing any contamination which may be released from the off-gas system during or after an earthquake.

5.3 Recovery from Casualties

This subsection outlines the recovery procedures performed by facility operating personnel to restore the system to a known, safe condition; to mitigate the effects of casualty events; and to assure personnel safety.

5.3.1 Loss of Cooling

While efforts are made to restore cooling water flow, the liquid inventory in the SBS Scrubber will become diminished. This will occur because interruption of melter feed will reduce the condensate accumulation rate, and the increase in scrubber temperature will increase the rate that water vapor is expelled with the off-gases. Therefore operators should monitor the scrubber liquid level, LT-3101, and periodically add water to the scrubber from the cold chemical system through line CH-3106 to keep the scrubber nearly filled.

5.3.2 Loss of Site Power

While efforts are made to restore site power, moisture may produce an increased pressure differential across the prefilter assembly in service. Supply standby power to the preheater that was in use by closing the appropriate breaker in System 63ED.

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5.3.3 Loss of Steam

While efforts are made to restore plant steam, monitor the liquid level in the SBS Receiver on LT-3111. Should the receiver become filled, melter feed operation will need to be interrupted.

5.3.4 Loss of Utility Air

While efforts are made to restore plant utility air, monitor the liquid level in the SBS Receiver on LT-3111. Should the receiver become filled, melter feed operation will need to be interrupted. The contents of the SBS Receiver must not be jetted when there is no utility air available to purge the steam from the jets, because steam condensing in the line to the jet could create suction and draw contaminated liquid from the SBS through the vitrification cell wall.

5.3.5 Loss of Instrument Air

While efforts are made to restore plant instrument air, discontinue all liquid transfer operations, while continuing to monitor system temperatures and flow to assure stability of the system.

5.3.6 Failure of Vessel Vent Pressure Control Valve

Failure of PCV-1505 is not critical to system operation. Because replacement of the valve requires that the system be opened to the cell atmosphere, resulting in loss of vacuum on the attached components, valve change-out should not be performed until the overall vitrification system is down for other reasons. When the vitrification system is down for other reasons, the entire non-condensibles jumper which holds the valve should be replaced to re-establish vacuum controls.

5.3.7 Failure of Condenser Tube Bundle

Upon confirmation of tube bundle failure, suspend melter feed operations in an orderly manner, then replace or repair the tube bundle.

5.3.8 Failure of HEME Preheater Element

Upon detection of failure of the HEME Preheater element, an alternate preheater should be activated. If Prefilter 63-T-035 is in service, activate Filter Preheater 63-E-034. If Prefilter 63-T-038 is in use, activate Filter Preheater 63-E-037. De-activate the HEME Preheater.

The HEME Preheater is not essential to system operation, and replacement of the heater element requires opening of the off-gas system to the cell atmosphere. Therefore, wait until the vitrification system is down for other reasons before changing the element.

5.3.9 Malfunction of HEME Preheater Element - Overheating

If after the high temperature alarm for TE-3212 has sounded, the temperature continues to climb, initiate power to the Filter Preheater in the off-gas train in service and terminate power to the HEME Preheater. Troubleshoot the controls to establish the cause of the malfunction and make corrections as required.

Availability of the HEME Preheater is not essential to system operation, and replacement of the heater element requires opening of the off-gas system to the cell atmosphere, so wait until the vitrification system is down for other reasons before changing the failed element.

5.3.10 Failure of HEME Pad

Upon failure of the pad or seal of the HEME in service, switch the off-gas flow to the alternate off-gas train, then remove and replace the HEME pad.

5.3.11 Failure of Filter Preheater Element

Upon detection of failure of the filter preheater element in service, the HEME Preheater should be activated to re-establish the off-gas temperature at the prefilter. The off-gas trains should then be switched, the other filter preheater should be activated, then the HEME Preheater should be de-activated.

5.3.12 Malfunction of Filter Preheater Element - Overheating

If after the high temperature alarm for TE-3408 or for TE-3709 has sounded, the temperature continues to climb, initiate power to the HEME Preheater and terminate power to the filter preheater in service. Switch off-gas trains to place a good filter preheater into service. This will include activation of the alternate filter preheater and de-activation of the HEME Preheater. Troubleshoot the controls to establish the cause of the malfunction, and make corrections as required.

5.3.13 Failure of Prefilter Elements

Upon failure of the prefilter assembly in service, the ability of the off-gas system to retain radioactive contamination within the Vitrification Cell will have been compromised, and feed to the melter must be interrupted. The off-gas trains should then be switched to place new prefilters into service, and the failed prefilter assembly should be replaced.

5.3.14 Failure of Postheater Element

The Postheater is redundant equipment, is not required for proper system operation, and is not to be placed into service. Therefore, no recovery activity is required should the element be installed and subsequently be found to be faulty.

5.3.15 Malfunction of Postheater Element - Overheating

The Postheater is redundant equipment, is not required for proper system operation, and is not to be placed into service. Therefore, no recovery activities are anticipated to be required.

5.3.16 Failure or Malfunction of Off-Gas Flowmeter

Replacement of the off-gas flowmeter, FE-3916, requires that the system be opened to the cell atmosphere. This is undesirable, so replacement should be postponed until such time as the system is already down for other reasons.

The interlock associated with the flowmeter is intended to assure that feed is suspended, and the heaters are deactivated when there is no detectable flow in the system. Because flow can be confirmed by the existence of a differential pressure across the prefilter assembly in service, the system can be safely returned to service after reprogramming the DCS to interlock melter feed, and electrical energy delivery to the heater elements, based upon simultaneous absence of differential pressure across both prefilter assemblies.

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5.3.17 Tornado

Following a tornado, an engineering assessment will need to be performed to determine what damage occurred, and what corrective actions must be taken before the system can be safely returned to service.

5.3.18 Earthquake

Following an earthquake, an engineering assessment will need to be performed to determine what damage occurred, and what corrective actions must be taken before the system can be safely returned to service.

6.0 MAINTENANCE

6.1 Maintenance Approach/Philosophy

All items of equipment in the In-Cell Off-Gas Treatment System requiring periodic routine maintenance are designed for remote maintenance or replacement. Equipment with a likely operating life of less than seven years is designed to be either remotely replaceable, or have installed backups.

Normally, one of the installed redundant off-gas trains (HEME, filter preheater, prefilter) is operated while the other off-gas train is valved out-of-service. While out-of-service, maintenance operations can be performed. A train is placed into service by opening the isolation valves in the jumpers upstream from the HEME and downstream from the prefilter. A train is removed from service by closing the same two isolation valves.

The vessel vent header, structural supports, service wall and stub wall are non-maintenance items.

A set of lifting yokes supplied with the off-gas equipment, which could be used to remove and replace in-cell off-gas equipment, are described in the appendices.

A discussion of decontamination and decommissioning is presented in the appendices.

6.2 Corrective Maintenance

6.2.1 Vessel Ventilation

A. Pressure Control Valve Replacement

NOTE: The pressure control valve cannot be replaced without loss of vacuum in the equipment ventilated by the vessel ventilation system. Therefore, this procedure should not be performed when significant amounts of radioactive gases or vapors are being directed into the system.

- Close valve IA-GL-009 to isolate the instrument air from pressure control valve PV-1502.
- Using the crane and impact wrench, remove the instrument air jumper to the PV-1502.
- Remove the jumper providing temperature monitoring service to the non-condensibles jumper.

- Remove the non-condensibles jumper, which holds PV-1502.
- Install a replacement non-condensibles jumper with replacement PV-1502.
- Re-install the jumper providing temperature monitoring service to the non-condensibles jumper.
- Reinstall the jumper providing instrument air to PV-1502.
- Reopen valve IA-GL-009.

B. Temperature Element Replacement

NOTE: The temperature element in the non-condensibles jumper cannot be replaced without risking a partial loss of vacuum in the equipment serviced by the off-gas and vessel ventilation system. Therefore, this procedure should not be performed when significant amounts of radiologically contaminated gases or vapors are being produced at the CFMT or melter.

- Using an impact wrench, release both ends of the temperature instrumentation jumper from the stub wall to the non-condensibles jumper.
- Using a crane, remove the temperature instrumentation jumper with the failed temperature element.

NOTE: The valve in the jumper between the melter and vessel vent header (System 63I) may automatically open. This is normal and work can proceed.

- Using a crane, install a jumper with a functional temperature element.
- Using an impact wrench, tighten both ends of the jumper.

C. Condenser Drain Flush

- Using the impact wrench, close condenser drain isolation valve V-1503.

- Open valve DW-GL-033 to deliver flush water to the drain line.
- As soon as water flows freely through valve DW-GL-033, close it to minimize the amount of uncontaminated water introduced into the system.
- Re-open condenser drain isolation valve V-1503.

D. Condenser Tube Bundle Replacement

NOTE: The condenser tube bundle cannot be replaced without loss of vacuum in the equipment ventilated by the vessel ventilation system. Therefore, this procedure should not be performed when significant amounts of radioactive gases or vapors are being directed into the system.

- Close valve 66-GL-632 to stop cooling water flow to the condenser.
- After valve 66-GL-632 has been closed, close valve 66-GL-046 to finish isolating the condenser from the cooling water system.
- Using the crane and impact wrench, remove the jumpers delivering cooling water to, and returning cooling water from, the condenser.
- Loosen the nuts securing the condenser head to the condenser shell.
- Remove the head from the condenser shell.
- Remove the condenser upper gasket.
- Remove the condenser tube bundle.
- Remove the condenser lower gasket, and install a new condenser lower gasket.
- Install the new condenser tube bundle.
- Install a new condenser upper gasket.
- Replace the condenser head.

- After obtaining the proper bolt tightening pattern from engineering, use the impact wrench to tighten the nuts securing the condenser head to the condenser shell, in accordance with the bolt tightening pattern.
- Reinstall the cooling water source and return jumpers.
- Open valves 66 GL-046 and 66-GL-632 to restore cooling water flow to the tube bundle.

6.2.2 Quenching/Scrubbing

A. Replacing SBS Solids Suspension System Pump and Motor

NOTE: The pump and motor assembly cannot be replaced without risking loss of vacuum at the melter. Therefore, melter feed operation should cease, and melter ventilation should be provided through the vessel vent header before attempting to replace the pump and motor. A partial loss of vacuum may also occur in the vessel vent header, so CFMT boiling operations should also be suspended.

- Using a crane and impact wrench, release the electrical supply to the SBS solids suspension system motor.
- Release the pump and motor assembly from SBS nozzles N and S, then remove the pump and motor assembly.
- Transfer the pump and motor assembly out of the cell for repair, or for storage as waste.
- Introduce into the cell a repaired pump and motor assembly, or a replacement pump and motor assembly.
- Install and fasten the pump and motor assembly onto SBS nozzles N and S.
- Fasten the motor to its electrical supply.

B. Replacing SBS Bed & Freeboard Temperature Elements

NOTE: The temperature elements in the SBS Bed and Freeboard cannot be replaced without risking a partial loss of vacuum in the equipment serviced by the off-gas and vessel ventilation system. Therefore, this procedure should not be performed when significant amounts of radiologically contaminated gases or vapors are being directed into the system.

- Using an impact wrench, release both ends of the temperature instrumentation jumper from the stub wall to SBS Nozzle D.
- Using a crane, remove the temperature instrumentation jumper

NOTE: The valve in the jumper between the melter and vessel vent header (System 63I) may automatically open. This is normal and work can proceed.

- Using a crane, remove the jumper.
- Using a crane, install the replacement jumper.
- Using an impact wrench, tighten both ends of the jumper.

C. Replacing SBS Receiver Temperature Element

NOTE: The temperature element in the SBS Receiver cannot be replaced without risking a partial loss of vacuum in the equipment serviced by the off-gas and vessel ventilation system. Therefore, this procedure should not be performed when significant amounts of radiologically contaminated gases or vapors are being directed into the system.

- Using an impact wrench, release both ends of the temperature instrumentation jumper from the stub wall to SBS nozzle E.
- Using a crane, remove the jumper.

NOTE: The valve in the jumper between the melter and vessel vent header (System 63I) may automatically open. This is normal and work can proceed.

- Using a crane, remove the jumper.
- Using a crane, install the replacement jumper.
- Using an impact wrench, tighten both ends of the jumper.

D. Flushing Mist Eliminator Pad

> NOTE: Based upon testing experience, the mist eliminator pad is not expected to plug as a result of normal operations. Should pluggage occur, engineering will need to evaluate previous operations to determine the probable cause of the plugging, and specify an appropriate flush solution. Water is preferred for water soluble pluggage. Use of other chemicals requires careful consideration of impacts on vitrification chemistry because the solutions ultimately will go to the melter.

- Establish a baseline differential pressure across the mist eliminator pad from PDT-3211.
- Arrange for the proper flush solution to be prepared in the Cold Chemical System.
- Open valve CH-2-3210A and accept delivery of the flush solution at 7.5 L/min (2 gpm).
- Close valve CH-2-3210A.
- Check PDT-3211 to measure the success of the flush.

NOTE: The valve in the jumper between the melter and vessel vent header (System 63I) may automatically open. This is normal and work can proceed.

6.2.3 High Efficiency Mist Elimination

A. HEME Preheater Element Replacement

NOTE: The HEME Preheater element cannot be replaced without loss of vacuum in the equipment ventilated by the off-gas and vessel ventilation system. Therefore, this procedure should not be performed when significant amounts of radioactive gases or vapors are being directed into the system. The HEME Preheater is not essential to off-gas system operation, and the system can continue to operate with a failed element in the HEME Preheater housing.

- Assure that the power source to the element is tagged out-of-service.
- Remove the jumper providing electrical service to the HEME Preheater element.
- Using the impact wrench, loosen the ten nuts securing the element to the HEME Preheater housing.
- Using a crane hook, remove the element from the housing.
- Remove the used preheater flange gasket, and install a new preheater flange gasket.
- Using a crane hook, install the replacement element.
- After obtaining the proper bolt tightening pattern from engineering, use the impact wrench to tighten the ten nuts securing the element to the HEME Preheater housing.
- Reinstall the jumper providing electrical service to the HEME Preheater element.
- Return HEME Preheater power supply to service.

B. HEME Preheater Temperature Element Replacement

NOTE: Temperature element TE-3212 is isolated from the off-gas by a thermowell, and can be removed without opening the off-gas system to the cell ambient.

- Using an impact wrench, release both ends of the instrumentation jumper from the stub wall to HEME Preheater Nozzle D.
- Using a crane, remove the jumper.
- Using a crane, install a replacement jumper.
- Using an impact wrench, tighten both ends of the replacement jumper.

C. HEME 63-T-033 Drain Flush

- Using the impact wrench, close HEME drain isolation valve V-3318.
- Open valve DW-GL-021 to deliver flush water to the drain line.
- As soon as water flows freely through the valve, close it to minimize the amount of uncontaminated water introduced into the SBS.
- Reopen HEME drain isolation valve V-3318.

D. HEME 63-T-036 Drain Flush

- Using the impact wrench, close HEME drain isolation valve V-3619.
- Open valve DW-GL-022 to deliver flush water to the drain line.
- As soon as water flows freely through the valve, close it to minimize the amount of uncontaminated water introduced into the SBS.
- Reopen HEME drain isolation valve V-3619.

E. HEME 63-T-033 Pad Soak

NOTE: The HEME must be ventilated through the inlet duct before the soak is introduced because the HEME exit is located low on the side of the vessel.

- Using the impact wrench, close train A isolation valve V-3901 and open train A isolation valve V-3206.
- After determining from engineering the chemical composition desired for the soak solution, arrange for 2740 L (725 gal) of the soak solution to be provided by the Cold Chemical System.

NOTE: Water is preferred for water soluble pluggage. Caustic should be avoided because it may dissolve some of the HEME element fibers. Use of other chemicals requires careful consideration of impacts on vitrification chemistry because the solutions will ultimately to the melter.

- Open valve CH-H-953 and accept the chemical soak into the HEME, then close valve CH-H-953.
- After engineering has declared that the desired soak period has elapsed and that adequate volume is available in the SBS, use the impact wrench to open drain valve V-3318 allowing the soak solution to drain to the SBS.
- Using the impact wrench, close train A isolation valve V-3206 then open train A isolation valve V-3901.

F. HEME 63-T-036 Pad Soak

NOTE: The HEME must be ventilated through the inlet duct before the soak is introduced because the HEME exit is located low on the side of the vessel.

- Using the impact wrench, close train B isolation valve V-3902 then open train B isolation valve V-3207.
- After determining from engineering the chemical composition desired for the soak solution, arrange for 2740 L (725 gal) of the soak solution to be provided by the Cold Chemical System.

NOTE: Water is preferred for water soluble pluggage. Caustic should be avoided because it may dissolve some of the HEME element fibers. Use of other chemicals requires careful consideration of impacts on vitrification chemistry because the solutions will ultimately to the melter.

- Open valve CH-H-950 and accept the chemical soak into the HEME, then close valve CH-H-950.
- After engineering has declared that the desired soak period has elapsed and that adequate volume is available in the SBS, use the impact wrench to open drain valve V-3619 allowing the soak solution to drain to the SBS.
- Using the impact wrench close train B isolation valve V-3207 then open train B isolation valve V-3902.

G. HEME 63-T-033 Pad Replacement

NOTE: The HEME pad cannot be replaced without temporarily losing availability of the installed redundant off-gas train.

- Assure that off-gases are being directed through HEME 63-T-036 by verifying that valves V-3207 and V-3902 are both open.
- Assure that the HEME is isolated by verifying that off-gas valves V-3206 and V-3901 are closed.
- Complete the isolation of the HEME by closing drain valve V-3318.
- Assure that the demineralized water isolation valve, DW-2-3318A, is closed, then remove the jumper providing demineralized water to the HEME spray unit.
- Using the impact wrench, loosen the three nuts securing the HEME spray unit to the HEME head.
- Remove the HEME spray unit.

NOTE: This step is necessary to prevent damage to the spray lance when the HEME head is removed.

- Remove the spray unit gasket.
- Using the impact wrench, loosen the twelve nuts securing the HEME head to the HEME vessel.
- Remove the head from the HEME vessel.
- Remove the upper head gasket.
- Remove the HEME element.
- Remove the lower head gasket and install a new lower head gasket.
- Install the replacement HEME element.
- Install a new upper head gasket.
- Replace the HEME head.

- After obtaining the proper bolt tightening pattern from engineering, use the impact wrench to tighten the twelve nuts securing the HEME head to the HEME vessel.
- Install a new spray unit gasket.
- Replace the HEME spray unit.
- Using the impact wrench, tighten the three nuts securing the HEME spray unit to the HEME head.
- Replace the jumper providing demineralized water to the HEME spray unit.
- Reopen HEME drain valve V-3318.

H. HEME 63-T-036 Pad Replacement

NOTE: The HEME pad cannot be replaced without temporarily losing availability of the installed redundant off-gas train.

- Assure that off-gases are being directed through HEME 63-T-033 by verifying that valves V-3206 and V-3901 are both open.
- Assure that the HEME is isolated by verifying that off-gas valves V-3207 and V-3902 are both closed.
- Complete the isolation of the HEME by closing drain valve V-3619.
- Assure that the demineralized water isolation valve, DW-2-3623A, is closed, then remove the jumper providing demineralized water to the top of the HEME vessel for the spray lance.
- Using the impact wrench, loosen the nuts securing the HEME head to the HEME vessel.
- Remove the head from the HEME vessel.
- Remove the upper head gasket.
- Remove the HEME element.
- Remove the lower head gasket and install a new lower head gasket.

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- Install the replacement HEME element.
- Install a new upper head gasket.
- Replace the HEME head.
- After obtaining the proper bolt tightening pattern from engineering, use the impact wrench to tighten the twelve nuts securing the HEME head to the HEME vessel.
- Install a new spray unit gasket.
- Replace the HEME spray unit.
- Using the impact wrench, tighten the three nuts securing the HEME spray unit to the HEME head.
- Replace the jumper providing demineralized water to the HEME spray unit.
- Reopen HEME drain valve V-3619.

6.2.4 Filtration

A. Preheater 63-E-034 Element Replacement

NOTE: The heating element cannot be replaced without temporarily losing availability of an installed redundant off-gas train.

- Assure that off-gases are being directed through Preheater 63-E-037 by verifying that valves V-3207 and V-3902 are both open.
- Assure the preheater is isolated by verifying that off-gas valves V-3206 and V3901 are both closed.
- Assure that the power source to the element is tagged out-of-service.
- Remove the jumper providing electrical service to the HEME element.
- Using the impact wrench, loosen the ten nuts securing the element to the Preheater housing.
- Using a crane hook, remove the element from the housing.

- Remove the used preheater flange gasket, and install a new preheater flange gasket.
- Using a crane hook, install the replacement element.
- After obtaining the proper bolt tightening pattern from engineering, use the impact wrench to tighten the ten nuts securing the element to the Preheater housing.
- Reinstall the jumper providing electrical service to the preheater element.
- Return the preheater power supply to service.

B. Preheater 63-E-037 Element Replacement

NOTE: The heating element cannot be replaced without temporarily losing availability of an installed redundant off-gas train.

- Assure that off-gases are being directed through Preheater 63-E-034 by verifying that valves V-3206 and V-3901 are both open.
- Assure the preheater is isolated by verifying that off-gas valves V-3207 and V-3902 are both closed.
- Assure that the power source to the element is tagged out-of-service.
- Remove the jumper providing electrical service to the preheater element.
- Using the impact wrench, loosen the ten nuts securing the element to the preheater housing.
- Using a crane hook, remove the element from the housing.
- Remove the used preheater flange gasket, and install a new preheater flange gasket.
- Using a crane hook, install the replacement element.

- After obtaining the proper bolt tightening pattern from engineering, use the impact wrench to tighten the ten nuts securing the element to the preheater housing.
- Reinstall the jumper providing electrical service to the preheater element
- Return preheater the power supply to service.

C. Preheater 63-E-034 Temperature Element Replacement

NOTE: Replacement of TE-3408 requires that the off-gas be directed through the other parallel off-gas train, and that Preheater 63-E-034 be isolated from the off-gas stream to minimize the risk of a partial loss of vacuum in the off-gas system.

- Assure that the off-gas valve upstream, V-3206, is closed.
- Using an impact wrench, close the off-gas valve downstream, V-3901.
- Using an impact wrench, release both ends of the instrumentation jumper from the cell wall to Preheater 63-E-034 Nozzle C.
- Using a crane, remove the jumper.
- Using a crane, install a replacement jumper.
- Using an impact wrench, tighten both ends of the replacement jumper.

D. Preheater 63-E-037 Temperature Element Replacement

NOTE: Replacement of TE-3709 requires that the off-gas be directed through the other parallel off-gas train, and that Preheater 63-E-037 be isolated from the off-gas stream to minimize the risk of a partial loss of vacuum in the off-gas system.

- Assure that the off-gas valve upstream, V-3207, is closed.
- Using an impact wrench, close the off-gas valve downstream, V-3902.

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- Using an impact wrench, release both ends of the instrumentation jumper from the service wall to Preheater 63-E-037 Nozzle C.
- Using a crane, remove the jumper.
- Using a crane, install a replacement jumper.
- Using an impact wrench, tighten both ends of the replacement jumper.

E. Prefilter Assembly 63-T-035 Replacement

NOTE: The prefilter assembly cannot be replaced without temporarily losing availability of an installed redundant off-gas train.

- Assure that off-gases are being directed through Prefilter 63-T-038 by verifying that valves V-3207 and V-3902 are both open.
- Assure that the prefilter is isolated by verifying that off-gas valves V-3206 and V-3901 are both closed.
- Using the impact wrench, loosen the nuts in the three-bolt flanges at the prefilter inlet and outlet.
- Remove the prefilter assembly.
- Remove the used gaskets from the preheater outlet and the off-gas jumper inlet, and install new gaskets.
- Install the replacement prefilter assembly.
- Using the impact wrench, tighten the nuts in the three-bolt flanges at the prefilter inlet and outlet.

NOTE: The HEPA elements in the prefilter assembly are prefilters to the HEPA filters located downstream in the Out-of-Cell Off-Gas Treatment System. In-place DOP testing of prefilters is specifically identified as "not required" by ANSI/ASME N510-1980 "Standard for Testing of Nuclear Air Cleaning Systems," Table 1, "Test and Recommended Test Frequency."

F. Prefilter Assembly 63-T-038 Replacement

NOTE: The prefilter assembly cannot be replaced without temporarily losing availability of an installed redundant off-gas train.

- Assure that off-gases are being directed through Prefilter 63-T-035 by verifying that valves V-3206 and V-3901 are both open.
- Assure the prefilter is isolated by verifying that off-gas valves V-3207 and V-3902 are both closed.
- Using the impact wrench, loosen the nuts in the three-bolt flanges at the prefilter inlet and outlet.
- Remove the prefilter assembly.
- Remove the used gaskets from the preheater outlet and the off-gas jumper inlet, and install new gaskets.
- Install the replacement prefilter assembly.
- Using the impact wrench, tighten the nuts in the three-bolt flanges at the prefilter inlet and outlet.

NOTE: The HEPA elements in the prefilter assembly are prefilters to the HEPA filters located downstream in the Out-of-Cell Off-Gas Treatment System. In-place DOP testing of prefilters is specifically identified as "not required" by ANSI/ASME N510-1980 "Standard for Testing of Nuclear Air Cleaning Systems," Table 1, "Test and Recommended Test Frequency."

G. Postheater Element Replacement

NOTE: The Postheater is not required for proper system operation, and its element cannot be replaced without loss of vacuum in equipment ventilated by the off-gas and vessel ventilation system. Because there is no need to place the Postheater into service, a failed element there should be left in place and isolated from its energy source.

H. Postheater Temperature Element (TE-3914) Replacement

NOTE: Temperature element TE-3914 is isolated from the off-gas by a thermowell, and can be removed without opening the off-gas system to the ambient.

- Using an impact wrench, release both ends of the instrumentation jumper from the service wall to Postheater Housing Nozzle D.
- Using a crane, remove the jumper.
- Using a crane, install a replacement jumper.
- Using an impact wrench, tighten both ends of the replacement jumper.

6.3 Preventive Maintenance

6.3.1 Vessel Ventilation

After being placed into service, no routine preventive maintenance procedures are required during the remainder of the service lives of the various items of equipment.

6.3.2 Quenching/Scrubbing

A. Scrubber Level

To restore the liquid level in the scrubber when an inventory of liquid is available in the receiver, activate the solids suspension system pump until the scrubber level indicator, LT-3101, shows the scrubber is filled. If the pump is not available, operate the receiver to scrubber jet, J-3105, until the scrubber level indicator, LT-3101, shows the scrubber is filled.

To restore the liquid level in the scrubber when no liquid is available in the receiver, open valve CH-H-930 and accept water from the Cold Chemical System until the scrubber level indicator, LT-3101, shows the scrubber is filled, then close the valve.

B. SBS Sludge Mobility

The accumulated solids on the SBS Scrubber and Receiver bottoms should be moved periodically to prevent the solids from agglomerating into a stiff mass. For one hour during each operating shift, run the solids suspension system pump. As a minimum, the pump should be operated for one hour on a 12-hour cycle.

6.3.3 High Efficiency Mist Elimination

A. HEME 63-T-033 Pad

- Verify that the SBS Receiver can accept additional liquid without forcing an interruption of waste feed operations to the melter.
- Assure that drain valve V-3318 is open.
- Establish a reference differential pressure from PDT-3315
- Open isolation valve DW-GL-662.
- Operate valve HV-3314 to introduce demineralized water to the spray lance in the HEME. Monitor flow at FE-3314 to assure that the total amount of demineralized water introduced does not exceed the amount that the SBS Receiver can accommodate.
- Close valve HV-3314 and observe PDT-3315. After the differential pressure stabilizes, determine if flushing has achieved the necessary reduction in the differential pressure. Repeat the above step as necessary.
- Close isolation valve DW-GL-662.

B. HEME 63-T-036 Pad

- Verify that the SBS Receiver can accept additional liquid without forcing an interruption of waste feed operations to the melter.
- Assure that drain valve V-3619 is open.
- Establish a reference differential pressure from PDT-3621.
- Open isolation valve DW-GL-664.

