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Preconceptual Design Description of the Type 2 Bin and Systems for Wet Waste Testing

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Test Programs Engineering
Westinghouse Waste Isolation Division

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Preconceptual Design Description of
the Type 2 Bin and Systems
for Wet Waste Testing

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1.0 INTRODUCTION

1.1 OVERVIEW

This report on the Type 2 Bin design provides a preconceptual description of the physical equipment, the operational systems, and the sub-systems which are necessary to comply with the requirements which are defined in the **Equipment Design Criteria. Wet Waste Testing Program. Draft. WP 09-15. Revision 1. May 3, 1993**. The **Equipment Design Criteria** (EDC) document has been reviewed and approved by the Department of Energy/ WIPP Project Site Office (DOE/WPSO), Sandia National Laboratory (SNL) and the Waste Isolation Division (WID), and lists the technical criteria and requirements for the test vehicle and data acquisition systems required for collecting data on Contact Handled (CH) transuranic (TRU) waste interactions in either a high humidity or a brine-inundated environment at elevated pressures. The EDC incorporates the requirements of the approved Bounding Conditions dated February 5, 1993, which specify a 36 ft^3 payload volume and a 2.675 pound payload weight capability. A reference copy of the Bounding Conditions and the **Equipment Design Criteria. Wet Waste Testing Program. Draft. WP 09-15. Revision 1, May 3, 1993** are included.

The EDC lists nineteen (19) specific systems, equipment, and processes which are addressed in this report. The component of primary interest is the TRU waste container, or Type 2 Bin. The Type 2 Bin is a pressure vessel that will provide the payload volume and weight capacities and the operating conditions that meet the requirements listed in section 3.1 of the EDC. The EDC establishes the technical requirements and specifications for each of the major pieces of equipment, systems, and processes. This includes the operating pressure ranges, temperature ranges, flow requirements, material(s) for construction, instrumentation requirements, and functional characteristics.

Public and personnel safety are the primary considerations throughout the design, start-up, operation, and post-test phases considered in this preconceptual design process. The specific safety areas covered by government regulations and agencies such as OSHA, MSHA, RCRA, NEPA, NMD, and DOE Order 6430.1a will be incorporated in the design as applicable. The systems and sub-systems required to support the Wet Waste Test Program through the cycle of waste receipt, test preparation, emplacement, test conduct, and post-test activities include:

- The Type 2 Bin which will contain the TRU wastes and provide the test environment specified in section 3.1 of the EDC.
- The Radiological Control Boundary (RCB) which is required to provide the mandated level of confinement for TRU materials as specified in section 3.2 of the EDC.
- The Gas Venting and Overpressure Protection system which provides safety protection from pressure-related events and minimizes the potential for test disruption as specified in section 3.3 of the EDC.

- The Volatile Organic Compound (VOC) Monitoring System will accept all gas from controlled and uncontrolled releases, and collect samples for analysis as specified in section 3.4 of the EDC.

- The Gas Mixing and Sampling system will gather samples for identification and quantification of data for the test as specified in section 3.5 of the EDC.

- The Brine Addition and Sampling system will add the brine to the waste for those bins requiring an inundated or humid environment, and draw a brine sample as specified in section 3.6 of the EDC.

- The Microbe Addition system will comply with the requirements for adding microbial material to the appropriate test bins as specified in section 3.7 of the EDC.

- The Gas Analyses system will comply with the requirements for identifying and quantifying gas sample data as specified in section 3.8 of the EDC.

- The Sample Containment/Confinement system will provide the canisters to draw gas samples as outlined in section 3.9 of the EDC.

- The Gas Purging system will precondition the internal atmosphere in the test bins to the test requirements as specified in section 3.10 of the EDC.

- The Gas Gettering system will reduce the oxygen level of the internal bin atmosphere to the levels as specified in section 3.11 of the EDC.

- The Temperature Monitoring/Measuring system will meet the instrumentation and data recording requirements as specified in section 3.12 of the EDC.

- The Pressure Monitoring/Measuring and Control system will meet the requirements for the instrumentation and data recording as specified in section 3.13 of the EDC.

- The Brine Stabilization equipment will meet the requirements to remove free liquids from the test bin after the completion of testing as specified in section 3.14 of the EDC.

- The Real Time Radiography inspection equipment will meet the requirements to verify that any material retrieved from the Waste Isolation Pilot Plant (WIPP) site complies with the transportation requirements of the Waste Acceptance Criteria, and as specified in section 3.15 of the EDC.

- The Container Handling Equipment to transport the components through the various stages of receipt, testing, and post-test activities will meet the requirements as specified in section 3.16 of the EDC.

- The Brine Solution Composition will meet chemical compositions and mixture ratios as specified in section 3.17 of the EDC.

- Backfill Composition will meet the requirements as specified in section 3.18 of the EDC.

- The Liquid Level Determination system will meet the requirements as specified in section 3.19 of the EDC.

1.2 Process Description

This section describes the process flow for a Type 2 Bin. and identifies the preconceptual sequence of operations that will be required for the receipt, test preparation. emplacement. test conduct. and post-test activities. Figure No. 1 illustrates the activities required to support normal bin operations. Note that this is a **preconceptual** description of the possible sequence of events. and it is recognized at this stage of development that additional systems. equipment and processes may become necessary to achieve success. Further system details will be determined as part of the design process. and will incorporate the experience and knowledge gained from the design and implementation of readiness of the Type 1 Dry Bin and the Type 1 Humid Bin. and their respective operational and support systems.