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- Operate valve HV-3623 to introduce demineralized water to the spray lance in the HEME. Monitor flow at FE-3314 to assure that the total amount of demineralized water introduced does not exceed the amount that the SBS Receiver can accommodate.
- Close valve HV-3623 and observe PDT-3621. After the differential pressure stabilizes, determine if flushing has achieved the necessary reduction in the differential pressure. Repeat the above step as necessary.
- Close isolation valve DW-GL-664.

6.4 In-Service Inspection - Not Applicable

6.5 Surveillance

6.5.1 Vessel Ventilation

A. Vessel Ventilation Header

The vacuum in the vessel ventilation header is continuously monitored from either the connected cold chemical addition line, the CFMT, the FHT, or the condenser shell. The vacuum is used as the basis for automatic operation of the pressure control valve in the non-condensibles jumper.

Pluggage of the vessel ventilation header is unlikely due to its size and lack of a source for solids to cause pluggage. However, if the vacuum at the condenser shell is maintainable, but the vacuum in one or more of the vessels to which the vessel ventilation header is connected is not maintainable, then pluggage of the header is a possibility. To troubleshoot the header, check for vacuum out-of-cell on the line between the vessel ventilation header and the Cold Chemical System. If it is under a vacuum similar to that of the condenser shell, then the vessel ventilation header is not plugged.

B. Condenser

Proper operation of the condenser is monitored by comparing the rate that liquid is evaporated from the CFMT, to the rate that the condensate drains through the weir in the bottom of the condenser shell. If appearances are that there is more liquid condensate than liquid evaporated, then a leak in the condenser tube bundle should be suspected.

To check for a leak, run cooling water through the tube bundle at a time when there is no boiling in the CFMT. Flow over the weir, measured by observing an increase in the liquid level in the bottom of the condenser shell, is a positive indication of a significant leak from the tube bundle.

C. Non-condensibles Jumper

Proper operation of the non-condensibles jumper is monitored by observing how well the pressure (vacuum) in the condenser shell is maintained. The likely failure mode in the jumper is loss of the valve operator. Should this happen, the valve will fail in the open position.

Failure of the control valve is indicated by an excessive and uncontrollable vacuum in the condenser shell, CFMT and FHT; one that approaches or equals the vacuum at the mist eliminator in the In-Cell Off-Gas Treatment System.

D. Condensate Drain

The condition of the condensate drain is monitored by observing the liquid level in the bottom of the condenser shell. An increasing liquid level when the drain valve is open is an indication of pluggage, probably in the loop seal between the condenser and Tank 8D-3.

6.5.2 Quenching/Scrubbing

A. SBS Scrubber

The depth of the liquid in the scrubber is continuously monitored. If the liquid level in the scrubber drops during operation, and there is no increase in the liquid level in the receiver vessel, the likely cause is excess evaporation into the off-gas.

If the liquid level in the scrubber drops during operation when there is little or no feed to the melter, the likely cause is lack of adequate condensation from the entering off-gas to make up for water lost as humidity in the exiting off-gas.

If the liquid level in the scrubber decreases while the liquid level in the receiver increases, the likely cause is a hole in the scrubber vessel.

There is no method to monitor directly the extent to which the SBS bed may have become plugged. Experience at Battelle Pacific Northwest Laboratories, reported by PNL-5780, demonstrated that most solid depositions do not become tenaciously attached, and the bed is continuously sparged by the rising off-gases. Therefore, plugging of the bed is considered unlikely.

B. SBS Receiver

The liquid level in the receiver vessel is continuously monitored. If the receiver vessel is filling too rapidly, possible causes include failure of the cooling coils in the scrubber, and excessive condensation from the off-gas. If the liquid level increases when no coolant is being directed to the cooling coils, the cooling coils are not the source of the accumulating liquid. If the cooling coils are not the source of the excessive accumulation of liquid, then the probable cause is excessive condensation in the scrubber from the off-gases.

C. Mist Eliminator

An initial pressure differential across the pad should be taken at normal flow conditions during facility start-up operations. During melter operations with radioactive wastes, the mist eliminator pressure differential should be monitored. If the operating pressure differential increases to 250 Pa (1 InWG) greater than the initial pressure differential, the pad is becoming plugged.

6.5.3 High Efficiency Mist Elimination

A. HEME Preheater

The outlet temperature of the HEME preheater is continuously monitored. When the HEME preheater is activated, this temperature will be used as the basis for controlling the amount of electrical energy supplied to

the heating element. If the desired temperature cannot be maintained, the probable cause is failure, or partial failure, of the heating element.

The heating elements are energized with three phase electricity. When the elements are functioning normally, each of the three legs should draw the same amount of current. Periodically, the amperage drawn by each leg should be checked. An imbalance is indicative of a partial failure of the heating elements.

B. Off-Gas Jumper to HEME

Whenever a valve in one of the off-gas jumpers to the HEMEs is turned, an operator must observe, through a shield window, the tab on the valve stem to assure that it turns the required 1.57 radians (90°) and that it contacts the tab stop. Failure of the stem to turn the full 1.57 radians (90°) is an indication of valve failure.

C. HEME

The conditions of the HEME pads are monitored by observing the pressure differentials across the pads during normal operation. A considerable reduction in the differential pressure across a HEME pad at a reference flow rate is indicative of a bypassing condition. This could be caused by fiber damage or a failure in the seal between the element mounting flange and its support. A considerable increase in the differential pressure across a HEME pad at a reference flow rate is indicative of element plugging.

The drain lines from the HEMEs are monitored by observing the liquid level in the bottom of the HEME vessels when the drain valves are open. An increase in the liquid level indicates pluggage in the drain line, probably in the bottom of the seal loop between the HEME and the SBS.

6.5.4 Prefiltration

A. Filter Preheater

The outlet temperature of the filter preheater in-service is continuously monitored. The temperature is used as the basis for controlling the amount of electrical energy supplied to the heating element. If the desired temperature cannot be maintained, the probable cause is failure, or partial failure, of the heating element.

The heating elements are energized with three phase electricity. When the elements are functioning normally, each of the three legs should draw the same amount of current. Periodically, the amperage drawn by each leg should be checked. An imbalance is indicative of a partial failure of the heating elements.

B. Prefilter

The pressure differential across the prefilter assembly in use is continuously monitored. When the prefilter elements are clean, the total pressure differential across the elements alone should be about 500 Pa (2 InWG).

NOTE: A larger actual differential pressure will be measured due to resistance to flow through the housing and ducting between the pressure taps. When the filters are clean, this "reference" differential pressure attributable to the housing and ducts should be established, then subtracted from future readings to estimate the actual differential pressure across the filter elements only.

As particulate material accumulates on the prefilter elements the pressure differential should slowly but steadily increase. After the total pressure differential across the elements alone reaches 2.25 kPa (9 InWG), the prefilter assembly should be replaced.

A decrease in the pressure across the prefilter assembly that is not accompanied by a decrease in off-gas flow is indicative of a failure of an element or of a seal. Should this occur, replacement of the prefilter assembly should be considered.

A sudden increase or decrease of pressure differential regardless of the flow rate, indicates a blown filter. Should this occur, feed to the melter should be stopped immediately, process flow should be switched to the parallel off-gas train as soon as possible, and the prefilter assembly should be replaced.

C. Off-Gas Jumpers from Prefilter

Whenever a valve in one of the off-gas jumpers to the postheater is turned, an operator must observe, through a shield window, the tab on the valve stem to assure that it turns the required 1.57 radians (90°) and that it contacts the tab stop. Failure of the stem to turn the full 1.57 radians (90°) is an indication of valve failure.

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6.6 Maintenance Descriptions

6.6.1 Vessel Ventilation

A. Vessel Ventilation Header

If there is reason to believe that the header is becoming plugged, then it can be flushed by introducing water, or an appropriate chemical solution, from the Cold Chemical System. While evaluating what to use as the flush solution, and how much of it to use, consider that all fluids introduced will eventually drain into the condenser shell and will be drained to Tank 8D-3 as radioactive waste.

B. Condenser

If a leak is detected, an engineering evaluation should be made to determine whether the leak can be ignored, or if the tube bundle should be replaced. Cooling water that leaks from the tube bundle must subsequently be processed as radioactive waste, but removal of the tube bundle will open the system to the cell atmosphere and prevent a vacuum from being maintained on the melter from either the In-Cell Off-Gas Treatment System or Vessel Ventilation System.

If the decision is made to eliminate the leak, it can be done by replacing the tube bundle (The failed bundle can be repaired when time is available for possible subsequent reuse.).

To remove the tube bundle from the condenser shell, first remove the two jumpers that provide cooling water supply and return, remove the condenser head, then remove the tube bundle. Water should be removed from the tube bundle by tipping the bundle and allowing the water to drain and flow into a sump. (As an alternative,

pressurized air could be applied to one end of the tubes to blow the water out of the other end. The water will have come from the Closed Loop Cooling Water System, so it will be clean.)

C. Non-condensibles Jumper

The control valve in the non-condensibles jumper can only be replaced after feed to the melter has been suspended, because when the jumper is removed, neither the Vessel Ventilation System nor the In-Cell Off-Gas Treatment System will be capable of maintaining a vacuum on the melter. The valve is removed by first removing the jumper that provides instrument air to the valve operator, followed by removal of the non-condensibles jumper (The valve is an integral part of the non-condensibles jumper.). The valve is replaced by replacing the non-condensibles jumper, and reinstallation of the instrument air jumper.

D. Condensate Drain

To flush the drain line, the drain valve should be closed and demineralized water should be introduced momentarily between the valve and the seal loop. After flushing, the demineralized water should be shut off and the drain valve reopened.

6.6.2 Quenching/Scrubbing

A. SBS

In the event of excess evaporation into the off-gas, the bed temperature should be decreased by increasing the cooling water flow rate to the heat exchanger in the scrubber.

If there is a lack of adequate condensation from the entering off-gases to replace of water lost as humidity in the exiting off-gas, water should be added to the scrubber, as required, from the Cold Chemical System.

If a hole is suspected in the scrubber vessel, feed to the melter should be suspended while an engineering evaluation is conducted to determine whether the system can be operated in a modified condition, or if repairs should be attempted. One method by which operation could be continued temporarily would be to add make-up water to the scrubber or receiver from the Cold Chemical System until the liquid level in the receiver is the same as the

top of the scrubber, then operate while keeping the receiver filled to this level.

If the cooling coils in the scrubber is found to be the cause of the an increasing liquid level in the receiver, melter feed operations must be suspended until the cooling coils can be repaired or replaced.

If excessive condensation from the off-gases is causing the receiver to fill too rapidly, the bed temperature should be increased so that more water vapor will escape with the off-gas.

B. Mist Eliminator

Should the pad start plugging, it should be flushed with demineralized water (The system can continue to operate.) until the pressure differential returns to its original level. A liquid rate of 1.1 to 2.6 L/min (0.3 - 0.7 gpm) to the spray nozzle, which corresponds to 8 to 20 L/min-m² (0.2 - 0.5 gpm/ft²) at the face of the pad, is recommended.

6.6.3 High Efficiency Mist Elimination

A. HEME Preheater

Failure of the HEME preheater element is not a serious event, and normal operation can continue with the HEME operating wet as a high efficiency mist eliminator, rather than as a dry filter. If dry operation is preferred, then the element can be replaced after feed to the melter has been suspended for other reasons. Replacement requires suspension of feed to the melter, removal of the jumper that delivers power to the element, replacement of the element, then reinstallation of the jumper.

B. Off-Gas Jumper to HEME

Failure of a valve in an off-gas jumper to a HEME does not necessarily require immediate suspension of feed to the melter because the valve in the off-gas jumper to the postheater can be used to remove the affected off-gas train from service, and the system can continue to operate using the redundant off-gas train. Feed to the melter will have to be suspended, however, to either replace the jumper holding the failed valve, or to perform any other maintenance activity requiring that the system be opened to the cell atmosphere.

The valve cannot be replaced without replacing the entire off-gas jumper. This will result in loss of vacuum on the melter by both the In-Cell Off-Gas Treatment and Vessel Ventilation Systems, so feed to the melter must be suspended. Replacement of the valve is accomplished by removal of the affected jumper and replacement with a duplicate jumper.

C. HEME

HEME pad fiber damage, or a failure in the seal between the element mounting flange and its support, requires correction by installation of a new element or restoration of the seal, and the HEME will need to be valved out-of-service to do it.

Should plugging of the HEME pad cause the pressure drop to become excessive, the HEME should be valved out-of-service and the pad should be flushed with demineralized water through the spray lance.

If the pressure differential across the HEME pad cannot be adequately reduced by demineralized water spray, the pad can be soaked in an appropriate chemical solution by first closing the drain valve, opening the isolation valve in the off-gas jumper to the postheater to prevent overpressurization, then adding the chemical solution from the Cold Chemical System. After a suitable soak, the drain valve to the SBS should be opened. The HEME must then be returned to service to measure the pressure differential and determine whether adequate cleaning was accomplished.

If the pad cannot be adequately cleaned, it can be replaced remotely. After closing both off-gas jumper isolation valves, the spray jumper then the vessel head and spray lance can be removed. The HEME pad and gasket can then be replaced followed by replacement of the vessel head/spray lance, then the spray jumper.

To flush a plugged HEME drain line, the drain valve should be closed and demineralized water should be introduced momentarily to the drain line between the valve and the seal loop. After flushing, the demineralized water should be turned off and the valve should be reopened.

6.6.4 Prefiltration

A. Filter Preheater

Should the filter preheater element fail, the off-gas jumper valve line-up should be reversed to place the redundant in-cell off-gas train into service. While valved out-of-service, the heater element should be replaced. This is done by removing the jumper that delivers power to the element, replacement of the element, then re-installation of the jumper.

B. Prefilter

Replacement of a prefilter assembly requires nothing more than removal and replacement of the affected assembly, because no process equipment is located above the prefilter assemblies and the jumpers used for monitoring the pressure differentials are located on adjacent equipment. Care should be exercised while handling the replacement assembly to avoid any jarring of the assembly that might result in loss of the seals between the prefilter elements and the prefilter housing.

Should the prefilters fail releasing contamination downstream, an evaluation of current status of the off-gas system downstream should be performed, and subsequent operations in the 01-14 Building should be modified as appropriate.

C. Off-Gas Jumpers from Prefilter

Failure of a valve in an off-gas jumper to the postheater does not necessarily require immediate suspension of feed to the melter because the valve in the off-gas jumper to the HEME can be used to remove the affected off-gas train from service and the system can continue to operate using the redundant off-gas train. Feed to the melter will have to be suspended, however, to either replace the jumper holding the failed valve, or to perform any other maintenance activity requiring that the system be opened to the cell atmosphere.

Replacement of the valve requires replacement of the entire off-gas jumper. Melter feed operation must be suspended to do this because removal of the jumper will result in loss of vacuum on melter regardless of whether the "emergency" vent line to the melter is open. Replacement of the valve requires removal of the prefilter assembly, removal of the instrumentation jumper

to the off-gas jumper, replacement of the affected
off-gas jumper, reinstallation of the instrumentation
jumper and reinstallation of the prefilter assembly.

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Drawing List

No.	Drawing No.	Description
1	900D-5737	Jumper, SBS Solids Centering Motor
2	900D-5738	Jumper, Elec. to SBS Solids Centering Motor
3	900D-8563	Jumper, PV-1502 Actuator
4	900E-705 Sh 1 A	P&ID, Abbreviations and Legend Sheet
5	900E-705 Sh 1 C	P&ID, Jet Control Details
6	900E-705 Sh 14	P&ID, SBS Scrubber Section
7	900E-705 Sh 15	P&ID, SBS Receiver Section
8	900E-705 Sh 19	P&ID, Vessel Ventilation System
9	900E-705 Sh 21	P&ID, Preheaters and HEMEs
10	900E-705 Sh 22	P&ID, Prefilters
11	905C-308 Sh 120-154	Functional Logic Diagrams
12	H-11-7332	Spool Piece, Vessel Vent Header
13	H-11-7335	Jumper, SBS Jet to CFMT (See System 63I)
14	H-11-7336	Jumper, SBS Scrubber Jet to SBS Receiver
15	H-11-7384	Jumper, SBS Scrubber CW Return
16	H-11-7385	Jumper, Condenser Drain to Hdr
17	H-11-7386	Jumper, Demin Water to Condenser Drain Seal
18	H-11-7389	Jumper, SBS Jet to Waste Header
19	H-11-7391	Jumper, Vent Header Drain to Condenser
20	H-11-7395	Jumper, Steam for SBS to Waste Header Jet
21	H-11-7417	Jumper, SBS Receiver Temp Instrumentation Hookup
22	H-11-7418	Jumper, SBS Scrubber Chemical Addition
23	H-11-7419	Jumper, SBS Receiver Press, Level & SpGr Taps
24	H-11-7421	Jumper, SBS Scrubber Cooling Water Supply
25	H-11-7422	Jumper, SBS Freeboard & Scrubber Temperature
26	H-11-7424	Jumper, SBS Receiver Chemical Addition
27	H-11-7425	Jumper, SBS Receiver Sampler
28	H-11-7426	Jumper, SBS Scrubber Press, Level & SpGr Taps
29	H-11-7427	Jumper, SBS Receiver Cooling Water Supply
30	H-11-7428	Jumper, SBS Receiver Cooling Water Return
31	H-11-7429	Jumper, Steam for SBS Receiver to Scrubber Jet
32	H-11-7430	Jumper, Steam for SBS to CFMT Jet (See System 63I)
33	H-11-7431	Jumper, HEME Drains to SBS, Seats
34	H-11-7432	Jumper, HEME 63-T-33 Drain Flush
35	H-11-7433	Jumper, HEME 63-T-36 Drain Flush
36	H-11-7434	Jumper, Mist Eliminator Pressure Taps & Flush
37	H-11-7435	Jumper, Power to HEME Preheater
38	H-11-7436	Jumper, HEME Preheater Temperature Hookup
39	H-11-7437	Jumper, Non-Condensibles Temperature Hookup
40	H-11-7438	Jumper, HEME 63-T-036 Liquid Drain
41	H-11-7439	Jumper, HEME 63-T-033 Liquid Drain
42	H-11-7441	Jumper, Condenser Drain, Valved
43	H-11-7442	Jumper, Non-Condensibles to Mist Eliminator
44	H-11-7443	Jumper, Condenser Pressure & Level Taps
45	H-11-7444	Jumper, Condenser Chemical Addition

46 H-11-7445	Jumper, Condenser Cooling Water Return
47 H-11-7446	Jumper, Condenser Cooling Water Supply
48 H-11-7447	Jumper, HEME 63-T-033 Pressure and Level Taps
49 H-11-7448	Jumper, Flush to HEME 63-T-033
50 H-11-7449	Jumper, HEME 63-T-033 Chemical Addition
51 H-11-7450	Jumper, Flush to HEME 63-T-036
52 H-11-7451	Jumper, HEME 63-T-036 Chemical Addition
53 H-11-7452	Jumper, HEME 63-T-036 Pressure and Level Taps
54 H-11-7453	Jumper, Power to Preheater E-034
55 H-11-7454	Jumper, Preheater 63-E-034 Pressure Tap
56 H-11-7455	Jumper, Preheater 63-E-034 Temperature
57 H-11-7456	Jumper, Preheater 63-E-037 Temperature
58 H-11-7457	Jumper, Preheater 63-E-037 Pressure Tap
59 H-11-7458	Jumper, Power to Preheater 63-E-037
60 H-11-7460	Jumper, Prefilter 63-T-038 Exit Pressure Tap
61 H-11-7462	Jumper, Postheater Temperature Hookup
62 H-11-7464	Jumper, Prefilter 63-T-035 Exit Pressure Tap
63 H-11-7465	Jumper, Postheater Flow Electrical Hookup
64 H-11-7654	Jumper, Power to Postheater
65 H-11-7655	Jumper, Utility Air to °C° Sampler
66 JFD 89169	Condenser Tube Bundle
67 Koch 32053-A-00-01	HEME Elements
68 PNL 288-01 to -02	SBS Receiver °C° Sampler Nozzle Flange
69 Rockford 41000441	6" Ball Valve, Fully Ported
70 SMC1 05401	Remote Pins, Studs, Nuts & Nut Clamps
71 SMC1 21001	Off-Gas Remote Flanges
72 SMC1 21002	Off-Gas Remote Flanges
73 SMC1 21003	Adapter for 6" Ball Valve
74 SMC1 21003	Adapter for 6" Ball Valve
75 SMC1 21201	Captive Bolt
76 SMC1 21301	SMCI Cover Sheet, Drawing List & General Notes
77 SMC1 21302	General Arrangement
78 SMC1 21303	Facility General Arrangement
79 SMC1 26901	Vessel Ventilation Header, 63-V-015
80 SMC1 26902	Vessel Vent Header Pipe Supports
81 SMC1 26903	Vessel Vent Header Pipe Supports
82 SMC1 26904	Vessel Vent Header Expansion Joint Assy. Detail
83 SMC1 26905	Vessel Vent Header Parts List
84 SMC1 27101	Mist Eliminator 63-C-032
85 SMC1 27102	Mist Eliminator 63-C-032 Miscellaneous Details
86 SMC1 27201	Off-Gas Jumpers, E-032 to T-033, E-032 to T-036
87 SMC1 27301	High Efficiency Mist Elim. 63-T-033 & 63-T-036
88 SMC1 27302	High Efficiency Mist Elim. 63-T-033 & 63-T-036
89 SMC1 27303	High Efficiency Mist Elim. 63-T-033 & 63-T-036
90 SMC1 27304	High Efficiency Mist Elim. 63-T-033 & 63-T-036
91 SMC1 27305	High Efficiency Mist Elim. 63-T-033 & 63-T-036
92 SMC1 27401	HEME Preheater Assy. 63-E-032 Gen'l Arrangement
93 SMC1 27402	HEME Preheater Assy. 63-E-032 Details
94 SMC1 27403	HEME Preheater Assy. 63-E-032 Assembly
95 SMC1 27501	Filter Preheater E-034 & E-037 Gen'l Arrangement
96 SMC1 27502	Filter Preheater E-034 & E-037 Assembly

97 SMC1 27503	Filter Preheater E-034 & E-037 Details
98 SMC1 27504	Filter Preheaters, Details
99 SMC1 27601	Off-Gas Prefilter T-035 & T-038
100 SMC1 27602	Off-Gas Prefilter Details T-035 & T-038
101 SMC1 27603	Off-Gas Prefilter Details T-035 & T-038
102 SMC1 27701	Postheater Assy. 63-E-039
103 SMC1 27702	Postheater Details 63-E-039
104 SMC1 27801	Off-Gas Heater Assy.
105 SMC1 27802	Off-Gas Heater Details
106 SMC1 28001	Off-Gas Jumper Assy T-035-B to E-039-A1
107 SMC1 28101	Off-Gas Jumper Assy T-038-B to E-039-A2
108 SMC1 29001	Condenser 63-E-015 General Arrangement
109 SMC1 29002	Condenser 63-E-015 Details
110 SMC1 29003	Condenser 63-E-015 Details
111 SMC1 29004	Condenser 63-E-015 Assembly & Details
112 SMC1 29005	Condenser 63-E-015 Details & Sections
113 SMC1 29201	Off-Gas Discharge Header
114 SMC1 29202	Off-Gas Discharge Header
115 SMC1 29301	Condensate Header to 8D-3
116 SMC1 29302	Condensate Header Pipe Support Details
117 SMC1 29303	Condensate Header Pipe Support Details
118 SMC1 29501	Stub Wall Assembly, Installation
119 SMC1 29502	Stub Wall Assembly
120 SMC1 29503	Stub Wall Assy. Piping Arrangement and Plans
121 SMC1 29504	Stub Wall Assy. Misc. Piping Plans and Details
122 SMC1 29505	Stub Wall Assy. Structural Frame Misc. Details
123 SMC1 29506	Stub Wall Assy. Misc. Sections and Details
124 SMC1 29507	Stub Wall Assy. South Panel Misc. Details
125 SMC1 29508	Stub Wall Assy. Piping Plans
126 SMC1 29509	Stub Wall Assy. Plate Details
127 SMC1 29510	Stub Wall Assy. Plate Details
128 SMC1 29511	Stub Wall Assy. Structural Details
129 SMC1 29512	Stub Wall Assy. Structural Details
130 SMC1 29513	Stub Wall Piping Spool Pieces
131 SMC1 29514	Stub Wall Piping Spool Pieces
132 SMC1 29515	Stub Wall Piping Spool Pieces
133 SMC1 29516	Stub Wall Piping Spool Pieces
134 SMC1 29517	Stub Wall Piping Support Details
135 SMC1 29518	Stub Wall Piping Support Details
136 SMC1 29601	Service Wall Installation
137 SMC1 29602	Service Wall Assembly
138 SMC1 29603	Service Wall Assy. Structural Details I
139 SMC1 29604	Service Wall Assy. Structural Details II
140 SMC1 29605	Service Wall Assy. Piping Arrangement
141 SMC1 29606	Service Wall Assy. Piping Plans
142 SMC1 29607	Service Wall Assy. Piping Plans
143 SMC1 29608	Service Wall Assy. Piping Plans
144 SMC1 29609	Service Wall Piping Spool Pieces
145 SMC1 29610	Service Wall Piping Spool Pieces
146 SMC1 29701	Equipment Supports, Framing Plans & Gen'l Notes
147 SMC1 29702	Equipment Supports, Elevations

148 SMC1 29703	Equipment Supports, Elev., Sections & Details
149 SMC1 29704	Equipment Supports, Misc. Sections & Details
150 SMC1 29705	Equipment Supports, Shop Details
151 SMC1 29706	Equipment Supports, Shop Details
152 SMC1 29707	Equipment Supports, Shop Details
153 SMC1 29801	Shipping Cradles for HEME's, Gen'l Arrangement
154 SMC1 29802	Shipping Cradles for HEME's, Details
155 SMC1 29901	Condenser Shipping Cradle, General Arrangement
156 SMC1 29902	Condenser Shipping Cradle, Details
157 SMC1 30001	Handling Yokes
158 SMC1 30002	Handling Yokes
159 SMC1 77703	Postheater Details 63-E-039
160 WEC 1990E31	SBS Vessel Layout
161 WEC 1990E32	SBS Vessel Assembly
162 WEC 1990E33	SBS Receiver Vessel Sub-Assembly
163 WEC 1990E34	SBS Scrubber Vessel & Sparger Assembly
164 WEC 1990E35	SBS Removable Scrubber Basket Assembly
165 WEC 1990E36	SBS Pins, Studs, Nut, Cap, Ball & Gasket
166 WEC 1990E37	SBS Wire Cloth & Nut Cup Weldments
167 WEC 1990E38	SBS Stud, Pin & Base Plate Details
168 WEC 1990E39	SBS Gas Inlet Gasket Assembly
169 WEC 1990E40	SBS Receiver Blind Flange Weldments
170 WEC 1990E41	SBS Scrubber Coil Assembly
171 WEC 1990E42	SBS Receiver & Scrubber Sparger Weldment
172 WEC 1990E43	SBS Receiver Top Head Weldment
173 WEC 1990E44	SBS SBS Receiver & Scrubber Withdrawal Weldments
174 WEC 1990E45	SBS Pins, Kick Plates & Flange
175 WEC 1990E46	SBS Vessel Nameplate

Equipment List

No.	ID	Number	Description	P&ID	Sht
1	E	63-A-3120	Jumper, SBS Rec. Sampler	900-E-705	14
2	E	63-A-3120	Jumper, SBS °C° Sampler Connect	900-E-705	14
3	E	63-A-None	Sampler, SBS Receiver	900-E-705	14
4	E	63-CH-1507	Jumper, Condenser Chem Addition	900-E-705	19
5	E	63-CH-3106	Jumper, SBS Scrubber Chem Add	900-E-705	14
6	E	63-CH-3115	Jumper, SBS Receiver Chem Add	900-E-705	15
7	E	63-CH-3210	Jumper, Mist Elim. Pad Flush	900-E-705	21
8	E	63-CH-3313	Jumper, HEME 63-T-033 Chem Add	900-E-705	21
9	E	63-CH-3624	Jumper, HEME 63-T-036 Chem Add	900-E-705	21
10	E	63-CWR-1509	Jumper, Condenser CW Return	900-E-705	19
11	E	63-CWR-3117	Jumper, SBS Receiver CW Return	900-E-705	15
12	E	63-CWR-3122	Jumper, SBS Scrubber CW Return	900-E-705	14
13	E	63-CWS-1508	Jumper, Condenser CW Supply	900-E-705	19
14	E	63-CWS-3118	Jumper, SBS Receiver CW Supply	900-E-705	15
15	E	63-CWS-3121	Jumper, SBS Scrubber CW Supply	900-E-705	14
16	E	63-C-032	Mist Eliminator	900-E-705	21
17	E	63-DW-1513	Jumper, DW to Condens. Drain Seal	900-E-705	19
18	E	63-DW-3314	Jumper, Flush to HEME 63-T-033	900-E-705	21
19	E	63-DW-3325	Jumper, HEME 63-T-33 Drain Flush	900-E-705	21
20	E	63-DW-3623	Jumper, Flush to HEME 63-T-036	900-E-705	21
21	E	63-DW-3626	Jumper, HEME 63-T-36 Drain Flush	900-E-705	21
22	E	63-EITE3102/	Jumper, SBS Freeboard & Scrub T	900-E-705	14
23	E	63-EITE3118A/	Jumper, SBS Rec Temp Ele Hookup	900-E-705	15
24	E	63-EITE-1502	Jumper, Non-Condensibles T Hookup	900-E-705	19
25	E	63-EITE-3408	Jumper, Preheater 63-E-034 Temp	900-E-705	22
26	E	63-EITE-3709	Jumper, Preheater 63-E-037 Temp	900-E-705	22
27	E	63-EITE-3914	Jumper, Postheater Temp Hookup	900-E-705	22
28	E	63-EIT-3212	Jumper, HEME Preheater T Hookup	900-E-705	21
29	E	63-ESH-3201/2	Jumper, Power to HEME Preheater	900-E-705	21
30	E	63-ESH-3403	Jumper, Power to Preheater E-034	900-E-705	22
31	E	63-ESH-3705	Jumper, Power to Preheater E-037	900-E-705	22
32	E	63-ESH-3912	Jumper, Power to Postheater	900-E-705	22
33	E	63-E-015	Vessel Ventilation Condenser	900-E-705	19
34	E	63-E-032	HEME Preheater	900-E-705	21
35	E	63-E-034	Filter Preheater #1	900-E-705	22
36	E	63-E-037	Filter Preheater #2	900-E-705	22
37	E	63-E-039	Postheater	900-E-705	22
38	E	63-IA-1502	Jumper, PV-1502 Actuator	900-E-705	19
39	E	63-IA-1504	Jumper, Condenser Inlet P Tap	900-E-705	19
40	E	63-IA-1505	Jumper, Condenser Outlet P Tap	900-E-705	19
41	E	63-IA-1506	Jumper, Condenser Liq Level Tap	900-E-705	19
42	E	63-IA-3102	Jumper, SBS Scrub Ref. P Tap	900-E-705	14
43	E	63-IA-3103	Jumper, SBS Scrub SpGr Tap	900-E-705	14
44	E	63-IA-3104	Jumper, SBS Scrub Level Tap	900-E-705	14
45	E	63-IA-3111	Jumper, SBS Receiver Level Tap	900-E-705	15
46	E	63-IA-3112	Jumper, SBS Receiver SpGr Tap	900-E-705	15
47	E	63-IA-3113	Jumper, SBS Receiver Ref P Tap	900-E-705	15

48 E	63-IA-3211	Jumper, Mist Elim Exit P Tap	900-E-705	21
49 E	63-IA-3212	Jumper, Mist Elim Entrance F Tap	900-E-705	21
50 E	63-IA-3315	Jumper, HEME 63-T-33 Inlet P Tap	900-E-705	21
51 E	63-IA-3316	Jumper, HEME 63-T-033 Exit P Tap	900-E-705	21
52 E	63-IA-3317	Jumper, HEME 63-T-033 Liq L Tap	900-E-705	21
53 E	63-IA-3406	Jumper, Preheater 63-E-034 P Tap	900-E-705	22
54 E	63-IA-3506	Jumper, Prefilt T-035 Exit P Tap	900-E-705	22
55 E	63-IA-3620	Jumper, HEME 63-T-036 Exit P Tap	900-E-705	21
56 E	63-IA-3621	Jumper, HEME 63-T-36 Inlet P Tap	900-E-705	21
57 E	63-IA-3622	Jumper, HEME 63-T-036 Liq L Tap	900-E-705	21
58 E	63-IA-3702	Jumper, Preheater 63-E-037 P Tap	900-E-705	22
59 E	63-IA-3610	Jumper, Prefilt T-038 Exit P Tap	900-E-705	22
60 E	63-J-3105	Jet, SBS Receiver to Scrubber	900-E-705	15
61 E	63-J-3124	Jet, SBS to Waste Header	900-E-705	15
62 E	63-None	Jumper, Elec. to SBS Motor	900-E-705	15
63 E	63-None	Jumper, SBS Pump & Motor	900-E-705	15
64 E	63-P-1503	Jumper, Condenser Drain to Hdr	900-E-705	19
65 E	63-P-1503'	Jumper, Condenser Drain w/ Valve	900-E-705	19
66 E	63-P-3105	Jumper, SBS Scrub to SBS Rec	900-E-705	14
67 E	63-P-3124	Jumper, SBS to Waste Header	900-E-705	15
68 E	63-P-3318	Jumper, HEME Seal Drains to SBS	900-E-705	21
69 E	63-P-3318	Jumper, HEME 63-T-033 Liq. Drain	900-E-705	21
70 E	63-P-3619	Jumper, HEME 63-T-036 Liq. Drain	900-E-705	21
71 E	63-S-3105	Jumper, Steam to SBS Scrub Jet	900-E-705	14
72 E	63-S-3124	Jumper, Steam to SBS-Wst Hdr Jet	900-E-705	15
73 E	63-T-033	HEME #1	900-E-705	21
74 E	63-T-035	Prefilter Assembly #1	900-E-705	22
75 E	63-T-036	HEME #2	900-E-705	21
76 E	63-T-036	Prefilter Assembly #2	900-E-705	22
77 E	63-V-015	(Same as 63-V-1501)	na	na
78 E	63-V-031	Submerged Bed Scrubber	900-E-705	14
79 E	63-V-1501	Vessel Vent Header	900-E-705	19
80 E	63-V-1501'	Vessel Vent Header Spool Piece	900-E-705	19
81 E	63-V-1502	Duct, Non-Condensibles to Mist E	900-E-705	19
82 E	63-V-1514	Vent Header Drain to Condenser	900-E-705	19
83 E	63-V-3206	Duct, Off-Gas to HEME 63-T-033	900-E-705	21
84 E	63-V-3207	Duct, Off-Gas to HEME 63-T-036	900-E-705	21
85 E	63-V-3502	Duct, OG from Prefilter 63-T-035	900-E-705	22
86 E	63-V-3804	Duct, OG from Prefilter 63-T-038	900-E-705	22
87 E	63-V-3916	Duct, Penetration 5001	900-E-705	22
88 I	DT-3101	Density, SBS Scrubber	900-E-705	14
89 I	DT-3112	Density, Scrub in SBS Receiver	900-E-705	15
90 I	FE-1508	Flow, Condenser CW Supply	900-E-705	19
91 I	FE-3118	Flow, SBS Receiver CW Supply	900-E-705	15
92 I	FE-3121	Flow, SBS Scrubber CW Supply	900-E-705	14
93 I	FE-3314	Flow Element, HEME Flush	900-E-705	21
94 I	FIC-1504	Condenser Bottom P Tap Air Flow	900-E-705	19
95 I	FIC-1505	Condenser Inlet P Tap Air Flow	900-E-705	19
96 I	FIC-1506	Condenser Level Tap Air Flow	900-E-705	19
97 I	FIC-3102	Flow, SBS Scrub Ref. P Tap Purge	900-E-705	14
98 I	FIC-3103	Flow, SBS Scrub SpGr Tap Purge	900-E-705	14

99	FIC-3104	Flow, SBS Scrub Level Tap Purge	900-E-705	14
100	FIC-3111	Flow, SBS Receiver L Tap Purge	900-E-705	15
101	FIC-3112	Flow, SBS Rec. SpGr Tap Purge	900-E-705	15
102	FIC-3113	Flow, SBS Rec. Ref. P Tap Purge	900-E-705	15
103	FIC-3211	Flow, Mist E Downstream P Tap	900-E-705	21
104	FIC-3212	Flow, Mist E Upstream P Tap	900-E-705	21
105	FIC-3315	Flow, HEME 63-T-033 P Tap	900-E-705	21
106	FIC-3316	Flow, HEME 63-T-033 DP Tap	900-E-705	21
107	FIC-3317	Flow, HEME 63-T-033 L Tap	900-E-705	21
108	FIC-3408	Flow, Preheater 63-E-034 P Tap	900-E-705	22
109	FIC-3506	Flow, Prefilter 63-T-035 P Tap	900-E-705	22
110	FIC-3620	Flow, HEME 63-T-036 DP Tap	900-E-705	21
111	FIC-3621	Flow, HEME 63-T-036 P Tap	900-E-705	21
112	FIC-3622	Flow, HEME 63-T-036 L Tap	900-E-705	21
113	FIC-3702	Flow, Preheater 63-E-037 P Tap	900-E-705	22
114	FIC-3810	Flow, Prefilter 63-T-038 P Tap	900-E-705	22
115	FT-1508	Transmit CW Flow to Condenser	900-E-705	19
116	FT-3118	Flow, SBS Receiver CW Supply	900-E-705	15
117	FT-3121	Transmit, SBS Scrubber CW Flow	900-E-705	14
118	FT-3314	Flow Transmitter, HEME Flush	900-E-705	21
119	FT-3918	Transmitter, Off-Gas Flow	900-E-705	22
120	HV-3105D	Iso., SBS Rec to Scrub Jet Steam	900-E-705	1C
121	HV-3105E	Iso., SBS Rec. to Scrub Jet Purge	900-E-705	1C
122	HV-3105F	Iso., SBS Rec to Scrub Jet Steam	900-E-705	1C
123	HV-3105G	Iso., SBS Rec to Scrub Jet Vent	900-E-705	1C
124	HV-3124	Iso., SBS to Waste Header Jet	900-E-705	1B
125	HV-3314	Iso., HEME 63-T-033 Flush	900-E-705	21
126	HV-3623	Iso., HEME 63-T-036 Flush	900-E-705	21
127	LT-1506	Transmit, Condenser Liq Level	900-E-705	19
128	LT-3101	Level, SBS Scrubber Vessel	900-E-705	14
129	LT-3111	Level, Scrub in SBS Receiver	900-E-705	15
130	LT-3317	Level, HEME 63-T-033	900-E-705	21
131	LT-3622	Level, HEME 63-T-036	900-E-705	21
132	PDT-1505	Transmit, Condenser Bundle DP	900-E-705	21
133	PDT-3101	Differential Press SBS Scrubber	900-E-705	14
134	PDT-3211	Differential Pressure, Mist Elim	900-E-705	21
135	PDT-3315	Diff. Press., HEME 63-T-033	900-E-705	21
136	PDT-3506	Press Diff., Prefilter 63-T-035	900-E-705	22
137	PDT-3621	Diff. Press., HEME 63-T-036	900-E-705	21
138	PDT-3810	Press Diff., Prefilter 63-T-038	900-E-705	22
139	PSV-1508	P Relief Valve, Condenser CWS	900-E-705	19
140	PT-1505	Transmit, Condenser Bottom P	900-E-705	19
141	PT-1508	Transmit CW Press to Condenser	900-E-705	19
142	PT-3105	P, Strn/JA, SBS Rec. to Scrub Jet	900-E-705	12
143	PT-3315	Pressure, HEME 63-T-033	900-E-705	21
144	PT-3408	Pressure, Filter Preheater E-034	900-E-705	22
145	PT-3621	Pressure, HEME 63-T-036	900-E-705	21
146	PT-3702	Pressure, Preheater 63-E-037	900-E-705	22
147	TE-1502	Temperature, Non-Condensibles	900-E-705	19
148	TE-1508	Temperature, Condenser CW Supply	900-E-705	19
149	TE-3102A	Temperature, SBS Freeboard Space	900-E-705	14

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150 I	TE-3102B	Temperature, SBS Freeboard Space	900-E-705	14
151 I	TE-3103A	Temperature, SBS Scrubber	900-E-705	14
152 I	TE-3103B	Temperature, SBS Scrubber	900-E-705	14
153 I	TE-3118A	Temperature, SBS Receiver	900-E-705	15
154 I	TE-3118B	Temperature, SBS Receiver	900-E-705	15
155 I	TE-3212	Temperature, HEME Preheater	900-E-705	21
156 I	TE-3406	Temp, Preheater 63-E-034	900-E-705	22
157 I	TE-3709	Temp, Preheater 63-E-037	900-E-705	22
158 I	TE-3914	Temp Element, Postheater Exit	900-E-705	22
159 I	TE-3915	Temp, Postheater, Push Through	900-E-705	22
160 I	TI-1508	Temp, Condenser CW Supply	900-E-705	19
161 I	TI-1509	Temp, Condenser CW Return	900-E-705	19
162 I	TI-3104	Temp, SBS Scrubber CW Return	900-E-705	14
163 I	TI-3117	Temp., SBS Receiver CW Return	900-E-705	15
164 I	TT-1502	Transmit, Non-Condensibles Temp	900-E-705	19
165 I	TT-3102	Temperature, SBS Freeboard Space	900-E-705	14
166 I	TT-3103	Temperature, SBS Scrubber	900-E-705	14
167 I	TT-3118	Temperature, SBS Receiver	900-E-705	15
168 I	TT-3212	Temperature, HEME Preheater	900-E-705	21
169 I	TT-3406	Temp., Filter Preheater 63-E-034	900-E-705	22
170 I	TT-3709	Temp., Filter Preheater 63-E-037	900-E-705	22
171 I	TT-3915	Temp., Postheater Push-through	900-E-705	22
172 I	TV-1508	Temp Control, Condenser CW Supp	900-E-705	19
173 I	TV-3118	Temp Control, SBS Rec CW Supply	900-E-705	15
174 I	TV-3121	Temp Control, SBS Scrub CW Supp	900-E-705	14
175 I	ZS-3124	Position, SBS to Waste HV-3124	900-E-705	18
176 L	63-2-246	Spare	900-E-705	14
177 L	63-P-1503A	Stub Wall Pene 2112 to Pene 6110	900-E-705	19
178 L	63-P-3318A	Stub Wall Pene 6118 to Pene 2101	900-E-705	21
179 L	63-P-3619A	Stub Wall Pene 6120 to Pene 2100	900-E-705	21
180 L	66-1-1/2-3118	Line, SBS Receiver CW Supply	900-E-705	15
181 L	66-1/2-1508B	Line, Condenser CWS Pressure Tap	900-E-705	19
182 L	66-2-091	Pene 2616, SBS Rec. CW Return	900-E-705	15
183 L	66-2-3118	Line, SBS Receiver CW Supply	900-E-705	15
184 L	66-2-3118A	Pene 2715, SBS Rec CW Supply	900-E-705	15
185 L	66-2-3121	Line, SBS Scrubber CW Supply	900-E-705	15
186 L	66-3-030	SBS Receiver Cooling Water Rtn.	900-E-705	15
187 L	66-3-032	SBS Scrubber CW Return	900-E-705	14
188 L	66-3-064	Condenser Cooling Water Return	900-E-705	19
189 L	66-3-089	Pene 5762, Condenser CW Return	900-E-705	19
190 L	66-3-090	Pene 2204, SBS Scrub CW Return	900-E-705	14
191 L	66-3-1508	Pene 5760, Condenser CW Supply	900-E-705	19
192 L	66-3-1508A	Line, Condenser CW Supply	900-E-705	19
193 L	66-3-3121A	Pene 2206, SBS Scrubber CW Supp	900-E-705	14
194 L	66-3/4-1508A	Line, Condenser CWS P Relief	900-E-705	19
195 L	66-4-1508B	Line, Condenser CW Supply	900-E-705	19
196 L	CH-1/2-3210A	Pene 5275A, Mist Elim Pad Flush	900-E-705	21
197 L	CH-2-1507A	Pene 5664, Condenser Chem Add	900-E-705	19
198 L	CH-2-1551A	Pene 9971, Chem Add to Vent Hdr	900-E-705	19
199 L	CH-2-3106A	Pene 2202, SBS Scrubber Chem Add	900-E-705	14
200 L	CH-2-3115A	Pene 2107, SBS Receiver Chem Add	900-E-705	15

201 L	CH-2-3313A	Pene 5657, HEME 63-T-33 Chem Add	900-E-705	21
202 L	CH-2-3624A	Pene 5555, HEME 63-T-36 Chem Add	900-E-705	21
203 L	DW-2-1513A	Pene 5273, DW to Cond Drain Seal	900-E-705	21
204 L	DW-2-3314	HEME 63-T-033 Flush	900-E-705	21
205 L	DW-2-3314A	Pene 5758, Flush to HEME 63-T-33	900-E-705	21
206 L	DW-2-3325A	Pene 5173, HEME T-33 Drain Flush	900-E-705	21
207 L	DW-2-3623	HEME 63-T-036 Flush	900-E-705	21
208 L	DW-2-3623A	Pene 5756, Flush to HEME 63-T-36	900-E-705	21
209 L	DW-2-3626A	Pene 5175, HEME T-36 Drain Flush	900-E-705	21
210 L	EITE-3915	Temp., Postheater Push-through	900-E-705	22
211 L	IA-1/2-1502F	Pene 4207B, Air to PV-1502 Actuator	900-E-705	19
212 L	IA-1/2-1502G	Pene 4207A, Air to PV-1502 Actuator	900-E-705	19
213 L	IA-1/2-1502H	Pene 4207C, Air from PV-1502 Actuator	900-E-705	19
214 L	IA-1/2-1504A	Pene 5671B, Cond. Inlet P Tap	900-E-705	19
215 L	IA-1/2-1505A	Pene 5671A, Cond. Outlet P Tap	900-E-705	19
216 L	IA-1/2-1506A	Pene 5671C, Cond. Lq Level Tap	900-E-705	19
217 L	IA-1/2-3102A	Pene 2415A, SBS Rec Ref P Tap	900-E-705	14
218 L	IA-1/2-3103A	Pene 2415B, SBS Rec SpGr Tap	900-E-705	14
219 L	IA-1/2-3104A	Pene 2415C, SBS Rec Level Tap	900-E-705	14
220 L	IA-1/2-3111A	Pene 2103C, SBS Rec Level Tap	900-E-705	15
221 L	IA-1/2-3112A	Pene 2103B, SBS Rec SpGr Tap	900-E-705	15
222 L	IA-1/2-3113A	Pene 2103A, SBS Rec Ref P Tap	900-E-705	15
223 L	IA-1/2-3211A	Pene 5275B, Mist Elim Exit P Tap	900-E-705	21
224 L	IA-1/2-3212A	Pene 5275C Mist Elim Inlet P Tap	900-E-705	21
225 L	IA-1/2-3315A	Pene 5559B, HEME T-33 Inlet P Tap	900-E-705	21
226 L	IA-1/2-3316A	Pene 5559A, HEME T-33 Exit P Tap	900-E-705	21
227 L	IA-1/2-3317A	Pene 5359C, HEME T-33 Lq, L Tap	900-E-705	21
228 L	IA-1/2-3408A	Pene 5446A, Preheater E-34 P Tap	900-E-705	22
229 L	IA-1/2-3506A	Pene 5427A, Prefilt T-035 Exit P	900-E-705	22
230 L	IA-1/2-3620A	Pene 5654A, HEME T-36 Exit P Tap	900-E-705	21
231 L	IA-1/2-3621A	Pene 5654B, HEME T-36 Inlet P Tap	900-E-705	21
232 L	IA-1/2-3622A	Pene 5654C, HEME T-36 Lq, L Tap	900-E-705	21
233 L	IA-1/2-3702A	Pene 7226A, Preheater E-37 P Tap	900-E-705	22
234 L	IA-1/2-3810A	Pene 8125A, Prefilt T-038 Exit P	900-E-705	22
235 L	IA-1/4-1504	Condenser Bottom Pressure Tap	900-E-705	19
236 L	IA-1/4-1505	Condenser Inlet P Tap	900-E-705	19
237 L	IA-1/4-1506	Condenser Level Tap	900-E-705	19
238 L	IA-1/4-3102	SBS Scrubber Ref. Press Tap	900-E-705	14
239 L	IA-1/4-3103	SBS Scrubber SpGr Tap	900-E-705	14
240 L	IA-1/4-3104	SBS Scrubber Level Tap	900-E-705	14
241 L	IA-1/4-3111	SBS Receiver Level Tap	900-E-705	15
242 L	IA-1/4-3112	SBS Receiver SpGr Tap	900-E-705	15
243 L	IA-1/4-3113	SBS Receiver Reference P. Tap	900-E-705	15
244 L	IA-1/4-3211	Mist Eliminator Dnstream P Tap	900-E-705	21
245 L	IA-1/4-3212	Mist Eliminator Upstream P Tap	900-E-705	21
246 L	IA-1/4-3315	HEME 63-T-033 Pressure Tap	900-E-705	21
247 L	IA-1/4-3316	HEME 63-T-033 Diff. Press. Tap	900-E-705	21
248 L	IA-1/4-3317	HEME 63-T-033 Level Tap	900-E-705	21
249 L	IA-1/4-3408	Filter Preheater 63-E-034 P Tap	900-E-705	22
250 L	IA-1/4-3506	Prefilter 63-T-035 P Tap	900-E-705	22
251 L	IA-1/4-3620	HEME 63-T-036 Diff. Press. Tap	900-E-705	21

252 L	IA-1/4-3621	HEME 63-T-036 Pressure Tap	900-E-705	21
253 L	IA-1/4-3622	HEME 63-T-036 Level Tap	900-E-705	21
254 L	IA-1/4-3702	Filter Preheater 63-E-037 P Tap	900-E-705	22
255 L	IA-1/4-3810	Prefilter 63-T-038 P Tap	900-E-705	22
256 L	IA-3/8-1504	Condenser Bottom P Tap	900-E-705	19
257 L	IA-3/8-1505	Condenser Inlet P Tap	900-E-705	19
258 L	IA-3/8-1506	Condenser Level Tap	900-E-705	19
259 L	IA-3/8-3102	SBS Scrubber Ref. Press Tap	900-E-705	14
260 L	IA-3/8-3103	SBS Scrubber SpGr Tap	900-E-705	14
261 L	IA-3/8-3104	SBS Scrubber Level Tap	900-E-705	14
262 L	IA-3/8-3111	SBS Receiver Level Tap	900-E-705	15
263 L	IA-3/8-3112	SBS Receiver SpGr Tap	900-E-705	15
264 L	IA-3/8-3113	SBS Receiver Reference P. Tap	900-E-705	15
265 L	IA-3/8-3211	Mist Eliminator Downstream P Tap	900-E-705	21
266 L	IA-3/8-3212	Mist Eliminator Upstream P Tap	900-E-705	21
267 L	IA-3/8-3315	HEME 63-T-033 Pressure Tap	900-E-705	21
268 L	IA-3/8-3316	HEME 63-T-033 Diff. Press. Tap	900-E-705	21
269 L	IA-3/8-3317	HEME 63-T-033 Level Tap	900-E-705	21
270 L	IA-3/8-3408	Filter Preheater 63-E-034 P Tap	900-E-705	22
271 L	IA-3/8-3506	Prefilter 63-T-035 P Tap	900-E-705	22
272 L	IA-3/8-3620	HEME 63-T-036 Diff. Press. Tap	900-E-705	21
273 L	IA-3/8-3621	HEME 63-T-036 Pressure Tap	900-E-705	21
274 L	IA-3/8-3622	HEME 63-T-036 Level Tap	900-E-705	21
275 L	IA-3/8-3702	Filter Preheater 63-E-037 P Tap	900-E-705	22
276 L	IA-3/8-3810	Prefilter 63-T-038 P Tap	900-E-705	22
277 L	SH-1/2-3105	SBS Rec. to Scrubber Jet P Tap	900-E-705	1C
278 L	SH-2-3105	SBS Rec. to Scrubber Jet Steam	900-E-705	15
279 L	SH-2-3105A	SBS Rec. to Scrubber Jet Vent	900-E-705	1C
280 L	SH-2-3105B	SBS Receiver to Scrubber Jet Strm	900-E-705	15
281 L	SH-2-3124	SBS to Waste Header Jet	900-E-705	15
282 L	SH-2-3124A	Pene 1330, Strm to SBS-Wst Hdr Jet	900-E-705	15
283 L	UA-1/2-082	Pene. 2614B, SBS Rec. Sampler	900-E-705	14
284 V	63-GL-246	Block, Spare	900-E-705	14
285 V	63-GL-246	Block, Spare	900-E-705	14
286 V	63-H-081	Block, Spare	900-E-705	14
287 V	63-H-177	Block, Spare	900-E-705	22
288 V	63-H-178	Block, Spare	900-E-705	22
289 V	63-H-179	Block, Spare	900-E-705	22
290 V	63-H-190	Block, Spare	900-E-705	22
291 V	63-H-191	Block, Spare	900-E-705	22
292 V	63-H-192	Block, Spare	900-E-705	22
293 V	63-H-193	Block, Spare	900-E-705	22
294 V	63-H-211	Block, Spare	900-E-705	22
295 V	63-H-212	Block, Spare	900-E-705	22
296 V	63-H-217	Block, Spare	900-E-705	22
297 V	63-H-218	Block, Spare	900-E-705	22
298 V	63-PV-1502	Press Control, Vessel Vent	900-E-705	19
299 V	63-V-1503	Shut-Off, Condenser Drain	900-E-705	19
300 V	63-V-3206	Iso., Off-Gas Train 1 Inlet	900-E-705	21
301 V	63-V-3207	Iso., Off-Gas Train 2 Inlet	900-E-705	21
302 V	63-V-3318	Shut-Off, HEME 63-T-033 Drain	900-E-705	21

303 V	63-V-3619	Shut-Off, HEME 63-T-036 Drain	900-E-705	21
304 V	63-V-3901	Iso., Off-Gas Train 1 Exit	900-E-705	22
305 V	63-V-3902	Iso., Off-Gas Train 2 Exit	900-E-705	22
306 V	66-GL-046	Block, Condenser CW Return	900-E-705	19
307 V	66-GL-057	Block, SBS Scrubber CW Return	900-E-705	14
308 V	66-GL-058	Block, SBS Receiver CW Return	900-E-705	15
309 V	66-GL-623	Block, SBS Receiver CW Supply	900-E-705	15
310 V	66-GL-626	Block, SBS Scrubber CW Supply	900-E-705	14
311 V	66-GL-632	Block, Condenser CW Supply	900-E-705	19
312 V	66-GT-621	Iso., SBS Receiver CW Supply	900-E-705	15
313 V	66-GT-622	Iso., SBS Receiver CW Supply	900-E-705	15
314 V	66-GT-624	Iso., SBS Scrubber CW Supply	900-E-705	14
315 V	66-GT-625	Iso., SBS Scrubber CW Supply	900-E-705	14
316 V	66-GV-648	Iso., Condenser CWS P Tap	900-E-705	19
317 V	66-H-630	Iso., Condenser CW Supply	900-E-705	19
318 V	66-H-631	Iso., Condenser CW Supply	900-E-705	19
319 V	CH-H-927	Block, SBS Receiver Chem Add	900-E-705	15
320 V	CH-H-930	Block, SBS Scrubber Chem Add	900-E-705	14
321 V	CH-H-947	Block, Vessel Yant Header	900-E-705	19
322 V	CH-H-950	Block, HEME 63-T-36 Chem Add	900-E-705	21
323 V	CH-H-953	Block, HEME 63-T-33 Chem Add	900-E-705	21
324 V	CH-H-956	Block, Condenser Chem Add	900-E-705	19
325 V	CH-H-959	Block, Mist Eliminator Flush	900-E-705	21
326 V	DW-GL-021	Block, HEME 63-T-33 Drain Flush	900-E-705	21
327 V	DW-GL-022	Block, HEME 63-T-36 Drain Flush	900-E-705	21
328 V	DW-GL-033	Block, DW to Condenser Drain	900-E-705	19
329 V	DW-GL-662	Block, Flush to HEME 63-T-33	900-E-705	21
330 V	DW-GL-664	Block, Flush to HEME 63-T-36	900-E-705	21
331 V	DW-H-660	Iso., HEME Flush	900-E-705	21
332 V	DW-H-661	Iso., HEME 63-T-033 Flush	900-E-705	21
333 V	DW-H-663	Iso., HEME 63-T-036 Flush	900-E-705	21
334 V	DW-XV-3314	Check, HEME 63-T-033 Flush	900-E-705	21
335 V	DW-XV-3623	Check, HEME 63-T-036 Flush	900-E-705	21
336 V	IA-GA-706	Block, Preheater 63-E-034 P Tap	900-E-705	22
337 V	IA-GA-710	Block, Prefilt 63-T-35 Ex P Tap	900-E-705	22
338 V	IA-GA-725	Block, SBS Receiver Level Tap	900-E-705	15
339 V	IA-GA-728	Block, SBS Receiver SpGr Tap	900-E-705	15
340 V	IA-GA-731	Block, SBS Receiver Ref P Tap	900-E-705	15
341 V	IA-GA-818	Block, HEME 63-T-33 Inlet P Tap	900-E-705	21
342 V	IA-GA-821	Block, HEME 63-T-33 Exit P Tap	900-E-705	21
343 V	IA-GA-824	Block, HEME 63-T-33 Liq Lev Tap	900-E-705	21
344 V	IA-GA-827	Block, HEME 63-T-36 Outlet P Tap	900-E-705	21
345 V	IA-GA-830	Block, HEME 63-T-36 Inlet P Tap	900-E-705	21
346 V	IA-GA-833	Block, HEME 63-T-36 Liq Lev Tap	900-E-705	21
347 V	IA-GA-836	Block, Condenser Bottom P Tap	900-E-705	19
348 V	IA-GA-839	Block, Condenser Inlet P Tap	900-E-705	19
349 V	IA-GA-842	Block, Condenser Liq Level Tap	900-E-705	19
350 V	IA-GA-878	Block, Mist Eliminator Exit P Tap	900-E-705	21
351 V	IA-GA-881	Block, Mist Elim. Inlet P Tap	900-E-705	21
352 V	IA-GA-884	Block, Preheater 63-E-037 P Tap	900-E-705	22
353 V	IA-GA-887	Block, Prefilter T-38 Exit P Tap	900-E-705	22

354 V	IA-GA-933	Block, SBS Scrubber Level Tap	900-E-705	14
355 V	IA-GA-936	Block, SBS Scrubber SpGr Tap	900-E-705	14
356 V	IA-GA-939	Block, SBS Scrubber Ref. P Tap	900-E-705	14
357 V	IA-G-703	Iso., Prefilt T-035 PDT-3506 HP	900-E-705	22
358 V	IA-G-704	Iso., Preheater E-034 PT-3408 LP	900-E-705	22
359 V	IA-G-706	Iso., Prefilt T-035 PDT-3606 LP	900-E-705	22
360 V	IA-G-732	Iso., SBS Receiver LT-3111 LP	900-E-705	15
361 V	IA-G-733	Iso., SBS Receiver LT-3111 HP	900-E-705	15
362 V	IA-G-734	Iso., SBS Receiver DT-3112 LP	900-E-705	15
363 V	IA-G-735	Iso., SBS Receiver DT-3112 HP	900-E-705	15
364 V	IA-G-874	Iso., Mist E PDT-3211 LP Tap	900-E-705	21
365 V	IA-G-875	Iso., Mist E PDT-3211 HP Tap	900-E-705	21
366 V	IA-G-886	Iso., Prefilt T-036 PDT-3810 HP	900-E-705	22
367 V	IA-G-889	Iso., Prefilt T-036 PDT-3810 LP	900-E-705	22
368 V	IA-G-890	Iso., Preheater E-037 FT-3702 LP	900-E-705	22
369 V	IA-G-908	Iso., HEME T-033 PDT-3315 HP Tap	900-E-705	21
370 V	IA-G-909	Iso., HEME T-033 PDT-3315 LP Tap	900-E-705	21
371 V	IA-G-910	Iso., HEME T-033 LT-3317 LP Tap	900-E-705	21
372 V	IA-G-911	Isp., HEME T-033 LT-3317 HP Tap	900-E-705	21
373 V	IA-G-913	Iso., HEME T-033 PT-3515 LP Tap	900-E-705	21
374 V	IA-G-914	Iso., HEME T-036 LT-3622 HP Tap	900-E-705	21
375 V	IA-G-915	Iso., HEME T-036 LT-3622 LP Tap	900-E-705	21
376 V	IA-G-916	Iso., HEME T-036 PDT-3621 HP Tap	900-E-705	21
377 V	IA-G-917	Iso., HEME T-036 PDT-3621 LP Tap	900-E-705	21
378 V	IA-G-918	Iso., HEME T-036 PT-3621 LP Tap	900-E-705	21
379 V	IA-G-920	Iso., Condenser Inlet P to PDT	900-E-705	19
380 V	IA-G-921	Iso., Condenser Bottom P to PDT	900-E-705	19
381 V	IA-G-922	Iso., Condenser Inlet P to LT	900-E-705	19
382 V	IA-G-923	Iso., Condenser Level P to LT	900-E-705	19
383 V	IA-G-924	Iso., Condenser Inlet P to PT	900-E-705	19
384 V	IA-G-940	Iso., SBS Scrubber LT-3101 HP	900-E-705	14
385 V	IA-G-941	Iso., SBS Scrubber LT-3101 LP	900-E-705	14
386 V	IA-G-942	Iso., SBS Scrubber PDT-3101 LP	900-E-705	14
387 V	IA-G-943	Iso., SBS Scrubber PDT-3101 HP	900-E-705	14
388 V	IA-G-944	Iso., SBS Scrubber DT-3101 HP	900-E-705	14
389 V	IA-G-945	Iso., SBS Scrubber DT-3101 LP	900-E-705	14
390 V	IA-H-162	Block, Air to PV-1502 Actuator	900-E-705	19
391 V	IA-H-163	Block, Air to PV-1502 Actuator	900-E-705	19
392 V	IA-H-164	Block, Air from PV-1502 Actuator	900-E-705	19
393 V	IA-H-705	Iso., Filter Preheat E-034 P Tap	900-E-705	22
394 V	IA-H-709	Iso., Prefilter 63-T-035 P Tap	900-E-705	22
395 V	IA-H-724	Iso., SBS Receiver Level Tap	900-E-705	15
396 V	IA-H-727	Iso., SBS Receiver SpGr Tap	900-E-705	15
397 V	IA-H-730	Iso., SBS Receiver Ref. P Tap	900-E-705	15
398 V	IA-H-817	Iso., HEME 63-T-033 P Tap	900-E-705	21
399 V	IA-H-820	Iso., HEME 63-T-033 DP Tap	900-E-705	21
400 V	IA-H-823	Iso., HEME 63-T-033 L Tap	900-E-705	21
401 V	IA-H-826	Iso., HEME 63-T-036 DP Tap	900-E-705	21
402 V	IA-H-829	Iso., HEME 63-T-036 P Tap	900-E-705	21
403 V	IA-H-832	Iso., HEME 63-T-036 L Tap	900-E-705	21
404 V	IA-H-835	Iso., Condenser Bottom P Tap	900-E-705	19

405 V	IA-H-838	Iso., Condenser Inlet P Tap Air	900-E-705	19
406 V	IA-H-841	Iso., Condenser L Tap Air	900-E-705	19
407 V	IA-H-877	Iso., Mist Elim Downstream P Tap	900-E-705	21
408 V	IA-H-880	Iso., Mist Elim Upstream P Tap	900-E-705	21
409 V	IA-H-883	Iso., Filter Preheat E-037 P Tap	900-E-705	22
410 V	IA-H-886	Iso., Prefilter T-038 P Tap	900-E-705	22
411 V	IA-H-932	Iso., SBS Scrubber Level Tap	900-E-705	14
412 V	IA-H-935	Iso., SBS Scrubber SpGr Tap	900-E-705	14
413 V	IA-H-938	Iso., SBS Scrubber Ref. P Tap	900-E-705	14
414 V	SH-GH-638	Block, Strn to SBS-Waste Hdr Jet	900-E-705	15
415 V	SH-GL-647	Block, SBS Rec to Scrub Jet Strn	900-E-705	15
416 V	SH-GL-649	Iso, SBS Rec to Scrub Jet PT	900-E-705	1C
417 V	SH-H-637	Iso., SBS to Waste Header Jet	900-E-705	15
418 V	SH-H-646	Iso., SBS Rec to Scrub Jet Steam	900-E-705	15
419 V	SH-XV-3105	Check, SBS Rec. to Scrubber Jet	900-E-705	15
420 V	SH-XV-3124	Check, SBS to Waste Header Jet	900-E-705	15
421 V	UA-GL-036	Block, SBS Receiver Sampler	900-E-705	14

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Interface List

No.	Syst	# Description	Definition
1	055	1 Nozzle for Pene. 4031, Vessel Vent Cond. to 8D-3	3" PUREX, 340 gph
2	063DW	1 DW-GL-021 Inlet, HEME 63-T-033 Seal Loop Flush	2" pipe, 50 gpm, 40 psig
3	063DW	2 DW-GL-022 Inlet, HEME 63-T-036 Seal Loop Flush	2" pipe, 50 gpm, 40 psig
4	063DW	3 DW-GL-033 Inlet, Condensate Loop Seal Flush	2" pipe, 50 psig, 25 gpm
5	063DW	4 DW-H-660 Inlet, HEMEs 63-T-033 & -036 Flush	2" pipe, 25 gpm, 40 psig
6	063ED	1 Motor for SBS Solids Suspension System	1.1 kW, 460 V, 3 ph
7	063ED	2 Pene. 5350, Elec. Connect, Preheater 63-E-034 Pwr	2" Connector, 50 kW, 480 V
8	063ED	3 Pene. 6427, Elec. Connect, HEME Preheater Power	2" Connector, 50 kW, 480 V
9	063ED	4 Pene. 7324, Elec. Connect, Preheater 63-E-037 Pwr	2" Connector, 50 kW, 480 V
10	063ED	5 Pene. 8220, Elec. Connect, Postheater Power	Not Required
11	063F	1 Shielding	Not Applicable
12	063G	1 Nozzle V-045-B, SBS Jet to Waste Header	2" PUREX, 25 gpm
13	063G	2 Nozzle V-1501-G, Waste Header Vent	2" PUREX, 50 scfm
14	063I	1 IA-G-943, SBS Bed DP Instrument Connection	1/4", 0-58 InWC min.
15	063I	2 Nozzle V-031-A, SCFM to SBS	6" flange, 760 acfm, 260 C
16	063I	3 Nozzle V-031-F, S&S to CFMUT Jet	3" PUREX, 25 gpm, 45 C
17	063I	4 Nozzle V-1501-C, Vent Header from CFMT	6" flange, 1120 acfm, 100 C
18	063I	5 Nozzle V-1501-D, Vent Header from Feed Hold Tank	6" flange, 50 scfm, 40 C
19	063I	6 Nozzle V-1501-F, Vent Header from SFCM	6" flange, 50 scfm, 260 C
20	063IA	1 FIC-1504 Inlet, Condenser Inlet P Tap	1/4" NPT, 0.5 scfh
21	063IA	2 FIC-1505 Inlet, Condenser Exit P Tap	1/4" NPT, 0.5 scfh
22	063IA	3 FIC-1506 Inlet, Condenser Level Tap	1/4" NPT, 0.5 scfh
23	063IA	4 FIC-3102 Inlet, SBS Bed P Tap	1/4" NPT, 0.5 scfh
24	063IA	5 FIC-3103 Inlet, SBS Bed SpGr Tap	1/4" NPT, 0.5 scfh
25	063IA	6 FIC-3104 Inlet, SBS Bed Level Tap	1/4" NPT, 0.5 scfh
26	063IA	7 FIC-3111 Inlet, SBS Receiver Level Tap	1/4" NPT, 0.5 scfh
27	063IA	8 FIC-3112 Inlet, SBS Receiver SpGr Tap	1/4" NPT, 0.5 scfh
28	063IA	9 FIC-3113 Inlet, SBS Receiver P Tap	1/4" NPT, 0.5 scfh
29	063IA	10 FIC-3211 Inlet, Mist Eliminator Downstream P Tap	1/4" NPT, 0.5 scfh
30	063IA	11 FIC-3212 Inlet, Mist Eliminator Upstream P Tap	1/4" NPT, 0.5 scfh
31	063IA	12 FIC-3315 Inlet, HEME 63-T-033 Inlet P Tap	1/4" NPT, 0.5 scfh
32	063IA	13 FIC-3316 Inlet, HEME 63-T-033 DP Tap	1/4" NPT, 0.5 scfh
33	063IA	14 FIC-3317 Inlet, HEME 63-T-033 Level Tap	1/4" NPT, 0.5 scfh
34	063IA	15 FIC-3408 Inlet, Preheater 63-E-034 Pressure	1/4" NPT, 0.5 scfh
35	063IA	16 FIC-3506 Inlet, Prefilter 63-T-035 Pressure	1/4" NPT, 0.5 scfh
36	063IA	17 FIC-3620 Inlet, HEME 63-T-036 DP Tap	1/4" NPT, 0.5 scfh
37	063IA	18 FIC-3621 Inlet, HEME 63-T-036 P Tap	1/4" NPT, 0.5 scfh
38	063IA	19 FIC-3622 Inlet, HEME 63-T-036 Level Tap	1/4" NPT, 0.5 scfh
39	063IA	20 FIC-3702 Inlet, Preheater 63-E-037 Pressure	1/4" NPT, 0.5 scfh
40	063IA	21 FIC-3810 Inlet, Prefilter 63-T-038 Pressure	1/4" NPT, 0.5 scfh
41	063IA	22 HV-3314 IA Connect, HEME 63-T-033 Flush Iso.	0 or 40 psig
42	063IA	23 HV-3623 IA Connect, HEME 63-T-036 Flush Iso.	0 or 40 psig
43	063IA	24 TV-3118 Connect to IA, Operator, SBS Rec. CW	3-15 psig
44	063IA	25 TV-3121 Connect to IA, Operator, SBS Bed CW	3-15 psig
45	063J	1 Nozzle V-031-Y, Decon Station Waste to SBS	7-1/2" flange
46	063J	2 Nozzle V-1501-H, Vent Header from Decon Station	2" PUREX, 50 scfm
47	063K	1 Impact Wrench Socket to Hex Nuts	2" hex nuts, 550 ft-lbs
48	063K	2 Lifting Fixtures & Bails to Crane Hooks	12 tons (Estab. by SBS wt.)

49 063SC	1 HV-3105D Inlet, SBS Bed Jet to CFMT Steam	2" pipe, 1000 lb/h, 95 psig
50 063SC	2 HV-3124 Inlet, SBS to Waste Header Jet Steam	2" pipe, 1000 lb/h, 95 psig
51 063UA	1 HV-3105E Inlet, SBS Scrub Jet Air	1/2" pipe, 95 psig
52 063UA	2 HV-3124 Inlet, SBS to Waste Header Jet Purge	2" pipe, 95 psig
53 063UA	3 UA-GL-036 Inlet, SBS Sampler Air	2" pipe, 10 scfm, 90 psig
54 063VH	1 HV-3105G Outlet, SBS to CFMT Jet Vent	2" pipe
55 063VH	2 HV-3114G Outlet, SBS Receiver to Scrubber Jet Vent	2" pipe
56 064	1 Pene. 5001, Off-Gas from Vitrification Cell	10" pipe, 1200 acfm, 225 F
57 065	1 CH-H-927 Inlet, SBS Receiver Chem Addition	2" pipe, 50 gpm, 40 psig
58 065	2 CH-H-930 Inlet, SBS Bed Chem Addition	2" pipe, 50 gpm, 40 psig
59 065	3 CH-H-947 Inlet, Vent Header Chem Addition	2" pipe, 50 gpm, 50 psig
60 065	4 CH-H-950 Inlet, HEME 63-T-036 Chem Addition	2" pipe, 50 gpm, 40 psig
61 065	5 CH-H-953 Inlet, HEME 63-T-033 Chem Addition	2" pipe, 50 gpm, 40 psig
62 065	6 CH-H-956 Inlet, Condenser Chem Addition	2" pipe, 50 gpm, 50 psig
63 065	7 CH-H-959 Inlet, Mist Eliminator Flush	1/2", 40 psig, 2 gpm
64 066	1 66-GT-012 Outlet, SBS Receiver Cooling Water Rtn	2" pipe, 35 gpm
65 066	2 66-GT-045 Outlet, SBS Bed Cooling Water Return	2" pipe, 100 gpm
66 066	3 66-GT-093 Entrance, Condenser Cooling Water Rtn	3" pipe, 200 gpm, 20 psig
67 066	4 66-GT-621 Inlet, SBS Receiver Cooling Water Source	2" pipe, <90 F, 35 gpm
68 066	5 66-GT-624 Inlet, SBS Bed Cooling Water Source	2" pipe, <90 F, 100 gpm
69 066	6 66-H-830 Inlet, Condenser Cooling Water Supply	3", 200gpm, <90F, 75psi
70 066	7 PSV-1508 Discharge, Condenser Cooling Water Relief	1" pipe
71 069A	1 Nozzle V-031-GG to C Sampler	3-Way PUREX Connector
72 200A	1 63-(No number), Motor Starter Connect to DCS	Not Established
73 200A	2 DT-3101, SBS Scrubber, Connect to DCS	4-20 mA Output
74 200A	3 DT-3112, SBS Receiver, Connect to DCS	4-20 mA Output
75 200A	4 FT-1508, Condenser CW Flow, Connect to DCS	4-20 mA Output
76 200A	5 FT-3121, SBS Bed CW Flow Element Connect to DCS	4-20 mA Output
77 200A	6 FT-3314, HEME Flush, Connect to DCS	4-20 mA Output
78 200A	7 FT-3916, Off-Gas Flowmeter, Connect to DCS	2" Connector, 4-20 mA Out
79 200A	8 HV-3105D IA Connect, SBS Scrubber Jet Steam	0 or 40 psig
80 200A	9 HV-3105E IA Connect, SBS Scrubber Jet Air	0 or 40 psig
81 200A	10 HV-3105F/G IA Connect, SBS Scrubber Jet Control	0 or 40 psig
82 200A	11 HV-3124, SBS to Waste Header Jet, Connect to DCS	0 or 120 V
83 200A	12 IA-H-162 Inlet, PV-1502 Actuator	1/4", 0-50 Psig
84 200A	13 IA-H-163 Inlet, PV-1502 Actuator	1/4", 0-50 psig
85 200A	14 IT-3130, Current to Motor, Connect to DCS	4-20 mA Output
86 200A	15 LT-1506, Condenser, Connect to DCS	4-20 mA Output
87 200A	16 LT-3101, SBS Scrubber, Connect to DCS	4-20 mA Output
88 200A	17 LT-3111, SBS Receiver, Connect to DCS	4-20 mA Output
89 200A	18 LT-3317, HEME 63-T-033, Connect to DCS	4-20 mA Output
90 200A	19 LT-3622, HEME 63-T-036, Connect to DCS	4-20 mA Output
91 200A	20 PDT-1505, Condenser, Connect to DCS	4-20 mA Output
92 200A	21 PDT-3101, SBS Scrubber, Connect to DCS	4-20 mA Output
93 200A	22 PDT-3211, Mist Eliminator, Connect to DCS	4-20 mA Output
94 200A	23 PDT-3315, HEME 63-T-033, Connect to DCS	4-20 mA Output
95 200A	24 PDT-3506, Prefilter 63-T-035, Connect to DCS	4-20 mA Output
96 200A	25 PDT-3621, HEME 63-T-036, Connect to DCS	4-20 mA Output
97 200A	26 PDT-3810, Prefilter 63-T-038, Connect to DCS	4-20 mA Output
98 200A	27 PT-1505 for Condenser Connect to DCS	4-20 mA Output
99 200A	28 PT-1508, Condenser CW, Connect to DCS	4-20 mA Output

100 200A	29 PT-3105, SBS Scrubber Jet, Connect to DCS	4-20 mA Output
101 200A	30 PT-3315, HEME 63-T-033, Connect to DCS	4-20 mA Output
102 200A	31 PT-3408, Preheater 63-E-034, Connect to DCS	4-20 mA Output
103 200A	32 PT-3621, HEME 63-T-036 Connect to DCS	4-20 mA Output
104 200A	33 PT-3702, Preheater 63-E-037, Connect to DCS	4-20 mA Output
105 200A	34 TT-1502, Non-Condensibles, Connect to DCS	4-20 mA Output
106 200A	35 TT-3102, SBS Freeboard, Connect to DCS	4-20 mA Output
107 200A	36 TT-3103, SBS Scrubber, Connect to DCS	4-20 mA Output
108 200A	37 TT-3118, SBS Receiver, Connect to DCS	4-20 mA Output
109 200A	38 TT-3212, HEME Preheater Temp., Connect to DCS	4-20 mA Output
110 200A	39 TT-3408, Preheater 63-E-034 T, Connect to DCS	4-20 mA Output
111 200A	40 TT-3709, Preheater 63-E-037, Connect to DCS	4-20 mA Output
112 200A	41 TT-3914, Postheater Temp, Connect to DCS	4-20 mA Output
113 200A	42 TT-3915, Postheater T, Push Thru, Connect to DCS	4-20 mA Output
114 200A	43 TV-1508 Connect to IA, Condenser CW	1/4" NPT, 20 psig
115 200A	44 TV-3118, SBS Receiver CW Flow, Connect to DCS	4-20 mA Input
116 200A	45 TV-3121, SBS Bed CW Valve, Operator Connect	4-20 mA Input
117 200A	46 ZS-3124, SBS to Waste Header Jet, Connect to DCS	0 or 24 V
118 200B	1 Alarms and Interlocks	As Applicable

Add'l interface defining info. is located in Section 4.0

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Design Mass Balance



From : Vitrifcation Design
WH : OF:88:0207
Date : April 7, 1988
Subject : Vitrifcation Off-Gas System Mass Balance for Normal Operation,
Rev. 2

To :
S. M. Barnes
R. R. Borisch*
P. Burn
D. E. Carl*
D. D. Daruwalla*
W. P. Drosjack
P. S. Klanian*
R. M. Mahany*
L. L. Petkus
J. M. Pope*
MRC - 0479, 0950
VIP - 1 L 01, 1 L

*Attachment A only

Reference: R. F. Vance, "Vitrification Off-Gas System Mass
Balance for Normal Operation, Revision 1",
Letter OF:88:0121, dated February 29, 1988

Transmitted with this letter is an updated version (Rev. 2) of the
Off-Gas System Mass Balance, which was previously published as an
attachment to the reference letter.

Two changes were made to the program which affected the balance.

First, provision was made in the program for liquid condensate in
the "noncondensibles" jumper between the vessel ventilation system
condenser and the off-gas system. Energy balance calculations
were then performed to establish the amount of condensation
expected due to expansion cooling across the pressure control
valve in the jumper. This information was inserted into the input
data.

Second, the program was revised to allow for thermal decomposition
of the sludge in the melter. This results in a slightly increased
amount of water vapor in the melter off-gas, and makes the
calculated mass of glass produced per liter of feed consistent
with that actually observed in the Component Test Stand.

Data from this revised Mass Balance will be incorporated into the
in-cell off-gas system design basis document and equipment
specification.

TWC0086:ENG-37*

APPENDIX E

OF:88:0207

- 2 -

April 7, 1988

If you have any questions regarding this Mass Balance, please call me at
Extension 4848.

R F Vance

R. F. Vance, Senior Engineer
Vitrification Design
West Valley Nuclear Services Co., Inc.

RFV:cmg

Attachments: A) Walter Off-Gas System Mass Balance, Normal Operation, Rev. 2
B) Changes to Mass Balance Program and Input Data

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Vendor Literature - Mist Eliminator Pad

OTTO H. YORK COMPANY, INC.

42 INTERVALE ROAD • P.O. BOX 3100

PARSIPPANY, NEW JERSEY 07054-0918

DEMISTER is the registered trademark for our mesh mist eliminators



PHONE 201-279-8200
CABLE OTTYORK
TELEX 120134

MAINTENANCE INSTRUCTIONS

The York DEMISTER[®] mist eliminator normally requires no special maintenance, and will provide many, many years of maintenance free service in services where dissolved or undissolved solids may be present.

An initial pressure drop reading across the DEMISTER[®] should be taken at normal flow conditions when the unit is first operated. During operation the pressure drop should be monitored. If the operating pressure drop rises to 1" of water above the initial pressure drop, at the same operating conditions, the pad should be flushed with liquid until the pressure drop returns to its original level. This flushing is most effective when spray is from underneath the pad with whatever solvent the user feels is viable to remove the buildup. A spray rate of 0.2 to 0.5 gallons per minute per square foot of mesh area is suggested.

If the pressure drop does not return to its original level after the cleaning procedure has been completed, an inspection of the internals should be made, as replacement may be required.

For any problems unique to your system, please consult York for our recommendation.

NOTES

- 1) MESH FABRICATED OVERSIDE TO INCLUDE 8000 P.T.
- 2) MESH SECURED WITH THE WIRE PUBLISHED WITH UNIT.
- 3) TORQUEMESH™ BORTED MESH STYLE 844
- 4) MESH MATERIAL: 304L
- 5) GRID MATERIAL: 304L
- 6) GRID STYLE: 80

ITEM NO. 1 OF 1 | REQUIRED S.B. NO. 011395

OTC 14.75 8.8 X 8.8 844 304L 80 P.T.
SPECIALTY MESH & CONSTRUCTORS INC.
REARIER, NY DISTRICT

OTTO H. YORK COMPANY, INC.
45 WATROUBLE ROAD
PARSONS, NY 12551-0010
(518) 535-8300
YORK PROCESS BLDG. CHEM-PRO BLDG. D

PLEASE REFER TO THE DRAWING FOR ALL DIMENSIONS AND TOLERANCES. THE DRAWING IS THE PROPERTY OF OTTO H. YORK COMPANY, INC. AND IS TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED ON THE DRAWING. IT IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.

DATE	21.35-11528
BY	JAC
CHECKED BY	TC
DATE	7-18-97
SCALE	1" = 1'-0"

B-147320

OTC 14.75 8.8 X 8.8 844 304L 80 P.T.
SPECIALTY MESH & CONSTRUCTORS INC.
REARIER, NY DISTRICT

OTC 14.75 8.8 X 8.8 844 304L 80 P.T.
SPECIALTY MESH & CONSTRUCTORS INC.
REARIER, NY DISTRICT

OTC 14.75 8.8 X 8.8 844 304L 80 P.T.
SPECIALTY MESH & CONSTRUCTORS INC.
REARIER, NY DISTRICT

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Vendor Literature - Heater Elements

High temperature air duct heaters

- 5 to 300 kW and above
- Outlet air temperatures to 1200°F
- 480 volt 3 phase (voltages to 600 V available)
- With .475 dia. tubular elements
- Types ADH and ADHT

Applications

- Heating air for various drying/curing operations up to 1200°F air temperature
- Heat treating
- Re-heating or dehumidification
- Other similar air heating applications

Features

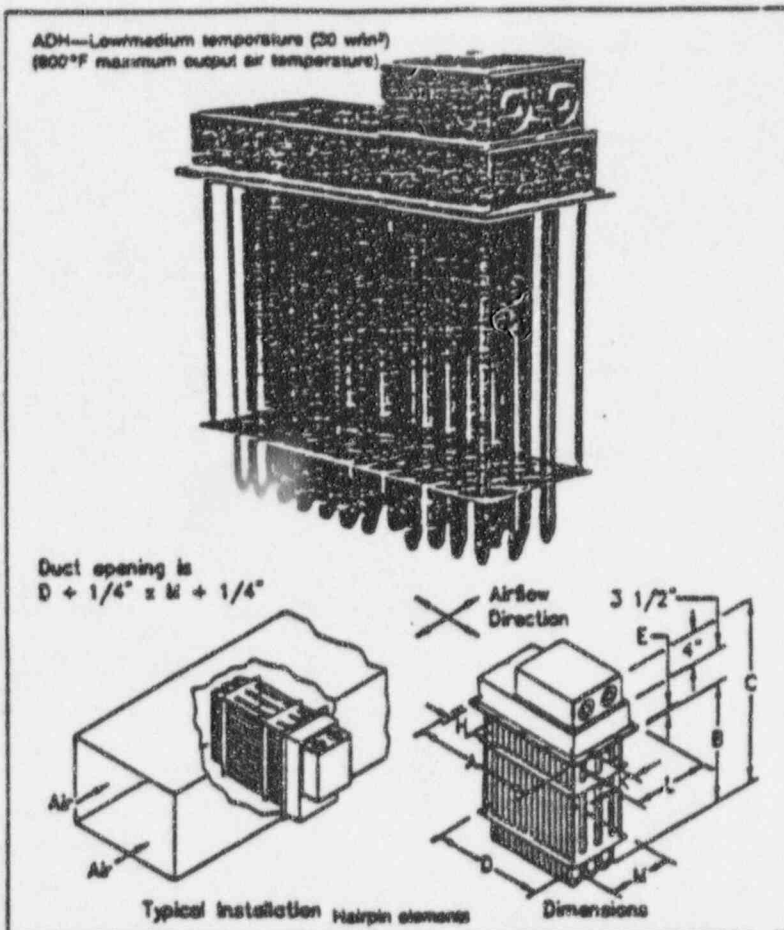
Rugged construction. Sturdy 0.475 diameter tubular elements mounted to a heavy 1/4 or 3/8 inch thick steel flange. Terminal housing made of 16 ga. galvanized steel. Element support rods of 16 ga. aluminum steel are held in place by stainless steel support rods. High temperature units have the additional feature of stainless steel material for the 3 inch insulation housing and element support plate -- all of which provides superior rigidity, strength and reliability.

Long life metal sheath tubular elements--Corrosion/oxidation resistant sheath. High grade Incoloy 800 sheath material for excellent corrosion/oxidation resistance at high operating temperatures.

High purity magnesium oxide. The elements are filled with highest purity blends of magnesium oxide refractory (MGO) compacted to a rock hard density to insure maximum thermal conductivity and electrical insulation resistance.

Superior grade resistance wire. The heart of each heating element is made of 80% nickel-20% chromium resistance wire for maximum long life.

Low watt density resistor wire. Watt density on the heating coil is designed for low watt density operation by increasing the coil diameter, gauge and length of resistance wire to give maximum surface area and low operating coil surface temperature -- providing longer coil life.



ADM--Low/medium temperature (30 w/in²)

KW	Dimensions--inches										No. Elements	No. Circ.	Catalog No.	Stator PCB	Wt. Lbs.
	A	B	C	D	E	H	I	J	K	L					
5	5 1/2	20 1/4	28 1/4	4	1/4	2 1/2	3 1/2	11 1/2	8 1/2	3	1	ADH-005	8	210016	8
10	7 1/4	20 1/4	28 1/4	6	1/4	3 1/2	3 1/2	11 1/2	1 1/2	6	1	ADH-010	8	210024	15
15	9 1/4	20 1/4	28 1/4	8	1/4	3	3 1/2	11 1/2	8 1/2	8	1	ADH-015	8	210032	25
20	11 1/4	20 1/4	28 1/4	10	1/4	3 1/4	3 1/2	11 1/2	8 1/2	12	1	ADH-020	8	210040	35
25	13 1/4	20 1/4	28 1/4	12	1/4	3 1/4	3 1/2	11 1/2	8 1/2	15	1	ADH-025	8	210050	40
30	15 1/4	20 1/4	28 1/4	14	1/4	3 1/4	3 1/2	11 1/2	8 1/2	18	1	ADH-030	8	210067	55
35	17 1/4	20 1/4	28 1/4	16	1/4	4 1/4	3 1/2	11 1/2	8 1/2	21	1	ADH-035	8	210075	65
40	19 1/4	20 1/4	28 1/4	18	1/4	4 1/4	3 1/2	11 1/2	8 1/2	24	2	ADH-040	8	210083	70
45	21 1/4	20 1/4	28 1/4	20	1/4	5 1/4	3 1/2	11 1/2	8 1/2	27	2	ADH-045	8	210091	75
50	23 1/4	20 1/4	28 1/4	22	1/4	5 1/4	3 1/2	11 1/2	8 1/2	30	2	ADH-050	8	210104	80
60	27 1/4	20 1/4	28 1/4	26	1/4	4 1/4	3 1/2	11 1/2	8 1/2	36	2	ADH-060	8	210112	105
80	35 1/4	20 1/4	28 1/4	34	1/4	4 1/4	3 1/2	11 1/2	8 1/2	48	4	ADH-080	85	210120	140
90	39 1/4	20 1/4	28 1/4	38	1/4	4 1/4	3 1/2	11 1/2	8 1/2	54	5	ADH-090	85	210130	160
100	43 1/4	20 1/4	28 1/4	42	1/4	5 1/4	3 1/2	11 1/2	8 1/2	60	5	ADH-100	3	210147	175
144	55 1/4	25	42 1/4	34	1/4	4 1/4	3 1/2	11 1/2	8 1/2	68	4	ADH-144	85	210135	185
162	59 1/4	25	42 1/4	38	1/4	4 1/4	3 1/2	11 1/2	8 1/2	84	6	ADH-162	8	210153	185
216	77 1/4	25	42 1/4	28	1/4	4 1/4	3 1/2	20	18 1/2	72	6	ADH-216F	8	210171	240
270	95 1/4	25	42 1/4	32	1/4	5 1/4	3 1/2	20	18 1/2	90	6	ADH-270C	8	210180	300

Locality: Country, catalog no., PCB, KW, or duct housing.

D/5 Process air heaters

Chromalox[®]

High temperature air duct heaters (cont.)

Application Guide

Selecting heater size. Refer to Technical Section for examples on determining HV requirements. For quick estimating purposes, the following formula may be used for standard conditions:

$$HW = CFM \times \text{temp. diff}/3000$$

Maximum work temperatures. Types ADH and ADHT process air heaters can generally be used at the following maximum temperatures shown, provided the minimum air velocity is maintained uniformly through the heater.

Air Velocity (F/Sec.)	Max. Outlet Air Temp. °F	
	ADH	ADHT
4	850	1050
5	900	1100
10	950	1150
25	970	1200
50	980	1200

Application assistance. Chromalox sales/application engineers are available to assist you in the design or selection of equipment. Please contact your local Chromalox Sales Office if you need engineering assistance.

Installation mounting tips

Low temperature duct heaters can be fastened directly to the sheet metal duct work with bolts or sheet metal screws.

High temperature duct heaters are generally mounted to a field fabricated stand off rather than the ductwork to position the heater such that the 3" insulation housing is in the same plane as the duct insulation.

All heaters can be mounted in any position; top, side or bottom (preferred) entry. Minimum duct size is A or L dimension plus 1/4" and B dimension plus 1/2".

Provide adequate heater support. Consideration should be given to installing hangers or some other means of heater support whenever there is any question about the ability of the ductwork to support the heater weight.

Overtemperature protection. All heaters should include an overtemperature (overheat) control whose temperature sensing element is located on the air discharge side of the heater as close to the heater as practical. High temperature ADHT units include an overtemperature (Type IQ) thermocouple as standard.

Additional protection can be achieved by installing an air flow or pressure differential switch to protect the heater against low air flow conditions.

Operational controls. Selection of these controls, thermostat, SCR units, contactors and etc., depends on the degree of accuracy required, reliability, electrical rating of heater and economic considerations. Refer to Control Section.

Field power & control circuit wiring. Must be capable of carrying the electrical load and be protected by overcurrent protective devices, such as fusing, circuit breakers or ground fault detection in accordance with the requirements of the National Electrical Code and local codes as applicable.

Tandem mounting. Multiple heaters may be mounted in tandem with each other provided the maximum recommended outlet air temperature is not exceeded.

Pressure drop. Depends on the size of heater, its orientation with respect to air flow and the velocity of the air. Curve G-277-2 in Technical Section lists pressure drops for various heaters. Note, if pressure drop must be kept to a minimum, the heater should be mounted in the duct with the narrow width of the heater perpendicular to the air flow.

Options available

Gas tight design. Achieved by the use of threaded compression fittings with fiber washers to attach heating elements to flange--prevents leakage of ducted air into terminal housing.

Overtemperature protection. Thermocouple welded to the element sheath surface and wired to a terminal block can be provided for accurate overheat protection. Standard on high temperature units.

Isolation or explosion-resistant terminal housings are available for those applications requiring special terminal protection.

Special ratings or sizes. Chromalox can custom fabricate a duct heater to your particular needs whether it be rating, physical size or other specifications.

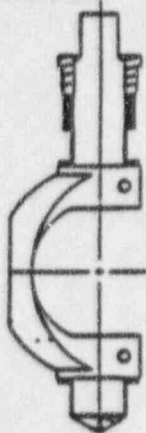
Contact your local Chromalox representative for assistance.

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Vendor Literature -Off-Gas Jumper Valves

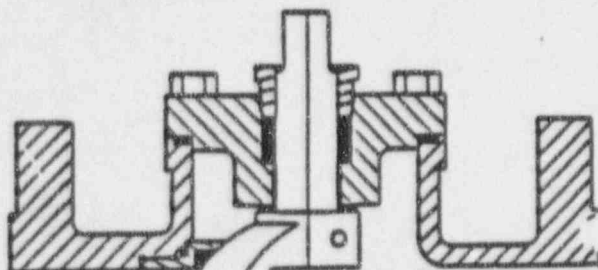
ECCENTRIC DISC CONSTRUCTION

The eccentric geometry provides excellent flow, throttling and shut-off characteristics while minimizing seat wear by eliminating interference. Rockford's patented dynamic disc motion provides increasingly tighter seating with increased lever force.



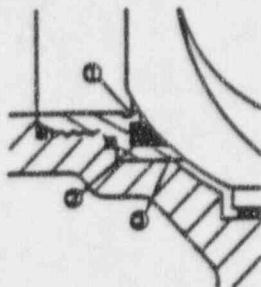
TOP-ENTRY DESIGN

Top-entry provides light maintenance to complete overhaul capability while still in-line, reducing down time and cutting maintenance cost. Top-entry eliminates potential body seal leakage inherent in split body designs, providing a safer working environment.



TRI-SEAL

With our patented TRI-SEAL seat arrangement, we offer three sealing surfaces. The first (1) is a dynamic flexible metal seal which gives you API 598 closure. The second (2) is a resilient seal giving bubble tight shut-off. The third (3) is a solid metal seal eliminating override and providing API 607 firesafe closure.



FULL PORT

Eliminates restricted flow and increases Cv values resulting in considerable system energy savings.

FULL PACKING CHAMBER

A deep stuffing box offers positive stem seal for operator safety. PTFE or Graphite packing available as specified.

TRUNNION MOUNTED

Provides exact alignment of the disc and seat, and ensures bi-directional sealing for reliable shut-off.

CONTAINED BONNET GASKET

A fully contained bonnet gasket with controlled compression ensures a tight bonnet seal and eliminates gasket blow-outs for operator safety and less maintenance requirements.

ANTI-STATIC GROUNDING SPRING

Eliminates the possibility of spark due to static electricity build-up, and decreases the potential for fire.

FIRESAFE DESIGN

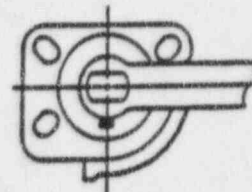
High temperature seats and packing, a primary flexible metal seal and a solid metal back-up seal are incorporated in Rockford's Firesafe design. Rockford valves meet or exceed API 607 standards.

LOW TORQUES

The eccentric design virtually eliminates torques except for minimal overtorque due to immediate opening or closure. Actuator sizes are smaller, resulting in reduced actuation expense.

SEGMENTED STOP PLATE

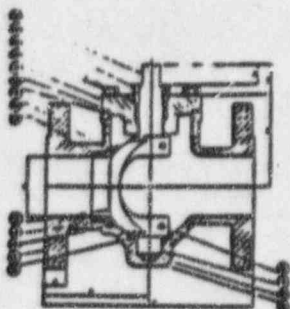
The segmented stop plate allows multiple disc positioning for throttling and exact flow control applications. Adjustments are easily made with the reactor handle as conditions demand.



BI-DIRECTIONAL

The Eccentric Tri-Seal's unique seat design provides bi-directional sealing for differential pressures across the disc. The valve can be mounted in any position with the seat upstream or downstream.

ROCKFORD
C-O-N-T-R-O-L-S



Handle - Class 2000, 1/2" x 1/2" dia.

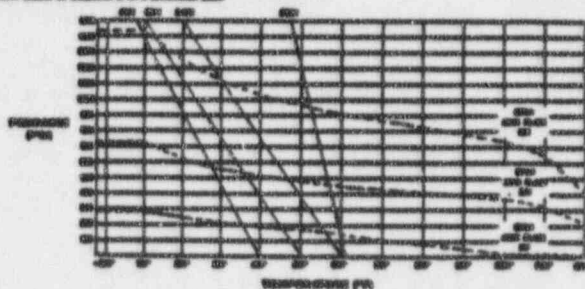


Size	A	B	C	D	E	F	G
1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"
3/4"	2"	2"	2"	2"	2"	2"	2"
1"	2 1/2"	2 1/2"	2 1/2"	2 1/2"	2 1/2"	2 1/2"	2 1/2"
1 1/2"	3 1/2"	3 1/2"	3 1/2"	3 1/2"	3 1/2"	3 1/2"	3 1/2"
2"	4 1/2"	4 1/2"	4 1/2"	4 1/2"	4 1/2"	4 1/2"	4 1/2"
2 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"	5 1/2"
3"	6 1/2"	6 1/2"	6 1/2"	6 1/2"	6 1/2"	6 1/2"	6 1/2"
3 1/2"	7 1/2"	7 1/2"	7 1/2"	7 1/2"	7 1/2"	7 1/2"	7 1/2"
4"	8 1/2"	8 1/2"	8 1/2"	8 1/2"	8 1/2"	8 1/2"	8 1/2"
4 1/2"	9 1/2"	9 1/2"	9 1/2"	9 1/2"	9 1/2"	9 1/2"	9 1/2"
5"	10 1/2"	10 1/2"	10 1/2"	10 1/2"	10 1/2"	10 1/2"	10 1/2"
5 1/2"	11 1/2"	11 1/2"	11 1/2"	11 1/2"	11 1/2"	11 1/2"	11 1/2"
6"	12 1/2"	12 1/2"	12 1/2"	12 1/2"	12 1/2"	12 1/2"	12 1/2"
6 1/2"	13 1/2"	13 1/2"	13 1/2"	13 1/2"	13 1/2"	13 1/2"	13 1/2"
7"	14 1/2"	14 1/2"	14 1/2"	14 1/2"	14 1/2"	14 1/2"	14 1/2"
7 1/2"	15 1/2"	15 1/2"	15 1/2"	15 1/2"	15 1/2"	15 1/2"	15 1/2"
8"	16 1/2"	16 1/2"	16 1/2"	16 1/2"	16 1/2"	16 1/2"	16 1/2"
8 1/2"	17 1/2"	17 1/2"	17 1/2"	17 1/2"	17 1/2"	17 1/2"	17 1/2"
9"	18 1/2"	18 1/2"	18 1/2"	18 1/2"	18 1/2"	18 1/2"	18 1/2"
9 1/2"	19 1/2"	19 1/2"	19 1/2"	19 1/2"	19 1/2"	19 1/2"	19 1/2"
10"	20 1/2"	20 1/2"	20 1/2"	20 1/2"	20 1/2"	20 1/2"	20 1/2"

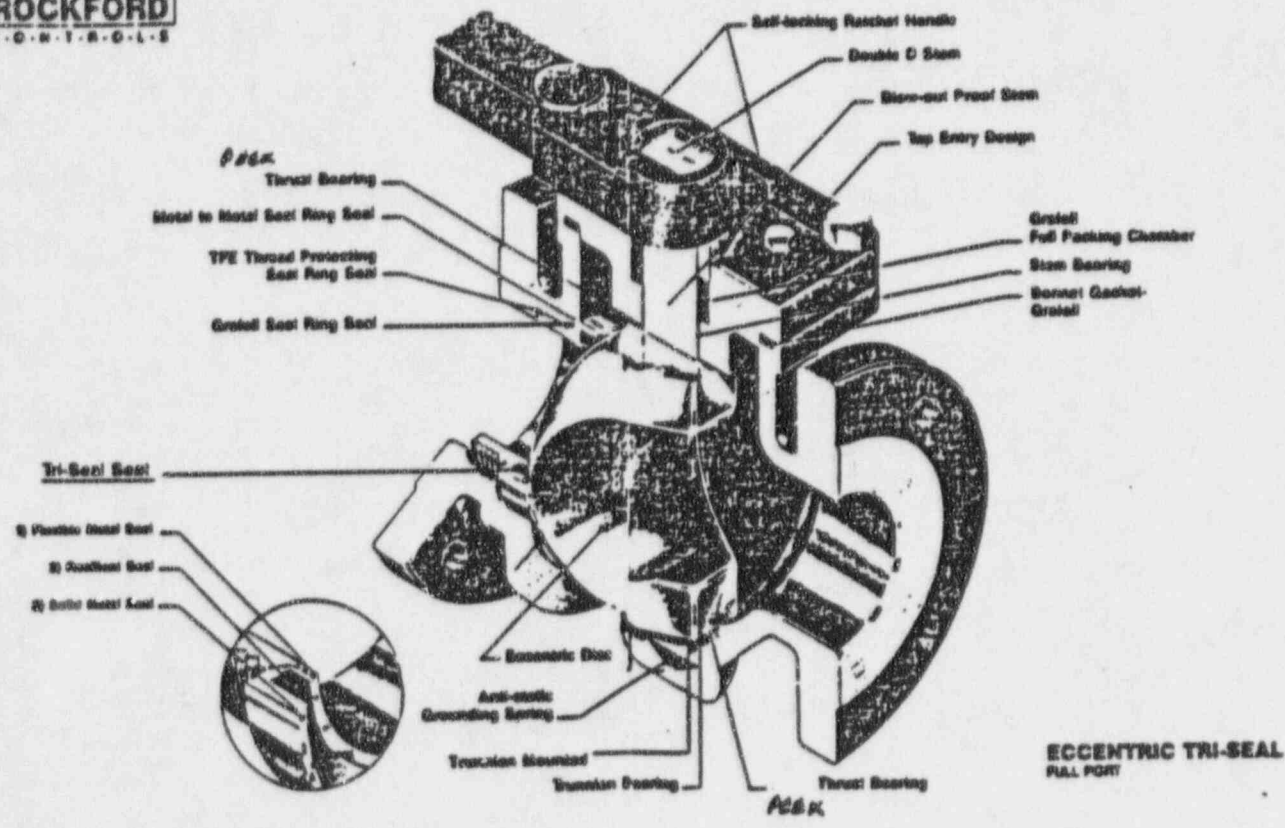
DIMENSIONS
ALL DIMENSIONS IN INCHES
PRESSURE CLASS 2000
1/2" - 10" x 1/2"

PRESSURE-TEMPERATURE LIMITS

Maximum Pressure: 1000 PSI at 100°F for Class 2000
Maximum Temperature: 100°F at 1000 PSI for Class 2000
See also limits for other classes in the catalog.



ROCKFORD
C O N T R O L S



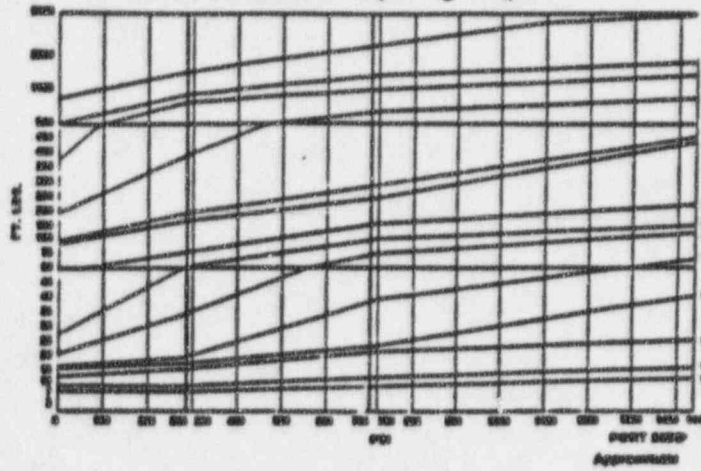
ROCKFORD
C.O.N.T.R.O.L.S

Seat Downstream - Closing Torque

Port Size	Class 150	Class 200	Class 600
1/2"	3	4	5
3/4"	4	6	8
1"	6	8	12
1 1/4"	7	12	20
1 1/2"	8	20	27
2"	17	22	30
2 1/2"	27	30	71
3"	43	36	112
4"	67	123	220
4 1/2"	93	145	240
6"	185	220	400
8"	270	310	670
10"	371	340	780
12"	510	1200	2171

Approximate

Seat Downstream - Opening Torque



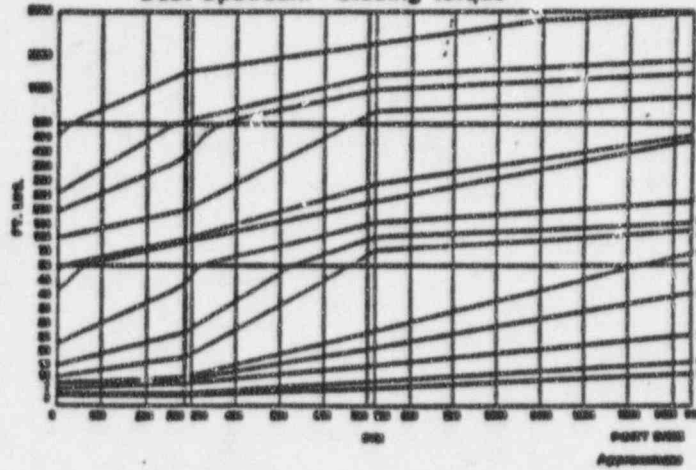
HIGH TEMPERATURE SERVICE
Our patented fire-resist seal offers API 598 closure at 1400° F. with special seal and packing arrangements.

Seat Upstream - Closing Torque

Port Size	Class 150	Class 200	Class 600
1/2"	2	4	5
3/4"	3	5	11
1"	4	7	12
1 1/4"	5	11	20
1 1/2"	6	14	27
2"	8	20	30
2 1/2"	14	22	71
3"	22	34	112
4"	40	50	220
4 1/2"	48	145	240
6"	90	220	400
8"	130	310	670
10"	220	340	780
12"	350	1200	2171

Approximate

Seat Upstream - Closing Torque



TORQUES
ECCENTRIC TRI-SEAL
PORT SIZE

Additional requirements to torque may be imposed by valve characteristics, size and cycle frequency of valve operation. For further information on valve automation, consult the actuator section of your catalog.

ROCKFORD
C-O-N-T-R-O-L-S

Item No.	Part Name	Standard Description	Qty	Material	Notes
1	Body	AS101 AND 51			
2	Bracket	AS101 AND 51			
3	Pin	AS101 AND 51			
4	Washers	AS101 AND 51			
5	Steel Bolts	AS101 AND 51			
6	Steel Bolts	AS101 AND 51			
7	Steel Bolts	AS101 AND 51			
8	Steel Bolts	AS101 AND 51			
9	Steel Bolts	AS101 AND 51			
10	Steel Bolts	AS101 AND 51			
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84	Steel Bolts	AS101 AND 51			
85	Steel Bolts	AS101 AND 51			
86	Steel Bolts	AS101 AND 51			
87	Steel Bolts	AS101 AND 51			
88	Steel Bolts	AS101 AND 51			
89	Steel Bolts	AS101 AND 51			
90	Steel Bolts	AS101 AND 51			
91	Steel Bolts	AS101 AND 51			
92	Steel Bolts	AS101 AND 51			
93	Steel Bolts	AS101 AND 51			
94	Steel Bolts	AS101 AND 51			
95	Steel Bolts	AS101 AND 51			
96	Steel Bolts	AS101 AND 51			
97	Steel Bolts	AS101 AND 51			
98	Steel Bolts	AS101 AND 51			
99	Steel Bolts	AS101 AND 51			
100	Steel Bolts	AS101 AND 51			

FLOW CHARACTERISTICS
VAL. PORT - FLANGED END

ROCKFORD
C-O-N-T-R-O-L-S

APPENDIX I - 10000

SIZE	AS101	AS102	AS103	AS104
1/2"	100	100	100	100
3/4"	100	100	100	100
1"	100	100	100	100
1 1/2"	100	100	100	100
2"	100	100	100	100
2 1/2"	100	100	100	100
3"	100	100	100	100
3 1/2"	100	100	100	100
4"	100	100	100	100
4 1/2"	100	100	100	100
5"	100	100	100	100
5 1/2"	100	100	100	100
6"	100	100	100	100
6 1/2"	100	100	100	100
7"	100	100	100	100
7 1/2"	100	100	100	100
8"	100	100	100	100
8 1/2"	100	100	100	100
9"	100	100	100	100
9 1/2"	100	100	100	100
10"	100	100	100	100

The data above are based on tests run at Rockford Valve Co. under various conditions. The data are for reference only and should not be used for design purposes.

THROTTLING PERCENTAGES OF RATED FLOW COEFFICIENTS (Cv)

APPENDIX I - 10000

Valve Size	10	20	30	40	50	60	70	80	90
1/2"	100	100	100	100	100	100	100	100	100
3/4"	100	100	100	100	100	100	100	100	100
1"	100	100	100	100	100	100	100	100	100
1 1/2"	100	100	100	100	100	100	100	100	100
2"	100	100	100	100	100	100	100	100	100
2 1/2"	100	100	100	100	100	100	100	100	100
3"	100	100	100	100	100	100	100	100	100
3 1/2"	100	100	100	100	100	100	100	100	100
4"	100	100	100	100	100	100	100	100	100
4 1/2"	100	100	100	100	100	100	100	100	100
5"	100	100	100	100	100	100	100	100	100
5 1/2"	100	100	100	100	100	100	100	100	100
6"	100	100	100	100	100	100	100	100	100
6 1/2"	100	100	100	100	100	100	100	100	100
7"	100	100	100	100	100	100	100	100	100
7 1/2"	100	100	100	100	100	100	100	100	100
8"	100	100	100	100	100	100	100	100	100
8 1/2"	100	100	100	100	100	100	100	100	100
9"	100	100	100	100	100	100	100	100	100
9 1/2"	100	100	100	100	100	100	100	100	100
10"	100	100	100	100	100	100	100	100	100

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Vendor Literature - HEME Element

KOCH

Form No. F587

KOCH ENGINEERING COMPANY INC

KOCH FLEXIFIBER® MIST ELIMINATOR INSTALLATION & OPERATING INSTRUCTIONS

INTRODUCTION:

The Koch FLEXIFIBER® element(s) you received has been specifically designed to satisfy your requirements. It is completely assembled and has no moving parts. With proper handling & installation, your element will provide years of dependable service with little periodic maintenance.

The vessel housing the FLEXIFIBER® element should be provided with connections, one upstream and one downstream of the element for connecting an instrument to monitor differential pressure across the element.

If it is necessary to store the element prior to installation, we recommend leaving it in the crate and storing it in the horizontal position, in a clean dry area, safe from accidental damage. The protective plastic wrapping on the element should remain in place during storage. If multiple elements are involved, crates can be stacked to a maximum of 4 high. The crate(s) are intended for re-use should the element need to be returned for repacking, and should be handled and stored accordingly.

INSTALLATION:

Remove the top of the crate only. Leave the plastic wrap on the element. To remove the element, tip the crate carefully and roll the element out or lift the element with two (wide) slings. After removal from the crate, the element should be lifted utilizing the integral lifting lugs provided. While moving the element to its operating location careful handling is essential to protect it from piercing, cutting, severe end impact, soiling, etc.

An effective seal between the element mounting flange and the support (tube sheet or vessel body flange) is critical for proper operation. A TFE fluorocarbon gasket and required hardware (if supplied) are provided. The plastic wrap should be removed from the element immediately prior to installing the element to its support. Mating Surfaces of element and support are to be clean, smooth and dry. Gasket installation and bolt tightening sequence as shown on next page should be observed. Lower the element into place, be careful to align the bolt holes without damaging gasket. Tighten machine bolts to approx. 40 ft./lbs of torque.

P.O. Box 8127 • Wichita, Kansas 67208 • 316/832-5110 • TLX 4318010 • Teletype 316/832-8843
Circle Address "KOCH"

APPENDIX J

1

SD:0001599.07

If the element is provided with a dip pipe (forward flow hanging elements), the pipe threads should be wrapped with teflon tape and the dip pipe installed. If the pipe is provided with a welded seal cup, the cup must be filled to overflow with a suitable liquid prior to operation. If a dip pipe is used without a cup, the vessel sump must have liquid added until the dip pipe is submerged to the proper dimension, prior to operation.

NOTE: prior to operation, all equipment and ducting should be thoroughly cleaned of foreign matter that could migrate downstream and cause pluggage of the FLEXIFIBER® element.

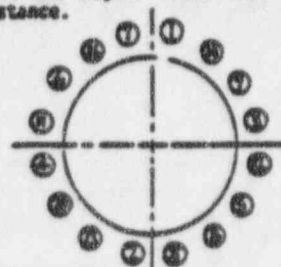
OPERATION

After start-up, the differential pressure instrument reading will gradually increase for several days, as the element becomes saturated and approaches design operational equilibrium. If the mist loads and characteristics remain constant, this ΔP reading should remain fairly steady. The differential pressure should be periodically monitored and recorded. If changes are made in the flow rate or liquid viscosity, a different equilibrium differential pressure will result.

A considerable drop in ΔP from the steady state ΔP reading is an indication of a bypassing condition. This could be caused by fiber damage, a failure in the seal between the element mounting flange and it's support or loss of the liquid drainage seal. This condition requires correction, by restoring the seal or repacking the element.

A considerable increase in the ΔP reading is an indication of element plugging. This condition also requires correction. Solvent or detergent cleaning will sometimes be sufficient to restore the element's capacity of throughput and efficiency. However, washing must be done cautiously to avoid damage to the fiber. If this does not correct the condition, repacking or replacement of the element is required.

Repacking should be done by the Koch Engineering Company. The customer should verify that the FLEXIFIBER® cage (flange, end & screens) does not have excessive wear, damage or corrosion. The glass fiber packing must be removed and the cage must be cleaned of chemical residue prior to returning it to Koch for repacking. Ship the cages in the reusable crate to Koch Engineering Company, Inc., 4111 E. 37th Street North, Wichita, KS 67220. Please call the Koch Engineering, Mist Eliminator Department, telephone no. 316/832-5110 and notify them when to expect the cages. Feel free to call them anytime with questions or for any assistance.



Bolt Tightening Sequence

KOCH

KOCH ENGINEERING COMPANY INC

KOCH FLEXIFIBER® MIST ELIMINATOR

SUPPLEMENTAL INSTALLATION, SHIPPING AND OPERATING INSTRUCTIONS

The element is shipped from Koch in a crate that incorporates adequate full length support.

If the element is to be installed in a vessel that will be shipped to the job site on its side the element must be provided with full length support within the vessel, to avoid bending and warpage of the element during transport.

The preferred procedure is to install the element into the vessel after the vessel has been erected and placed on its foundation at the job site. This avoids the bending/warpage and damage potential incurred when shipping the unit previously installed in the vessel.

Koch should be informed and consulted for support approval before proceeding with any remote installation.

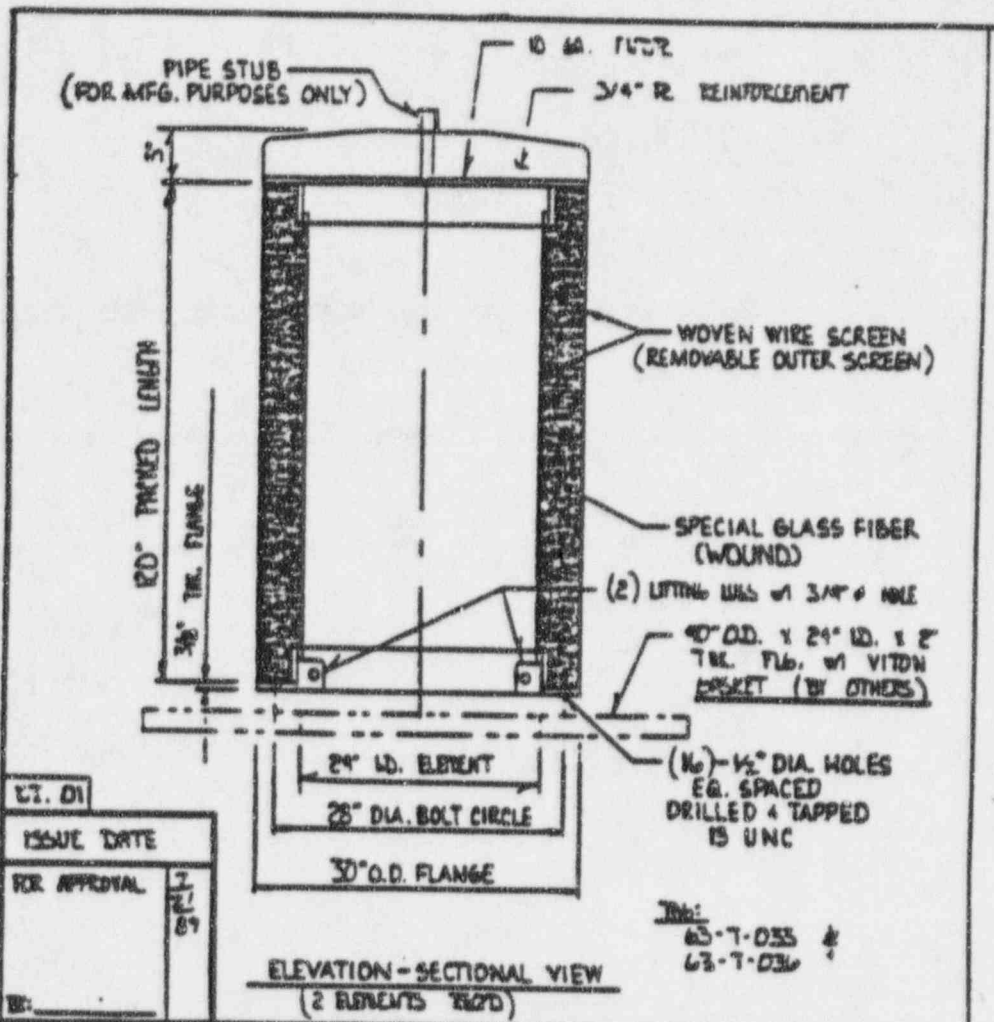
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316/832-5110 • TLX 4318010 • Telex 216/832-8843

APPENDIX J

3

SD:0001599.07

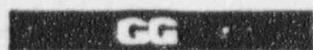


QTY.	DESCRIPTION	MAT'L	FURNISH BY	SIZE
16	BOLTS & WASHERS	304	X	1/2" x 3" HEX HD. M.B. (13 UNC) & FLAT WASH
2	ELEMENT: MAT'L - 304L			
	w/ 3/16" SCREENS & SPECIAL			
	GLASS FIBER			
2	BASKET - MAT'L - TFE			
	FLUOROCARBON 1/2" DIA. (SORTED)			

CUSTOMER ORDER NO. 2132-11579	FLEXIFIBER® ELEMENT TYPE BD-FRF MARK II
	SPECIALTY MAINTENANCE UNCEPND
	KOCH ENGINEERING COMPANY, INC.
	WICHITA, KANSAS
DATE: 07.01	DRIVING
F32053	32053-A-00-01

Vendor Literature - HEME Spray Nozzles

FullJet
WIDE ANGLE
STANDARD TYPE



REMOVABLE CAP & VANE
1/8" - 1/2" NPT (M)

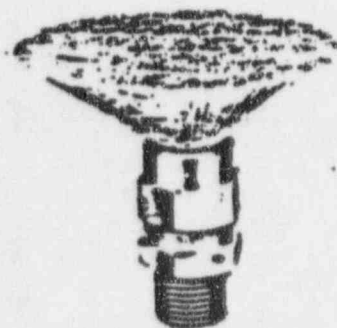


DIMENSIONS & WEIGHTS

Based on largest/nearest version of each type



Nozzle Inlet Conn. (NPT)	A	B	Net Weight
1/8"	1 1/2"	3/8" HBL.	1/4 oz.
1/4"	1 3/4"	1/2" HBL.	1 1/2 oz.
3/8"	1 7/8"	3/4" HBL.	2 1/2 oz.
1/2"	2"	1" HBL.	6 oz.



DESIGN FEATURES

Wide Angle FullJets feature a solid cone-shaped spray pattern with a round impact area and spray angles of 120° to 125°.

They produce a uniform spray of medium to coarse droplets across their entire spray area . . . to give excellent results in spraying applications requiring complete coverage of an area or zone.

This uniform spray distribution

results from a unique vane design and exacting internal proportions . . . engineered to assure accurate and consistent performance.

G-W and GG-W Wide Angle FullJet nozzles feature three-piece construction (body/cap/vane) with removable vane. This style of nozzle is especially well suited for header and manifold installations . . . allowing the removal and inspection of the cap and vane without removal of the nozzle body from the header.

Vendor Literature - Prefilter Seals

Flanders® Product Data Sheet

FLANDERS FILTERS, INC. P.O. Box 1708 Washington, NC 27889-1708 (919) 946-8081

— BLU-JEL® Seal —

The most advanced filter-to-frame seal
from the inventors of the fluid seal concept.
Available only from Flanders.

General Description

Flanders BLU-JEL Seal is a unique, ice-blue silicone gel specially designed to create and preserve an airtight seal between high-efficiency particulate air filters and their holding frames or housings. The gel is factory-installed and factory-cured in the perimeter channels of filters designed for fluid seal applications. The cured gel has the self-healing qualities of a liquid while retaining the stability and non-flow characteristics of a solid. These properties are maintained at both high and low temperature extremes and are not lost even when aged continuously at high temperatures. BLU-JEL Seal exhibits excellent bonding characteristics to many materials. It is also highly self-adhesive, allowing knife edges and filter starts to be cleanly withdrawn. The hydrophobic nature of the gel makes it ideally suited for applications that require long-term sealing against moisture and other atmospheric contaminants.

Temperature Range

The recommended constant operating temperature range for BLU-JEL Seal is -70°F to $+382^{\circ}\text{F}$. Short terms (1-2 hours) at higher temperatures should be limited to 500°F . Exposure to either extreme will not alter the properties of the gel when returned to ambient temperature. Temperatures below -70°F will increase hardness; the gel will become brittle at -90°F and will be prone to cracking if subjected to mechanical shock. Continuous exposure to temperatures above $+382^{\circ}\text{F}$ will result in degradation of the polymer.

Fire and Explosion Data

Flash Point: Determined by Cleveland ASTM D92 Open Cup Method. Result: No flash at 450°F .

Exposure to Flame

A flame exposure test evaluating BLU-JEL Seal's flammability and self-extinguishing characteristics was performed, following the same procedure used in the Underwriters UL 94-VO test. The gel turned to ash on the outer surface, but the inner core remained normal. The gel maintained its physical shape and did not run or

meit. Based on the testing, it is concluded that BLU-JEL Seal is a self-extinguishing material that will perform its designed function as a filter-to-housing sealant until flame impingement totally turns the sealant to ash.

Volatility

The non-volatile content of BLU-JEL Seal, as determined by testing 2 grams for 2 hours at 302°F (150°C) is 98%. The volatility rate of the gel, measured after it has been cured at the factory and is ready for shipment is 0.2%.

Penetration

The effect of temperature on the hardness of BLU-JEL Seal has been tested using a Brookfield LVT No. 3 test machine. The following results are expressed in points of penetration ($\text{mm} \times 10^{-1}$) as measured by the machine.

at -58°F : 35 at $+77^{\circ}\text{F}$: 57 at $+382^{\circ}\text{F}$: 34

Chemical Resistance

Information on BLU-JEL Seal's resistance to a wide variety of oils, fuels, hydraulic fluids, solvents, silicone fluid, greases, food products, water and steam, acids, bases, salts and other chemicals are available from the factory upon request.

Radiation Effects

The expected radiation resistance of BLU-JEL Seal is 20 megarads at room temperature, 10 megarads at $+150^{\circ}\text{C}$, and 5 megarads at $+200^{\circ}\text{C}$. Radiation exposure at these levels will not affect the sealing properties of the compound. Exposure to higher levels of radiation and temperature will result in brittleness, which is not reversible. Further information on radiation testing is available from the factory.

Non-Nutrient

BLU-JEL Seal is a non-nutrient and will not of itself support biological growth. The compound does not contain a fungicide.

— BLU-JEL® Seal Applications —

The fluid seal technique provides a simple solution to a problem that has long been associated with air filters used in critical applications: bypass leakage at the interface of the filter and its housing or supporting framework. This bypass can contribute to high particle counts in clean rooms and laminar flow work areas.

Bypass leakage occurs primarily where gaskets are used to seal filters. Many factors contribute to its occurrence: improper gasket joints; mating flanges which are not flat or which have been distorted by clamping

mechanisms used to compress the gasket; "memory" loss or aging of the gasket material; or bad seats or welds in the filter mounting framework.

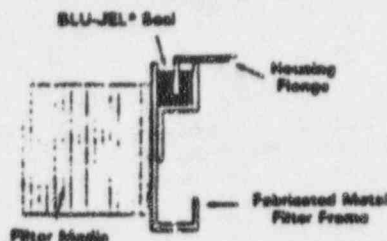
The fluid seal technique, first developed and patented by Flanders in 1969, succeeds in eliminating bypass leakage because it avoids the major factors that cause it: the use of gaskets and the need for absolutely flat mating surfaces. The technique also eliminates clamping devices and allows filters to be easily installed and replaced.

Fluid Seal Filters

Instead of a gasket, Flanders' '05' and '06' filter frame styles feature a continuous groove or channel around one perimeter, or face, of the filter. Placement of the channel is typically upstream in the '05' design and downstream in the '06' design. The channel is factory-

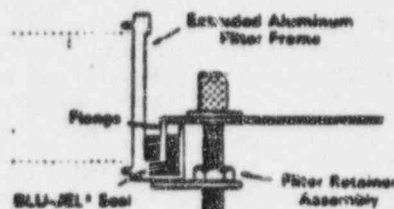
filled with BLU-JEL® Seal. The filter-to-frame seal is effected when a continuous knife edge flange located in the filter housing or holding frame mates into the channel of sealant.

'05' Frame Style



Section View

'06' Frame Style

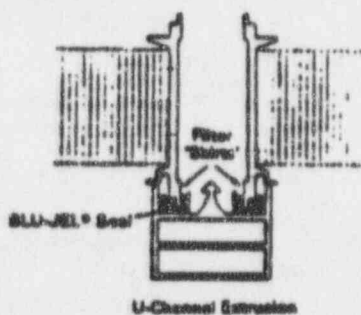


CHANNEL-CEIL® Systems

Flanders' CHANNEL-CEIL® System is an open-plenum, vertical laminar flow cleanroom filter ceiling based on a suspended gridwork of V-shaped or U-shaped extruded aluminum channels. Hepa filters are designed with

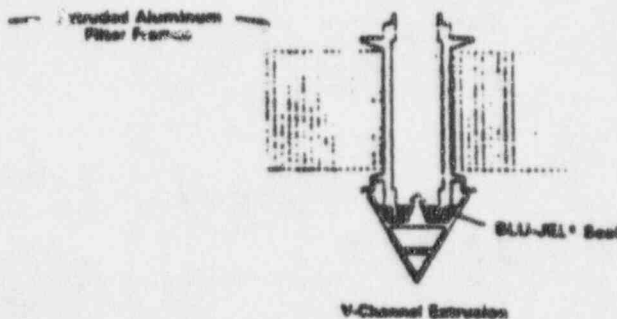
"skirts" sited to fit into the gridwork of channels. The channels are filled with BLU-JEL® Seal. The skirted filter frames mate into the gel, thus effecting the filter-to-grid seal.

LPF Grid



Section View

LPV Grid



Handling Equipment

In-Cell Off-Gas System and Vessel Ventilation System equipment is installed, replaced, and removed, using a bare crane hook, a Type I lifting yoke, a Type II lifting yoke, or a 150 mm (6") Flange Gasket Yoke. The Type I, Type II, and 150 mm (6") Flange Gasket lifting yokes are considered to be parts of the In-Cell and Vessel Vent System equipment because they serve no purpose other than supporting these systems.

The Type I yoke has two 13.6 Mg (15 ton) carbon steel hooks positioned parallel with the yoke beam and weighs 195 kg (430 lb_m). The Type II yoke has two similar hooks positioned perpendicular to the yoke beam and weighs 200 kg (440 lb_m). For both types, the positions of the hooks on the beam are adjustable so that several separate items of equipment can be accommodated by a single yoke. Figures 7.14-1 and 7.14-2 show the configurations of the two handling yokes. Figure 7.14-3 shows the 150 mm (6") Flange Gasket Yoke which weighs only 6.8 kg (15 lb_m). Table 7.14-1 identifies the items of equipment designated for handling by bare crane hooks, the Type I Yokes, the Type II Yokes, and the Flange Gasket Lifting Yoke (FGLY). Where Type I and Type II yokes are required, the appropriate hook separation for each item is identified by the table.

The HEME's and Condenser were delivered in cradles which have been retained for possible future use. The two HEME Shipping Cradles measure 6290 mm (20'-7.5") long, 2250 mm (7'-4.5") wide, 1300 mm (4'-3") high, and are equipped with tipping trunions. The Condenser Shipping Cradle measures 6450 mm (21'-2") long, 1830 mm (6'-0") wide, 1300 mm (4'-3") high, and is equipped with a tipping trunion.

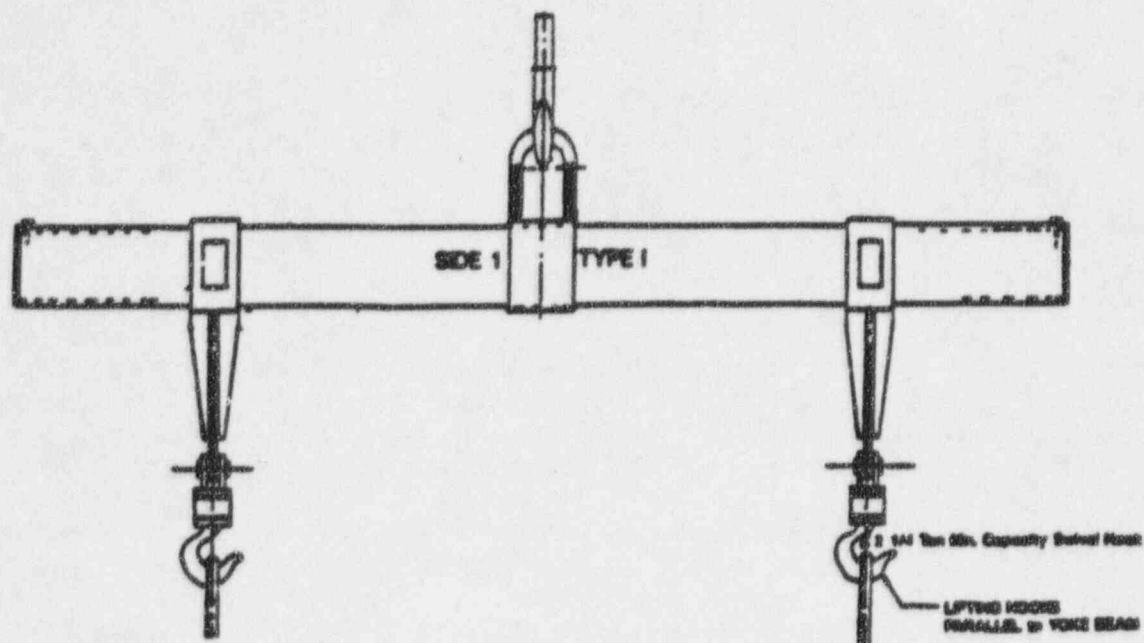


Figure 7.14-1: Handling Yoke Type I

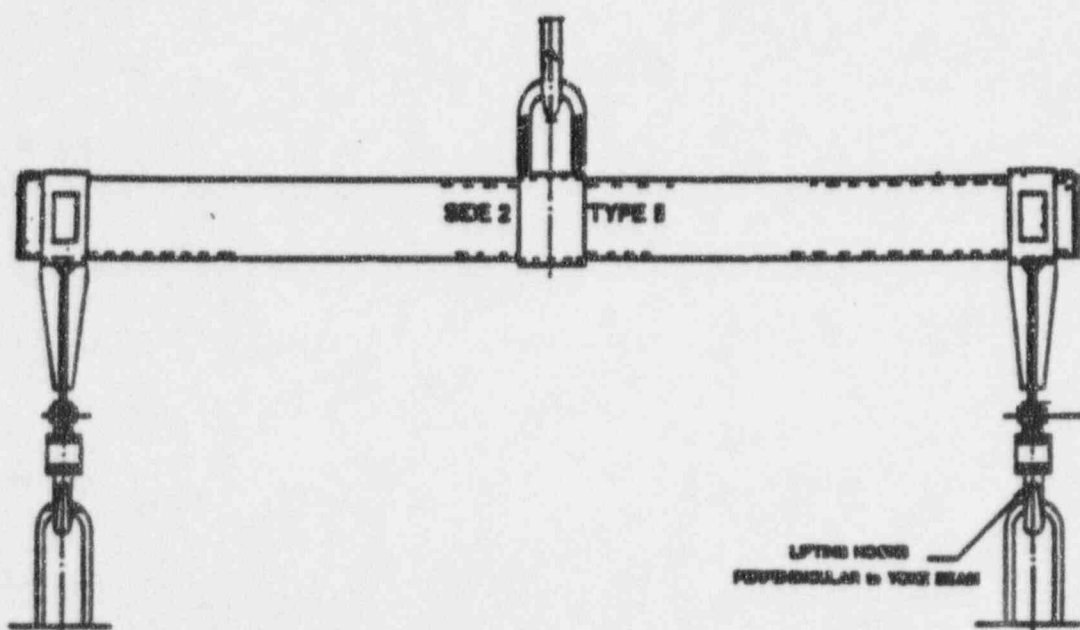


Figure 7.14-2: Handling Yoke Type II

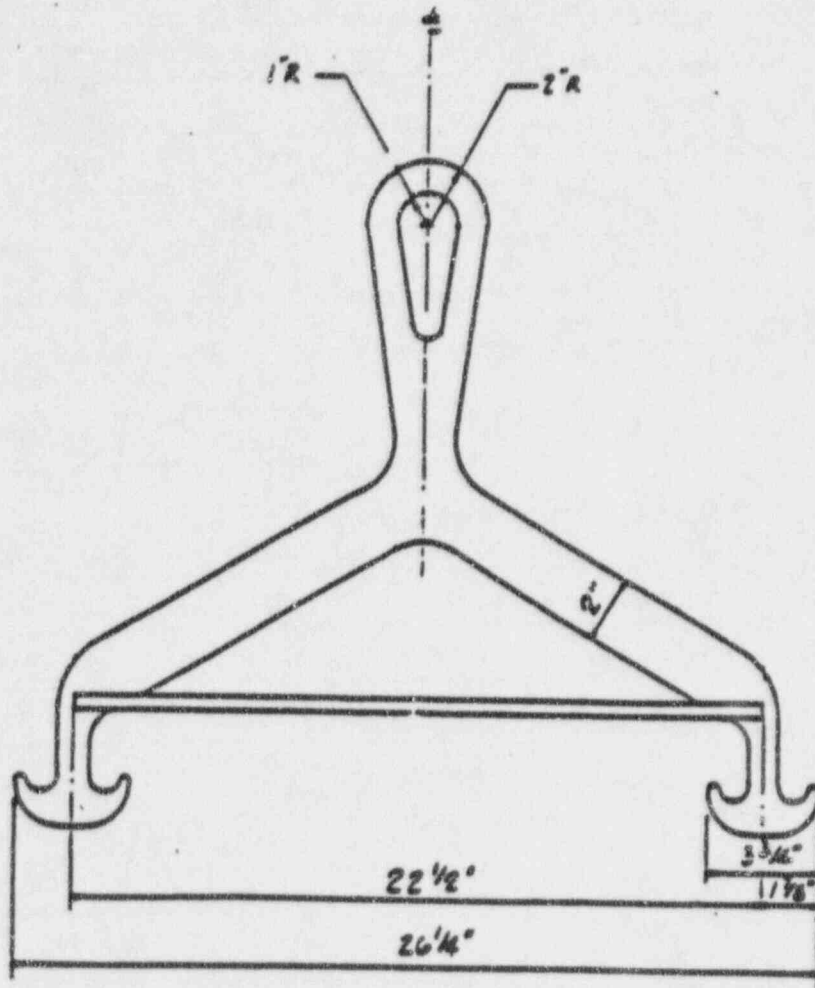


Figure 7.14-3: 150 mm (6") Flange Gasket Lifting Yoke

Table 7.14-1: Lifting Applications

No.	Item	Method	Hook Separation	
			mm	in.
1	Mist Eliminator	Hook	na	na
1a	Mist Eliminator Flange Gasket	FGLY	na	na
2	HEME Preheater	Yoke I	1213	47.75
2a	HEME Preheater Element	Hook	na	na
2b	HEME Preheater Element Gasket	Yoke I	686	27.00
2c	HEME Preheater Flange Gaskets ⁽¹⁾	Yoke I	686	27.00
3	Off-Gas Jumpers to HEMEs	Hook	na	na
3a	Off-Gas Jumper Flange Gaskets	FGLY	na	na
4	HEMES	Yoke II	813	32.00
4a	HEME Spray Units ⁽²⁾	Yoke I	584	23.00
4b	HEME Spray Unit Gaskets	FGLY	na	na
4c	HEME Elements	Yoke II	959	37.75
4d	HEME Dished Heads	Yoke II	813	32.00
4e	HEME Dished Head Gaskets	Yoke I	1448	57.00
4f	HEME Flange Gaskets ⁽³⁾	FGLY	na	na
4g	HEME Rotation	Yoke II	813	32.00
5	Filter Preheaters	Yoke I	1067	42.00
5a	Filter Preheater Elements	Hook	na	na
5b	Filter Preheater Element Gaskets ⁽¹⁾	Yoke I	1016	40.00
5c	Filter Preheater Flange Gaskets	FGLY	na	na
6	Prefilters	Yoke II	2108	83.00
7	Off-Gas Jumpers to Postheater	Hook	na	na
7a	Off-Gas Jumper Flange Gaskets	Yoke I	572	22.50

Table 7.14-1: Lifting Applications (Concluded)

No.	Item	Method	Hook Separation	
			mm	in
8	Postheater	Yoke I	1286	50.63
8a	Postheater Element Gasket ⁽¹⁾	Yoke I	686	27.00
8b	Postheater Flange Gaskets	FLGY	na	na
9	Discharge Flowmeter	Hook	na	na
9a	Discharge Flowmeter Gasket	FLGY	na	na
10	Vent Header	na	na	na
10a	Vent Header Gaskets ⁽⁴⁾	Yoke I	572	22.50
11	Condenser Shell	Yoke II	584	23.00
11a	Condenser Flange Gasket	FLGY	na	na
11b	Condenser Upper Gasket	Yoke I	1143	45.00
11c	Condenser Tube Bundle	Yoke I	1181	46.50
11d	Condenser Lower Gasket	Yoke I	1143	45.00

(1) Use auxiliary hooks. Must use gasket lifting yoke for Nozzles D and F.
(2) The process bridge crane turntable will need to be rotated so the yoke beam can be positioned above the bottom of the bridge beams.
(3) HEME 63-T-033 Nozzle B gasket requires the 150 mm (6") Flange Gasket Yoke because the HEME body will interfere with use of the Type I yoke.
(4) Vessel Vent Header Nozzles D & F require the 150 mm (6") Flange Gasket Yoke because their locations in the corners of the cell prevent access by the Type I yoke.

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Vessel Vent Header Performance Testing Requirements

1.0 Introduction and Purpose

The Vessel Vent Header System in the WVDP Vitrification Cell provides for the safe removal of the process gases from the melter and other related vessels while maintaining vessels and ducting at a slight vacuum for contamination control.

The information contained in this report defines the performance testing requirements for the Vessel Vent Header System.

The stated objectives of test 63H-DC-20 are:

- To demonstrate the functionality of the system for normal and abnormal operation using administrative operating procedures, and
- To demonstrate the ability to "handle (the) alternate melter vent path."

The testing requirements which follow are to be performed after precommissioning testing has confirmed that all related piping connections and instrumentation has been properly installed.

Successful testing to these requirements should assure the Vessel Vent Header System will be able to fulfill its mission.

2.0 Demonstrate Functionality for Normal and Abnormal Operation

NOTE: The following procedures satisfy the first requirements of Test Number 63H-DC-20.

2.1 Vacuum Control with the CFMT Idling & the Melter Isolated from the Vessel Vent Header

NOTE: This procedure will demonstrate the ability of the system to maintain vacuum in the vent header, and the responsiveness of the control valve to changing conditions. The off-gas systems must be placed into active service before this procedure can be performed.

Configure the DCS to modulate control valve PY-1502 to control the vessel ventilation header vacuum, as measured by PT-1505.

Assure that one of the off-gas system blowers is operating; that the CFMT, FHT, Waste Header and Canister Decontamination Station are open to the vent header; that the melter is isolated from the vent header, and that the CFMT is in idle mode.

Establish the vent header vacuum control set point at -34 kPa gage (-5 InWG), and record the set point. After equilibrium has been established, record the data requested by Table 2.1, Column 1.

Acceptance Criterion: The vessel vent header vacuum must be held between -0.75 kPa gage (-3.0 InWG) and -1.7 kPa gage (-7.0 InWG).

Establish the vent header vacuum control set point at -14 kPa gage (-2 InWG), and record the set point. After equilibrium has been established, record the data requested by Table 2.1, Column 2.

Acceptance Criterion: The vessel vent header vacuum must be held between 0.0 kPa gage (0.0 InWG) and -1.0 kPa gage (-4.0 InWG).

Establish the vent header vacuum control set point at -55 kPa gage (-8 InWG), and record the set point. After equilibrium has been established, record the data requested by Table 2.1, Column 3.

Acceptance Criterion: The vessel vent header vacuum must be held between -1.5 kPa gage (-6.0 InWG) and -2.5 kPa gage (-10. InWG).

2.2 Vacuum Control with the CFMT Boiling & the Melter Isolated from the Vessel Vent Header, and Condenser Performance Testing

NOTE: These integrated tests will demonstrate the ability of the system to maintain a vacuum in the CFMT during boiling operations, and the ability of the vessel vent condenser to perform satisfactorily over a range of abnormal operating conditions.

Assure that condensate will not be delivered to tank 8D-3 or any other tank in the tank farm.

Establish a method to measure flow of condensate from the bottom of the condenser during operation of the condenser. Any convenient method which produces accurate information (flow meter, bucket and stop watch, etc.) is acceptable.

NOTE: This measurement system will be used for confirmation of weir calibration, confirmation of CFMT boildown rate, and establishment of condenser performance characteristics.

Assure the DCS is configured to control the temperature at the condenser exit, as measured by TE-1502, by modulating the cooling water flow at TV-1508. Establish an initial temperature set point of 49 °C (120 °F).

Configure the DCS to modulate control valve PY-1502 to control the vacuum in the CFMT freeboard, as measured by PT-0114, and to maintain a vacuum in the CFMT freeboard of -34 kPa gage (-5 InWG).

Assure the condenser drain valve is open, and that a liquid seal is established in the condenser drain "U" trap.

Assure that one of the off-gas system blowers is operating; that the CFMT, FHT, Waste Header and Canister Decon Station are open to the vent header; and that the melter is isolated from the vent header.

Place the Vessel Vent Condenser into service as described by the system description, WVNS-SD-063H.

Immediately before initiation of boiling in the CFMT, record the data requested by Table 2.2, Column 1.

Establish boiling in the CFMT at a rate of about 190 L/h (50 gph), which is equivalent to the presently anticipated boil down rate. After the system has achieved equilibrium, record the data as requested by Table 2.2, Column 2.

Acceptance Criterion: The pressure in the CFMT must be maintained at less than the cell ambient pressure.

Increase the boiling rate in the CFMT to about 645 L/h (170 gph). After the system has achieved equilibrium, record the data as requested by Table 2.2, Column 3.

Increase the boiling rate in the CFMT to about 1100 L/h (290 gph), which is approximately the maximum available boiling rate. After the system has achieved equilibrium, record the data as requested by Table 2.2, Column 4.

Leave the boiling rate in the CFMT unchanged at about 1100 L/h (290 gph) and change the Condenser outlet temperature set point to 38 °C (100 °F). After the system has achieved equilibrium, record the data as requested by Table 2.2, Column 5.

Leave the boiling rate in the CFMT unchanged at about 1100 L/h (290 gph) and change the Condenser outlet temperature set point to 60 °C (140 °F). After the system has achieved equilibrium, record the data as requested by Table 2.2, Column 6.

NOTE: Based upon performance testing by the condenser vendor, data in column 1 can be used to measure the dry gas flow rate through the condenser.

NOTE: Data in columns 2, 3 & 4 relate condenser performance for changes in CFMT and vent header, vacuum levels, and demonstrates the flexibility of the control system.

NOTE: Data in columns 2, 5 & 6 relate condenser performance for changes in condenser outlet temperature set points. This is significant because, should we decide to adjust the SBS operating temperature to change the amount of water expelled to the stack, a corresponding adjustment should be made for the condenser.

3.0 Demonstrate Ability to Handle Alternate Melter Vent Path

NOTE: This procedure satisfies the second requirement of Test Number 63-DC-20. The melter and off-gas systems must be placed into active service before this procedure can be performed.

Establish a method to measure the skin temperature of the vessel vent header immediately downstream from Nozzle F where the hot gases from the melter will enter.

NOTE: This measurement will be used to confirm the design of the vent header, which was based upon theoretical calculations showing the temperature at Nozzle F could be about 260 °C (500 °F).

Assure the DCS is configured to open the valve (HV-2001) in the jumper from the melter to the vent header upon insufficient vacuum in the melter. Establish the set point which would initiate opening of the valve at -14 kPa gage (-2 InWG) in the melter.

Assure the DCS is configured to interrupt delivery of steam to the CFMT coils when the valve (HV-2001) opens.

Configure the DCS to modulate control valve PY-1502 to control the vacuum in the CFMT freeboard, as measured by PT-0114, and establish a set point of -34 kPa gage (-5 InWG).

Assure the DCS is configured to modulate control valve TV-1508 to control the condenser exit temperature, as measured by TE-1502, and establish a set point of 49 °C (120 °F).

Assure that one of the off-gas system blowers is operating; that the CFMT, FHT, Waste Header and Canister Decon Station are open to the vent header; and that the melter is isolated from the vent header.

Assure the condenser drain valve is open, that a liquid seal is established in the condenser drain "U" trap, and that condensate will not be delivered to tank 8D-3 or any other tank in the tank farm.

Place the Vessel Vent Condenser into service as described by the system description, WVNS-SD-011. Immediately before initiation of boiling in the CFMT, record the data requested by Table 3.0, Column 1.

Establish boiling in the CFMT at a rate of about 1100 L/h (290 gph). After equilibrium has been established, record the data requested by Table 3.0, Column 2.

NOTE: These data will be used to establish the reference dry gas rate in the header and the boiling rate in the CFMT.

By manual means, slowly increase the in-bleed air to the melter until the valve in the jumper to the vent header automatically opens, then stop opening the air inbleed valve, and do not close it.

Observe, measure with a stopwatch, and record the length of time between the moment the valve opens and the moment the vacuum in the melter begins to increase.

Acceptance Criterion: The melter plenum pressure must never exceed the vitrification cell ambient pressure.

Observe, and record the approximate length of time between the moment the valve opens and the moment the vacuum in the melter achieves equilibrium.

NOTE: The responsiveness of the vacuum control at the melter may be slowed by the response time required to suspend boiling in the CFMT. This procedure is intended to observe and quantify that phenomenon.

Reconfigure the DCS to modulate the control valve (PV-1502) in the non-condensibles jumper based upon vacuum readings in the melter.

Observe how much time is required before the melter vacuum no longer increases. Record the time required and the final vacuum which was achieved.

NOTE: This will demonstrate the system's response to operator intervention to place the melter in a known and safe condition.

Measure and record the skin temperature of the Vessel Vent Header immediately downstream from Nozzle F.

Acceptance Criterion: The vent header skin temperature must not exceed 260 °C (500 °F).

Return the entire vitrification system to a known and safe condition.

4.0 Useful References

4.1 Process and Instrument Diagrams

CTS Vessel Vent System Process & Instrument Diagram, WVNS Drawing 900E-705, Sheet 19, latest revision

CTS Concentrator Feed Make-up Tank 63-V-001 Piping & Instrumentation Diagram, WVNS Drawing 900E-705, Sheet 2, latest revision

Melter Pneumatic Instrumentation, WVNS Drawing 900E-705, Sheet 9, latest revision

4.2 Arrangement

In-Cell Off-Gas Treatment System Facility General Arrangement, SMCI Drawing 21303, latest revision

4.3 Equipment Drawings

In-Cell Off-Gas Treatment System Vessel Vent Header 63-V-015, SMCI Drawings 26901 through 26905 inclusive, latest revisions

In-Cell Off-Gas Treatment System Condenser 63-E-015, SMCI Drawings 29001 and 29002, latest revisions

Table 2.1
Data for Vacuum Control with the CFMT Idling
& the Melter Isolated from the Vessel Vent Header

Measurement	Instrument	1	2	3
Date (dd/mm/yr)	na			
Time (Use 24 hour clock or indicate a.m. or p.m.)	na			
SBS Freeboard Vacuum	PT-3120			
Condenser Diff. Pressure	PDT-1505			
Header Vacuum Set Point	na			
Header Vacuum	PT-1505			
Operator Initials	na			

If the indicated units for data are not consistent with instrumentation, line out the indicated units and write-in the units actually measured

Table 2.2
Data for Vacuum Control with the CFMT Boiling
& the Melter Isolated from the Vessel Vent Header,
and for Condenser Performance Testing

Measurement	Instru- ment	1	2	3	4	5	6
Date (dd/mm/yr)	na						
Time (Use 24 hour clock, or show a.m. or p.m.)	na						
SBS Vacuum (InWG)	PT-3120						
Header Vacuum (InWG)	PT-1505						
CFMT Vacuum Set Point (InWG)	DCS	-5	-5	-2	-8	-5	-5
CFMT Vacuum(InWG)	PT-0114						
Cond Exit Temp Set Point (°C)	DCS	49	49	49	49	38	60
Condenser Exit Temp (°C)	TT-1502						
Condensate Flow (GPH)	As Devised	0					
Liq. Level in Condenser (Inches)	LT-1506						
Condenser Diff. Press. (InWG)	PDT-1505						
CFMT Temperature (°C)	TT-0101						
Cooling Water Source T (°C)	TI-1508						
Cooling Water Return T (°C)	TI-1509						
Cooling Water Flow (GPM)	FE-1508						
Operator Initials							

If the indicated units for data are not consistent with instrumentation, line out the indicated units and write-in the units actually measured.

Table 3.0
Data for Demonstration of
Ability to Handle Alternate Melter Vent Path

Measurement	Instrument	1	2	3	4
Date (dd/mm/yr)	na				
Time (Use 24 hour clock, or show a.m. or p.m.)	na				
SBS Freeboard Vacuum (InWG)	PT-3120			na	na
Header Vacuum (InWG)	PT-1505			na	na
CFMT Pressure Set Point (InWG)	DCS	-5	-5	na	na
CFMT Pressure (InWG)	PT-0114			na	na
Cond Exit Temp Set Point(°C)	DCS	49	49	na	na
Condenser Exit Temp (°C)	TT-1502			na	na
Condensate Flow (GPH)	As Devised	0		na	na
Liq. Level in Condenser (Inches)	LT-1506			na	na
Condenser Diff. Press. (InWG)	PDT-1505			na	na
CFMT Temperature (°C)	TT-0101			na	na
Cooling Water Source T (°C)	TI-1508			na	na
Cooling Water Return T (°C)	TI-1509			na	na
Cooling Water Flow (GPM)	FE-1508			na	na
Minimum Melter Vacuum (InWG)	PT-2004	na	na		na
Final Melter Vacuum (InWG)	PT-2004	na	na	na	
Elapsed time (sec)	na	na	na		
Operator Initials	na				

If the indicated units for data are not consistent with instrumentation, line out the indicated units and write-in the units actually measured.

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SBS Performance Testing Requirements

1.0 Introduction and Purpose

The Off-Gas and Vessel Vent System (System 63H) in the West Valley Demonstration Project (WVDP) Vitrification Cell provides for the safe removal of the process gases from the melter, and other related vessels, while maintaining vessels and ducting at a slight vacuum for contamination control.

The information contained in this report defines the performance testing requirements for the Submerged Bed Scrubber (SBS) of System 63H.

The stated objectives of test 63H-DC-10 are:

- To display compliance with WVNS-DC-010
- To show that the bed can accommodate maximum flow conditions while maintaining required efficiency
- To demonstrate the use of cooling, sparging, sampling, and sludge removal systems
- To demonstrate the operation of the steam jets and that process fluid does not suck back into gallery, and
- To determine the effect of the sampler on the off-gas stream.

The stated objective of test 63-DC-30 is:

- To show that both the vessel vent and the submerged bed scrubber can work together over an extended time period without excessive water condensing in the wrong places.

The testing requirements which follow are to be performed after precommissioning testing has confirmed that all related piping connections and instrumentation has been properly installed, and that System 63H has been properly initialized according to Section 3.0 of the system description (WVNS-SD-63H).

Prior to performance of all tests described by this report, the System Engineer for System 63H should be notified so that he may be present to observe.

Successful testing to these requirements should assure the Submerged Bed Scrubber will function as intended.

2.0 Submerged Bed Scrubber Start-up

The test requirements described in this section satisfy the needs defined by Test Number 63H-DC-10 of the test program plan.

2.1 Compliance with WVNS-DC-10

Each of the Functional Requirements and Operational Requirements of the SBS, as defined by WVNS-DC-010, are discussed in the following subsections. The Design Requirements, Interface Requirements and Quality Assurance Requirements defined by WVNS-DC-010 will have been met necessarily before WVNS accepts delivery of the SBS from the fabricator, so they do not need to be addressed here.

- 2.1.1 "The SBS shall be designed to scrub 99.9% of the particules greater than 1 micron in size from the melter off-gas." (WVNS-DC-010, para. 2.1, with supplemental data in para. 3.1.1)

A full scale SBS was operated throughout the five year Functional And Checkout Testing of System (FACTS) pilot plant program from 1984 to 1989. The report issued after the testing program, an attachment to memorandum EN:90:0037, stated that "A primary function is to remove the large diameter particulate from the off-gas ... the desire is 99.9% (viz, DF = 1,000) removal of all particulate >1.0 micron." The report goes on to conclude "Preliminary data reduction of "dust" ... indicates the SBS met the desired result."

To assure that the process SBS vessel would provide the same particulate removal efficiency as the full scale pilot plant SBS, the critical geometric parameters were retained. These included the diameter of the off-gas downcomer, the location the off-gases are delivered beneath the bed, the depth and diameter of the bed, the packing used in the bed, the diameter and depth of the scrubber vessel, and the location of the bed within the scrubber vessel. Therefore, we can conclude, based upon test results, that the process SBS will provide the particulate removal efficiency required by WVNS-DC-010.

No additional testing is required to meet this criterion of WVNS-DC-010.

- 2.1.2 "The SBS must be capable of quenching the off-gas to below 45°C (113 °F)." (WVNS-DS-010, para. 2.2, with supplementary information in para. 3.1.2)

NOTE: The certified design report for the process SBS concludes "... 6.3 coil turns, as defined in Figure 2, will remove the required amount of heat transferred from the off-gas to the scrub solution to maintain its temperature at 113 °F," (See "Heat Transfer Analysis" sheet 26 of 75.). The final design, which is keyed to the information presented in Figure 2 of the design report, has 6.73 turns (See Westinghouse Nuclear Waste Technology drawing

1990E31, Sheet 1). Because the design report applied the worst case cooling water temperature, 32 °C (90 °F), to its analysis, as opposed to the cooler temperatures normally anticipated, and because the actual heat transfer coils include more turns, and thus more heat transfer surface area, than required by the design report, confidence is very high that the heat exchanger can provide the required performance, and verification testing can be delayed until the planned 30 day non-radioactive, integrated, vitrification system run.

NOTE: The testing described below is intended to meet the needs not only of Section 2.1.2, but also of Section 2.3.1 of this report.

Assure the Distributed Control System (DCS) is configured to control the temperature in the SBS bed (TT-3103) by modulating the position of the valve (TY-3121) which controls the flow of cooling water to the SBS Scrubber heat exchanger, as required by the system description, WVNS-SD-63H.

When no feed is being introduced into the melter and the vitrification system is operating at equilibrium, record the data required by Table 2.1.2., Column 1. After approximately one hour, record the data required by Table 2.1.2, Column 2.

When feed is being introduced into the melter and the vitrification system is operating at equilibrium, record the data required by Table 2.1.2, Column 3. After approximately one hour, record the data required by Table 2.1.2 Column 4.

Table 2.1.2
Data for Demonstrating SBS Quenching to WVNS-DC-010 Requirements

Measurement ⁽¹⁾	Instru- ment	1	2	3	4
Date (dd/mm/yr)	na				
Time (Use 24 hour clock, or show a.m. or p.m.)	na				
Melter Feed Rate (L/hr) (Time weighted average per shift supervisor)	Log Book	0.0	0.0		
Film Cooler Air Rate (SCFM)	FT-2020				
Injection Air Rate (SCFM) (Time weighted average from FT-2004 per shift supervisor)	Log Book				
SBS Off-Gas Inlet Pressure (InWC) ⁽²⁾	PT-3120				
SBS Off-Gas Inlet Temp. (°C)	TT-3101				
SBS Bed Temperature (°C)	TT-3103				
SBS Plenum Temperature (°C)	TT-3102				
SBS Differential Pressure (InWC)	PDT-3101				
SBS Scrubber Level (In)	LT-3101				
SBS Receiver Level (In)	LT-3111				
Cooling Water Flow Rate (GPM)	FT-3121				
Cooling Water Inlet Temperature (°C)	TT-002				
Cooling Water Outlet Temperature (°C)	TI-3104				
Operator Initials	na				
<p>⁽¹⁾ If the indicated units for data are not consistent with instrumentation, line out the indicated units and write-in the units actually measured.</p> <p>⁽²⁾ Report raw data. Do not report data compensated to the vacuum in the vitrification cell.</p>					

- 2.1.3 "The SBS receiver shall provide an interim storage capability for the accumulation of condensate and decontamination solutions." "The working volume of the receiver vessel shall be 5.45 m³ (1440 gal) minimum." (WVNS-DC-010, para. 2.3 and para. 3.2.1)

The certified design report for the process SBS concludes "the working volume in the receiver at the liquid level noted in Figure 2 is 1493 gal. which is greater than the minimum volume requirement cited in the design criteria," (See Volume and Liquid Level," sheet 14 of 20.). The design of the process SBS is keyed to the information presented in Figure 2 of the design report, so the working volume in the SBS receiver can be accepted as being greater than the required minimum of 5.45 m³ (1440 gal.).

No additional testing is required to meet this criterion of WVNS-DC-010.

- 2.1.4 "The SBS receiver shall cool the condensate and decon solutions from 50 °C (122 °F) to below 40 °C (104 °F) ... in no more than four hours." (WVNS-DC-010, para. 2.4 and para. 3.2.2)

NOTE: The certified design report concludes "... that the half-pipe jacket defined in Figure 2 will remove the required amount of heat from the scrub and decon solutions to reduce the temperature from 122 °F to 104 °F within the specified time of 4 hours" (See "Heat Transfer Analysis" sheet 33 of 75.). The final design is keyed to the information presented in Figure 2 of the design report. Because the design report applied the worst case cooling water temperature, 32 °C (90 °F), to its analysis. The report goes on to conclude that, using a more normal cooling water temperature of 16 °C (60 °F), the receiver's contents can be cooled within 1.5 hours. Therefore, confidence is very high that the heat exchanger can provide the required performance, and verification testing can be delayed until the 30 day non-radioactive run.

Prior to the 30 day non-radioactive run, assure the DCS is configured to control the receiver liquid temperature (TT-3118) by modulating the position of the valve (TY-3118) which controls the flow of cooling water to the SBS Receiver half-pipe jacket, as required by the system description, WVNS-SD-63H.

During the 30 day non-radioactive run, immediately before initiating cooling of the SBS receiver in anticipation of transferring the contents of the SBS to the CFMT, record the data required by Table 2.1.4., Column 1. As soon as the contents of the receiver have been cooled to the requisite 40 °C (104 °F), record the data required by Table 2.1.4, Column 2.

- 2.1.5 "Normal operation shall be passive, requiring no mechanical parts in continuous motion, with the exception of the solids mobilization system." (WVNS-DS-010, para. 3.0)

This is a criterion regarding the physical design, as opposed to a performance requirement. Examination of the P&ID reveals that the only mechanical parts which would be routinely in motion are associated with the scrub pump and motor, as permitted by WVNS-DC-010.

No additional testing is required to meet this criterion of WVNS-DC-010.

- 2.1.6 "Once placed into radioactive service, the assembled SBS shall be continuously operable regardless of whether feed is being directed to the melter." (WVNS-DC-010, para. 3.0)

The ability of the SBS to perform its function is independent of whether feed is being directed to the melter because the flow rate to the SBS is essentially independent of the melter feed rate. This is due to the pressure control scheme which effectively maintains a constant differential pressure across the off-gas jumper between the melter and the SBS. With a relatively constant differential pressure driving force, the off-gas flow rate is also maintained relatively constant.

The primary impact at the SBS when melter feed operation is suspended is a change from condensation accumulation in the scrubber to evaporation from the scrubber. This is countered by the continuous pumping of liquid from the receiver to the scrubber, which keeps the scrubber filled. Should the inventory of liquid in the receiver become depleted, provision has been made to add water.

That operation of the full scale, pilot plant SBS demonstrated independence of melter operation is reflected in the fact that no SBS problems related to the melter mode were noted in the lessons learned published following the 5 year FACTS testing program.

No additional testing is deemed necessary to meet this criterion.

Table 2.1.4 Data for Demonstrating SBS Receiver Cooling to WVNS-DC-010 Requirements			
Measurement ⁽¹⁾	Instru- ment	1	2
Date (dd/mm/yr)	na		
Time (Use 24 hour clock, or show a.m. or p.m.)	na		
SBS Bed Temperature (°C)	TT-3103		
SBS Receiver Temperature (°C)	TT-3118		
SBS Receiver Level (In)	LT-3111		
Cooling Water Flow Rate (GPM)	FT-3118		
Cooling Water Inlet Temperature (°C)	TT-002		
Cooling Water Outlet Temperature (°C)	TI-3117		
Operator Initials	na		
⁽¹⁾ If the indicated units for data are not consistent with instrumentation, line out the indicated units and write-in the units actually measured.			

2.1.7

"Provisions shall be made to transfer the scrub solutions and accumulated solids out of the scrubber vessel by steam jet. A solids resuspension system shall be incorporated to insure that settled particles are resuspended into the liquid and will be transferred with the liquid contents. The transfer shall be made without reducing the liquid inventory in the bed below that which is required to provide adequate scrubbing." (WVNS-DC-010, para 3.1.3)

Jet J-3114 has been provided to transfer the contents of the SBS to the CFMT. Developmental testing of sludge mobilization and transfer was conducted at the Westinghouse Science and Technology Center. This testing (See test report NWT-TR-089.) using full scale equipment, and sludge accumulated in the full scale pilot plant SBS during FACTS testing, demonstrated the solids transfer efficiency of the equipment in the process SBS. The technique of transferring liquid from the receiver to the scrubber at a rate faster than the liquid is transferred from the scrubber to the CFMT assures that liquid transfers will be made without reducing the liquid inventory in the bed.

The test described in Section 2.4 of this report, "Demonstration of Jet Operation . . .," is designed, among other things, to demonstrate that the liquid level in the scrubber does not become diminished during jet transfer.

No additional testing is deemed necessary to meet this criterion.

2.1.8

"Provisions shall be made to transfer the receiver solutions and accumulated solids from the receiver vessel to the scrubber vessel or Waste Header by steam jet. A solids resuspension system shall be incorporated to insure that settled particles are resuspended into the liquid and transferred with the liquid contents." (WVNS-DC-010, para 3.2.3)

Jet J-3105 has been provided to transfer the contents of the receiver to the scrubber. Jet J-3124 has been provided to transfer the contents of the receiver to the waste header.

Developmental testing of sludge mobilization and transfer was conducted at the Westinghouse Science and Technology Center. This testing (See test report NWT-TR-089.) using full scale equipment, and sludge accumulated in the full scale pilot plant SBS during FACTS testing, demonstrated the solids transfer efficiency of the equipment in the process SBS.

No additional testing is deemed necessary to meet this criterion.

- 2.1.9 "Provisions shall be made for the addition of demineralized water and monitoring of the liquid level." (WVNS-DC-010, para. 3.1.4)

Provision has been made to add demineralized water via the Cold Chemical System piping to the SBS through penetration 2202, and liquid level monitors for the Scrubber and Receiver are provided by LT-3101 and LT-3111 respectively. (See P&ID 900-E-705 Sheets 14 & 15.)

No testing is deemed necessary to meet this criterion.

- 2.1.10 "The receiver and scrubber vessels shall have provisions to remove the settled solids and liquids. No more than 2 gallons of liquid and solids combined shall remain in either vessel." (WVNS-DC-010, para 3.3)

Jet J-3105 has been provided to transfer contents of the receiver, including solids, to the scrubber. Jet J-3114 has been provided to transfer contents of the scrubber, including solids, to the CFMT. (See P&ID 900-E-705 sheets 14 & 15.) Developmental testing of sludge mobilization and transfer was conducted at the Westinghouse Science and Technology Center, and was used as the basis for designing the suction configuration of the jets, and the solids centering equipment in the SBS. This testing (See test report NWT-TR-089.) used full scale equipment, as well as sludge accumulated in the full scale pilot plant SBS during FACTS testing, and demonstrated that the vessels, as finally designed, could be jetted leaving no more than 8 liters (2 gal.) of sludge.

No additional testing is deemed necessary to meet this requirement.

2.2 Accommodation of Maximum Flow while Maintaining Required Efficiency

The flow rate through the SBS will not vary significantly during normal operation, regardless of whether feed is being directed to the melter. This is due to the pressure control scheme which, in effect, maintains a constant differential pressure across the hot off-gas jumper to the SBS. Because the driving force for off-gas flow remains essentially constant, the flow rate remains essentially constant. That operation of the full scale pilot plant SBS demonstrated the ability to maintain the required efficiency is reported in the lessons learned, published following the 5 year FACTS testing program.

No additional testing is deemed necessary to meet this requirement.

2.3 Demonstration of Cooling, Sparging, Sampling, and Sludge Removal Systems

2.3.1 Demonstration of Cooling

SBS cooling capabilities are demonstrated by the tests of paragraphs 2.1.2 and 2.1.4 above.

2.3.2 Demonstration of Sparging

NOTE: The sludge mobilization technique no longer employs sparging. Instead, the solids are centered on the tank bottom by swirling the liquid contents of the tank, followed by pick-up of the solids using a specially designed jet suction.

Developmental testing of sludge mobilization and transfer was conducted at the Westinghouse Science and Technology Center and was used as the basis for designing the solids centering equipment in the process SBS. This testing (See test report NWT-TR-089.) used full scale equipment, as well as sludge accumulated in the full scale pilot plant SBS during FACTS testing, and demonstrated that the sludge mobilization equipment was effective because the tanks could be jettted leaving no more than 8 liters (2 gal.) of sludge.

No additional testing is deemed necessary to meet this requirement.

2.3.3 Demonstration of Sampling

The ability to take samples, and the impact of taking SBS samples on the off-gas system are to be tested simultaneously, as described in Section 2.5, "Determination of the Effect of the Sampler on the Off-Gas Stream."

2.3.4 Demonstration of Sludge Removal

Developmental testing of sludge mobilization and transfer was conducted at the Westinghouse Science and Technology Center and was used as the basis for designing the sludge removal (solids centering and jetting) equipment in the process SBS. This testing (See test report NWT-TR-089.) used full scale equipment as well as sludge accumulated in the full scale pilot plant SBS during FACTS testing. It demonstrated that the sludge removal equipment, as finally designed, is capable of removing essentially all sludge, leaving no more than 8 liters (2 gal.) of sludge.

No additional testing is deemed necessary to meet this requirement.

2.4 Demonstration of Steam Jet Operation, and Prevention of Fluid "Suck Back"

2.4.1 Jets J-3114 and J-3105

NOTE: The following test, which documents steam jet transfer to the CFMT, also meets the requirement of Section 2.1.7, of showing that the liquid level in the scrubber does not become diminished during jet transfer. Jet J-3105, which transfers liquid from the SBS Receiver to the SBS Scrubber, and Jet J-3114, which transfers liquid from the SBS Scrubber to the CFMT, are to be interlocked such that J-3114 cannot operate unless Jet J-3105 is operating.

During the 30 day non-radioactive run, immediately before a routine liquid transfer is made from the SBS to the CFMT, deactivate the SBS solids mobilization pump and activate the receiver to scrubber jet, J-3105. Record the data requested by Table 2.4, Column 1. Initiate jet transfer to the CFMT using J-3114. For the time, record the time that HV-3114D opened. As soon as valve HV-3114D is closed, record the data requested by Table 2.4, Column 2.

Observe whether or not the line was flushed with air by noting whether HV-3114E opened to allow utility air to enter the jet steam line, as required by the system description (See paragraph 3.3.1.A of WVNS-SD-63H).

Table 2.4
Data for Demonstrating Steam Jet Operation

Measurement ⁽¹⁾	Instrument	1	2
Date (dd/mm/yr)	na		
Time (Use 24 hour clock, or show a.m. or p.m.)	na		
Melter Feed Rate (L/hr) (Time weighted average per shift supervisor)	Log Book		
Film Cooler Air Rate (SCFM)	FT-2020		
Injection Air Rate (SCFM) (Time weighted average from FT-2004 per shift supervisor)	Log Book		
SBS Off-Gas Inlet Pressure (InWG) ⁽²⁾	PT-3120		
SBS Plenum Temperature (°C)	TT-3102		
SBS Differential Pressure (InWC)	PDT-3101		
SBS Scrubber Level (In)	LT-3101		
SBS Receiver Level (In)	LT-3111		
CFMT Level (In)	LT-0148		
CFMT Level (In)	LT-0153		
CFMT Level (In)	LT-0156		
Valve HV-3114E opened as required and introduced utility air into the steam line (yes/no).	HY-3114E		
Operator Initials	na		
<p>⁽¹⁾ If the indicated units for data are not consistent with instrumentation, line out the indicated units and write-in the units actually measured. ⁽²⁾ Report raw data. Do not report data compensated to the vacuum in the vitrification cell.</p>			

2.4.2

Jet J-3124

Establish a set-up to test Jet J-3124, which is used to make transfers from the SBS Receiver to the Waste Header. The setup must be designed to measure the actual liquid pumping rate. The test setup may be in the Vitrification Cell employing the SBS, or it may be in an alternate location with or without the SBS. The setup must be such that the liquid pumped by the jet is not delivered to the tank farm. The liquid to be pumped is water.

Before assembling the test set-up, obtain the concurrence of the Systems Engineer for the Off-Gas and Vessel Vent System (System 63H) that the proposed setup and proposed data collection will generate the necessary data to evaluate the performance of the jet.

When conducting the test, collect the following data:

- The date and time of the test,
- The vertical distance from the top surface of the water to the jet,
- The temperature of the water,
- The temperature, pressure and flow rate of the steam delivered to the jet,
- The raw data used to determine the pumping rate (This might be the diameter of the tank, the initial level in the tank, the final level in the tank, and the duration of the jetting as measured by a stopwatch.), and
- The initials of the operator.

Deliver a copy of the test results to the Systems Engineer for System 63H.

2.5 Determination of the Effect of the Sampler on the Off-Gas Stream

NOTE: Theoretical calculations suggest that vacuum in the melter may be lost when the sample bottle is removed from the C-Sampler. Therefore, this test should be conducted only during melter idle operation.

When the Off-Gas System is running and the melter is in idle mode, use the C-Sampler to withdraw a liquid sample from the SBS Receiver, and transfer the sample bottle to the sample station. Observe, and record in the operations log, any reduction of vacuum in the SBS plenum when the sample was removed, as measured by PT-3120, and note whether or not vacuum was lost in the melter. Enter this information into the operations log.

3.0 Simultaneous Operation of SBS & Vessel Vent

The test requirements described in this section satisfy the needs defined by Test Number 63H-DC-30 of the test program plan.

The stated objective of test 63-DC-30 is to show that both the vessel vent and the submerged bed scrubber can work together over an extended time period without excessive water condensing in the wrong places.

Throughout the 30 day and 60 day non-radioactive runs, observe the differential pressure across the prefilter assembly in service for any indication of a differential pressure build-up which may have been caused by an accumulation of moisture on the elements. Should any differential pressure increase occur, which is not otherwise explained, notify the System Engineer for System 63H.

Upon conclusion of the cold runs, remove the prefilter assembly which was in service, being careful to observe whether any moisture had accumulated there. Record all observations made regarding the condition of the prefilter assembly in the operations log.

Notify the System Engineer for System 63H of the observations made.

4.0 Useful References

4.1 Program Plan

W.E. Mateer, WVDP CTS Conversion to Vitrification Facility Test Program Plan, WVNS-TPL-63-001, Rev. 2, 07/30/93

4.2 Design Criteria

R. DiBiase, Submerged Bed Scrubber Design Criteria, WVNS-DC-010, Rev. 5, 06/10/93

4.3 Test and Design Reports

J. Paul, "FACTS Lessons Learned," memorandum EN:90:0037 to P.S. Klanian, April 5, 1990, Attachment Section D, "Off-Gas and Vessel Vent System"

Walter Drosjack, SBS Modifications Project, Phase II, Detail Fabrication Design, Certified Design Report NWT-TR-093 from Westinghouse Nuclear Waste Technology, Rev. 0, May 1993

Walter G. Vaux, Centering and Withdrawal of SBS Sludge in a Full-Scale, Transparent Test Scrubber, Test Report NWT-TR-089 from Westinghouse Science and Technology Center, Rev. 0, March 1993

4.4 Equipment Drawings

Westinghouse Nuclear Waste Technology Drawing 1990E31 through 1990E46 inclusive, Submerged Bed Scrubber, all sheets, latest revisions

4.5 Process and Instrument Diagrams

WVNS drawing 900-E-705, Sheet 14, Primary Scrubber, Scrub Section, latest revision

WVNS drawing 900-E-705, Sheet 15, Primary Scrubber, Receiver Tank, latest revision

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Vessel Vent and Off-Gas System Maintenance Performance Testing Requirements

1.0 Introduction and Purpose

The Off-Gas and Vessel Vent System in the WVDP Vitrification Cell provides for the safe removal of the process gases from the melter and other related vessels while maintaining vessels and ducting at a slight vacuum for contamination control.

The information contained in this report defines the maintenance testing requirements for the Vessel Vent and Off-Gas System.

The stated objective of tests 63H-VN-10 and 63H-VN-20 is to demonstrate the ability to remotely perform corrective and preventive maintenance procedures described in the system description (WVNS-SD-63H), including replacement and disposal of spent HEME pads and prefilter assemblies. The test requirements which follow address these objectives, with the exception of demonstrating disposal of the spent HEME pads and prefilter assemblies. Disposal is an issue beyond the scope of Vitrification Startup Testing.

The corrective maintenance test procedures can be performed after the vessel ventilation system has been installed and the necessary remote handling equipment is available, without first placing the off-gas systems into service. One of the preventive maintenance test procedures, however, requires that the off-gas systems be functioning.

The testing requirements which follow are to be performed after precommissioning testing has confirmed that all related piping connections and instrumentation has been properly installed.

2.0 CORRECTIVE MAINTENANCE

Document each of the following tests by recording what tools were used, what difficulties were encountered, how the difficulties were overcome, and how much time was required to accomplish individual each step. Recommendations on how each of the procedures might be made easier are encouraged.

2.1 (Deleted)

2.2 (Deleted)

2.3 Condenser Drain Flush

NOTE: The only remote operation deemed necessary to assure the procedure can be performed is turning of the condenser drain valve.

Using the crane and impact wrench, remotely close and open condenser drain valve V-1503.

2.4 (Deleted)

2.5 (Deleted)

2.6 (Deleted)

2.7 Flushing Mist Eliminator Pad

(No Maintenance Testing Required)

NOTE: No remote handling operations are required to perform this procedure, and no testing is deemed necessary to assure the procedure can be performed.

2.8 (Deleted)

2.9 (Deleted)

2.10 Flushing HEME 63-T-033 Drain

NOTE: The only remote operation deemed necessary to assure the procedure can be performed is turning of the HEME drain valve.

Using the crane and impact wrench, remotely close and open HEME drain valve V-3318.

2.11 Flushing HEME 63-T-036 Drain

NOTE: The only remote operation deemed necessary to assure the procedure can be performed is turning of the HEME drain valve.

Using the crane and impact wrench, remotely close and open HEME drain valve V-3619.

2.12 Soaking HEME 63-T-033 Pad

NOTE: No remote handling operations, other than turning the valves which redirect flow from one off-gas train to another, plus closing and opening of the drain valve, are required to perform this procedure. The drain valve is to be tested by a separate test requirement in this report.

Using the crane and impact wrench, remotely close and open off-gas valves V-3206, V-3207, V-3901 and V-3902.

2.13 Soaking HEME 63-T-036 Pad (No Maintenance Testing Required)

NOTE: No remote handling operations, other than turning the valves which redirect flow from one off-gas train to another, plus closing and opening of the drain valve, are required to perform this procedure. All these valves are to be tested by separate test requirements in this report.

2.14 (Deleted)

2.15 (Deleted)

2.16 (Deleted)

2.17 (Deleted)

2.18 (Deleted)

2.20 Replacement of Prefilter Assembly 63-T-035

Using only remote methods, remove and replace Prefilter Assembly 63-T-035. Follow the procedures outlined in Section 6.2.4.E of WVNS-SD-011.

2.21 Replacement of Prefilter Assembly 63-T-038

Using only remote methods, remove and replace Prefilter Assembly 63-T-038. Follow the procedures outlined in Section 6.2.4.F of WVNS-SD-011.

3.0 Preventive Maintenance

Document each of the following tests by recording what tools were used, what difficulties were encountered, how the difficulties were overcome, and how much time was required to accomplish individual each step. Recommendations on how each of the procedures might be made easier are encouraged.

3.1 Maintenance of SBS Scrubber Liquid Level (No Maintenance Testing Required)

NOTE: The new SBS has been designed to recirculate liquid from the SBS Receiver to the SBS Scrubber. No remote operations are required to maintain an adequate liquid level in the SBS Scrubber.

3.2 HEME 63-T-033 Pad Flushing (No Maintenance Testing Required)

NOTE: No remote handling operations are required to perform this procedure, and no testing is deemed necessary to assure the procedure can be performed.

3.3 HEME 63-T-036 Pad Flushing (No Maintenance Testing Required)

NOTE: No remote handling operations are required to perform this procedure, and no testing is deemed necessary to assure the procedure can be performed.

4.0 Useful References

4.1 Documents

- Walter G. Vaux, Test Report: Centering and Withdrawal of SBS Sludge in a Full-Scale, Transparent Test Scrubber, NWT-TR-089, March 1993

4.2 Process and Instrument Diagrams

- Primary Scrubber Scrub Section, WVNS drawing 900E-705, Sheet 14
- Primary Scrubber Receiver Tank, WVNS drawing 900E-705, Sheet 15
- CTS Vessel Vent System Process & Instrument Diagram, WVNS drawing 900E-705, Sheet 19
- Melter Off-Gas System Pre-Heater and HEMEs P&ID, WVNS drawing 900E-705, Sheet 21
- Vessel Off-Gas Filters and Heaters Process & Instrument Diagram, WVNS drawing 900E-705, Sheet 22

4.3 Arrangement

- In-Cell Off-Gas Treatment System Facility General Arrangement, SMCI drawing 21303

4.4 Equipment Drawings

- Off-Gas Jumper Assy. E-032-B1 to T-0330A, E-032-B2 to T-036-A, SMCI drawing 27201
- High Efficiency Mist Eliminator, SMCI drawings 27301 to 27303
- HEME Preheater Assy. 63-E-033, SMCI drawing 27401
- Filter Preheaters 63-E-034 and 63-E-037, SMCI drawing 27501
- Off-Gas Prefilter, SMCI drawing 27601
- Post Heater Assy. 63-E-039, SMCI drawing 27701
- Off-Gas Heater Assy., SMCI drawings 27801 & 27802
- Off Gas Jumper Assy. T-035-B to E-039-A1, SMCI drawing 28001
- Off Gas Jumper Assy. T-038-B to E-039-A2, SMCI drawing 28101
- Condenser 63-E-015, SMCI drawings 29001 and 29002
- VF-24 Ton Lifting Yokes, WVNS drawing 900D-4876

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Decontamination and Decommissioning

1.0 General

1.1 Decontamination

Prior to radiologically "hot" operation, decontamination requirements can only be hypothesized. Therefore, all decontamination discussions in this section should be considered as reasonable forecasts. Actual decontamination requirements will be established when the final contamination characteristics are known.

The decontamination process will produce significant quantities of solution requiring processing as radioactive waste. Therefore, the assumptions are made that the waste header, tank farm, and IRTS will still be in service at the time that the vitrification cell is decontaminated.

The primary radioactive contaminant in the In-Cell Off-Gas Treatment System equipment should be Cesium-137. Because cesium compounds are typically water soluble, an aqueous decontamination solution should be appropriate. The primary water insoluble material requiring dissolution should be borosilicate glass. Because borosilicate and other glasses are soluble in hot caustic solution, an aqueous hot caustic (NaOH) solution will likely be an appropriate decontamination solution.

Experiments performed at Savannah River Laboratory, and reported by E.I. DuPont de Nemours & Co. letter DPST-84-376-TL, show that an appropriate solution for dissolving glass media such as HEME and HEPA elements is a nearly boiling 5 wt% sodium hydroxide solution. The low concentration allows for high dissolution, about 39 grams of glass per liter of solution (0.326 lb_m/gal). Dissolution time is dependent upon the thickness of the glass being dissolved, but, for HEME and HEPA elements, 48 hours should always be more than sufficient. Upon cooling, a finely divided insoluble white precipitate forms which would need to be resuspended by agitation prior to transfer.

After vitrification operations are completed, the CFMT; with its large volume, 1170 mm (46") diameter top opening, overhead crane access, heating jackets, chemical introduction system, and waste header jet; would provide an excellent chemical decontamination soaking capability. Concurrent In-Cell Off-Gas Treatment System decommissioning work would be over the cell apron, well away from the CFMT which is in the pit.

As decommissioning proceeds, the CFMT should be left in service with connections to the Cold Chemical System, steam supply, condensate return, sampling, and steam jet to waste header. Residual water from the SBS should be directed to the empty CFMT, followed by sampling then addition of a caustic solution from the Cold Chemical System formulated to produce a 5 wt% NaOH solution after blending. The blended solution should be heated to near boiling by directing steam to the vessel jacket. Each component to be decontaminated should be dipped into the solution by suspension from a crane for 24 to 48

hours. Based upon sampling, make-up water may need to be added from time to time to replace evaporated water and maintain the low solution concentration. At the end of the decontamination campaign, the solution should be cooled, agitated, and transferred by the steam jet via the waste header to the tank farm for subsequent processing by the IRTS.

Decontamination operations at the CFMT should be scheduled such that the least contaminated components are decontaminated first, the HEME elements are dissolved next to last, and the prefilter elements are dissolved last. In this sequence, the solution should retain its dissolution capacity to the end, and the less contaminated components will not become more contaminated by being immersed in a highly contaminated solution.

1.2 Decommissioning

Of the decommissioning options; mothballing, entombment, and dismantling; the last option, dismantling, is assumed to be the most likely to be selected for the vitrification cell. This section, then, addresses dismantling of the In-Cell Off-Gas Treatment and Vessel Ventilation Systems. Mothballing and entombment are not addressed.

All of the In-Cell Off-Gas Treatment System equipment, except for the stub wall, service wall, and structural supports, are designed to be remotely removed or dismantled following the vitrification campaign. The stub wall and service wall are realistically extensions of the vitrification cell walls, but for convenience, were procured with and described as, In-Cell Off-Gas Treatment System equipment. The service wall rests on the structural supports. Therefore, the structural supports cannot be removed until after the service wall has been removed.

The transfer cart is used to remove all of the dismantled equipment from the vitrification cell to the EDR.

2.0 Vessel Vent Header

2.1 Decontamination

The vessel vent header can be decontaminated by introducing water, or other aqueous decontamination solution, from the Cold Chemical System into the end of the header. The solution will flow by gravity into the condenser then through the condenser drain to the tank farm at tank 8D-3. Do not pressurize the liquid entering the header because that could direct the solution to the decontamination station, the waste header, the turntable, the melter, the sample station, the FHT and the CFMT.

2.2 Decommissioning

There are no provisions for remote removal of the vessel vent header. It is permanently installed on a ledge where there is no access by either crane hooks or master slave manipulators. Therefore, after the cell has been

decontaminated and all equipment that can be remotely removed has been removed, manned entries will probably be required remove the header.

3.0 Condenser

3.1 Decontamination

The exterior surfaces of the tube bundle, and the interior surface of the shell, can be flushed, when the Vessel Vent Header is flushed, by closing the condenser drain valve and collecting the Vessel Vent Header decontamination flush from the Cold Chemical System. Care must be exercised to assure that the shell is not overfilled because excess fluids could overflow through the non-condensibles jumper and In-Cell Off-Gas Treatment System mist eliminator into the SBS.

3.2 Decommissioning

After the cooling water supply and return jumpers have been removed, the head can be removed from the condenser shell, after which the tube bundle can be removed. The tube bundle could then be suspended in the CFMT for decontamination.

After the non-condensibles jumper, the spool piece to the vessel vent header, the jumper to the vessel vent header, the jumper to the Cold Chemical System, the instrumentation jumper, and the drain line have been removed, the condenser shell can be removed.

4.0 Non-Condensibles Jumper

4.1 Decontamination

No provisions are in-place for remote decontamination of the non-condensibles jumper.

If necessary, decontamination fluids could be directed into the jumper by overfilling the condenser shell, but this is not recommended without first assessing the value of such an action based upon actual post vitrification contamination levels and existing equipment conditions.

4.2 Decommissioning

After the instrument air jumper to the pressure control valve and the temperature instrumentation jumper have been removed, the non-condensibles jumper can be removed and could be suspended in the CFMT for decontamination. The valve will be open, so it will not trap air in the jumper when the jumper is immersed.

5.0 Condensate Drain

5.1 Decontamination

The condensate drain will be flushed whenever vessel vent header or condenser decontamination solutions are allowed to exit the condenser shell.

A final flush for the condensate drain should be performed by closing the isolation valve in the drain line, then introducing demineralized water into the drain line to flush the seal loop.

5.2 Decommissioning

Before removing the drain jumper from the condenser, open the isolation valve to allow any liquid remaining in the condenser shell and drain line to proceed toward the tank farm. This jumper could then be suspended in the CFMT if additional decontamination is required.

Remove the drain line from the condenser before removing the seal loop jumper so that any liquid released when the isolation valve in the drain line is opened will remain contained. After the drain line and the demineralized water jumper are removed, the seal loop jumper can be removed. Take precautions not to spill the liquid still contained in the loop until it can be carefully drained into an appropriate receptacle.

6.0 Submerged Bed Scrubber

6.1 Decontamination

The SBS should not be decontaminated until after the HEMEs have been decontaminated, because liquids introduced at the HEMEs should be able to drain into the SBS receiver.

Close the isolation valves on the HEME drain lines, then flush the drain lines and seal loops with demineralized water.

Following final use of the SBS, the scrubber vessel should remain filled with water. Operate the solids mobilization system, then jet the contents out of the SBS. It could be directed to the CFMT to be used as the initial charge of decontamination solution there. As required, based upon remote radiation surveys, add water to the scrubber and repeat the procedure. After this flushing procedure has been completed, there may be a sludge "heel" of about 4 liters (1 gal) in each vessel. These heels could be removed by a hose and pump arrangement. Based upon pre-commissioning studies, the sludge in the SBS is expected to have characteristics like those presented in Tables Q-1 and Q-2.

Table Q-1: Sludge Characteristics

Characteristic	Description
General Character	Similar to silty sand containing small amount of magnetic fines
Settling Character	Stratified with larger particles on the bottom, fines in the middle, and micro-fines on top
Density	1.52 g/cm ³ for wet settled sludge 2.41 g/cm ³ ultimate particle density
Stiffness	Increases gradually, in proportion to $t^{1/2}$, for a few days, then increases abruptly. Should be agitated regularly to prevent conglomeration into a stiff mass.
Cohesive Strength	Little if any. A ball of sludge crumbles readily upon gentle squeezing.
Walter G. Vaux, "Task 1 Report: Characteristics of SBS Scrubber Sludge," Westinghouse Electric Corp., Science & Technology Center, to Ms. Hollfelder, WVNS, April 23, 1992	

Table Q-2: Sludge Particle Characteristics

Mesh	Mean Size (Microns)	Mass Fraction	Settling Velocity (cm/s)	Geometry
10	2378	0.0030	about 10	Elliptical Beads
20	1303	0.0070		
40	601	0.1140		
60	325	0.2570		
140	162	0.0390	about 0.1	Crystalline Blocks
200	89	0.0100		
400	48	0.1740		
991	26	0.1400		
992	16	0.0930		
993	11	0.0200		
994	8	0.0200	about 0.0001	Amorphous Fines
995	4	0.0200		
996	2	0.0060		
Pan	1	0.0970		

Walter G. Vaux, "Task 1 Report: Characteristics of SBS Scrubber Sludge," Westinghouse Electric Corp., Science & Technology Center, to Ms. Hollfelder, WVNS, April 23, 1992

6.2 Decommissioning

The SBS bed is supported from the lid on the 1020 mm (40") flange of Nozzle A. Remove the hot off-gas duct, then remove the bed with the lid. The bed could be decontaminated at the CFMT.

Remove all of the jumpers connected to the SBS. Take precautions not to spill the liquid contents of the seal loops from the HEMEs, then pour the liquid into a sump or other appropriate receptacle. The three jet assemblies, the two temperature probe measurement jumpers, and the two bubbler (pressure measurement) probe assemblies could be decontaminated at the CFMT.

To keep the waste header in service, attach blanked-off Purex connectors to Nozzle B, where the SBS jet was connected, and to Nozzle H, where the SBS overflow was connected.

7.0 Mist Eliminator

7.1 Decontamination

The mist eliminator pad is decontaminated by spraying the pad with water, or an appropriate chemical solution from the Cold Chemical System.

7.2 Decommissioning

The off-gas jumpers to the HEMEs, the HEME preheater, the non-condensibles jumper from the Vessel Vent System, and the mist eliminator utility services jumper must be removed before the mist eliminator can be removed. When removing the mist eliminator, take care not to spill the cup of contaminated water which will be in the seal of the drain line. The assembly could be transferred to the CFMT for decontamination of the leg that dipped into the SBS. If this is done, care should be taken to collect the decontamination solution from the cup following decontamination.

8.0 High Efficiency Mist Eliminator Preheater

8.1 Decontamination

No provisions are in-place for remote decontamination of the HEME preheater.

8.2 Decommissioning

The instrumentation jumper should be removed, and could be decontaminated at the CFMT. After the electrical power jumper is removed, the heater element should be removed, and could be decontaminated at the CFMT. After the off-gas jumpers to the HEMEs are also removed, the HEME preheater housing can be removed. If the housing requires decontamination, it could be done with manipulators at the Weld Station.

9.0 Off-Gas Jumpers to High Efficiency Mist Eliminators

9.1 Decontamination

No provisions are in-place for remote decontamination of the off-gas jumpers to the HEMEs.

9.2 Decommissioning

Before removing the off-gas jumpers to the HEMEs, open the isolation valves so that air and decontamination solutions can pass through them. After removal, they could be decontaminated at the CFMT.

10.0 High Efficiency Mist Eliminators

10.1 Decontamination

Decontamination of the HEMEs should proceed decontamination of the SBS, so liquids generated during decontamination of the HEMEs can be directed to the SBS.

For each HEME, flush the element with demineralized water through the spray lance. (This is done to minimize contamination spread when the HEME element is removed from the vessel.) Remove the demineralized water jumper to the spray lance, remove the head of the HEME vessel, extract the HEME element, then reinstall the head and demineralized water jumper. Next flush the interior surface of the HEME vessel with demineralized water through the spray lance.

Alternatively, or if the water spray is insufficient, the vessel could be decontaminated by closing the drain valve and flooding with an appropriate decontamination chemical solution.

10.2 Decommissioning

The HEME elements could be dissolved in the CFMT.

Open the isolation valve in the liquid drain line to allow any liquid upstream from the valve to drain toward the SBS.

Before the HEME vessels can be removed, the off-gas jumpers from the HEME preheater, the prefilters, the filter preheaters, the demineralized water jumpers, the instrumentation jumpers, the cold chemical supply jumpers, and the drain lines must be removed.

11.0 Filter Preheaters

11.1 Decontamination

No provisions are in-place for remote decontamination of the filter preheaters.

11.2 Decommissioning

After the electrical power jumpers are removed, the heater elements can be removed and could be decontaminated at the CFMT. After the instrumentation jumpers and prefilter assemblies have been removed, the heater housings can be removed. If the housings require decontamination, it could be done with manipulators at the Weld Station.

12.0 Prefilter Assemblies

12.1 Decontamination

No provisions are in-place for remote decontamination of the prefilter assemblies.

12.2 Decommissioning

Following removal of the prefilter assemblies they could be suspended from one end in the CFMT to dissolve the filter elements.

13.0 Off-Gas Jumpers to Postheater

13.1 Decontamination

No provisions are in-place for remote decontamination of the off-gas jumpers to the postheater.

13.2 Decommissioning

Before removing the off-gas jumpers to the postheater, remove the instrumentation jumpers and open the isolation valves so air and decontamination solutions can pass through them. After removal, they could be decontaminated at the CFMT.

14.0 Postheater Housing

14.1 Decontamination

No provisions are in-place for remote decontamination of the postheater housing.

14.2 Decommissioning

After the instrumentation jumper and off-gas jumpers to the postheater are removed, the housing can be removed. If the housing requires decontamination, it could be done with manipulators at the Weld Station.

15.0 Discharge Header

15.1 Decontamination

No provisions are in-place for remote decontamination of the discharge header.

15.2 Decommissioning

After removing the instrumentation jumper to the flowmeter, the flowmeter can be removed and could be decontaminated in the CFMT. The nozzle that held the flowmeter should be covered to block a possible pathway to the environment.

After removal of the prefilters, the off-gas jumpers to the postheater housing, and the postheater housing itself, the discharge header inlet flange should be covered.

16.0 Stub Wall

16.1 Decontamination

The exterior surfaces of the stub wall should be flushed when the interior walls of the vitrification cell are flushed. The stub wall is seal welded to the vitrification cell wall liner, and all the lines that carried contaminated process fluids (penetrations 6110/2112, 6118/2101, and 6120/2100) should already have been flushed as a result of decontamination of the condenser shell and the HEMEs, so internal surfaces of the stub wall should not be seriously contaminated.

16.2 Decommissioning

All of the piping between the vitrification cell wall and the stub wall should be cut using remote pipe cutting equipment, and capped or otherwise sealed to prevent contamination spread to out-of-cell through the pipe stubs.

Because the stub wall is seal welded to the vitrification cell wall, and is bolted to the floor, special remote cutting equipment will need to be developed, or the stub wall will have to be removed by manned entry after the vitrification cell has been decontaminated.

17.0 Service Wall

17.1 Decontamination

The exterior surfaces of the service wall should be flushed when the interior walls of the vitrification cell are flushed. The service wall is seal welded to the vitrification cell wall liner, and it held no pipes that carried process fluids, so internal surfaces of the service wall should not be seriously contaminated.

17.2 Decommissioning

Because the service wall is seal welded to the vitrification cell wall liner, special remote cutting equipment will need to be developed, or the service wall will have to be removed by manned entry after the vitrification cell has been decontaminated.

18.0 Structural Supports

18.1 Decontamination

The structural supports should be flushed when the interior surfaces of the vitrification cell wall are flushed.

18.2 Decommissioning

The structural supports can be freed for removal by cutting structural members or bolts near the floor using remote cutting equipment.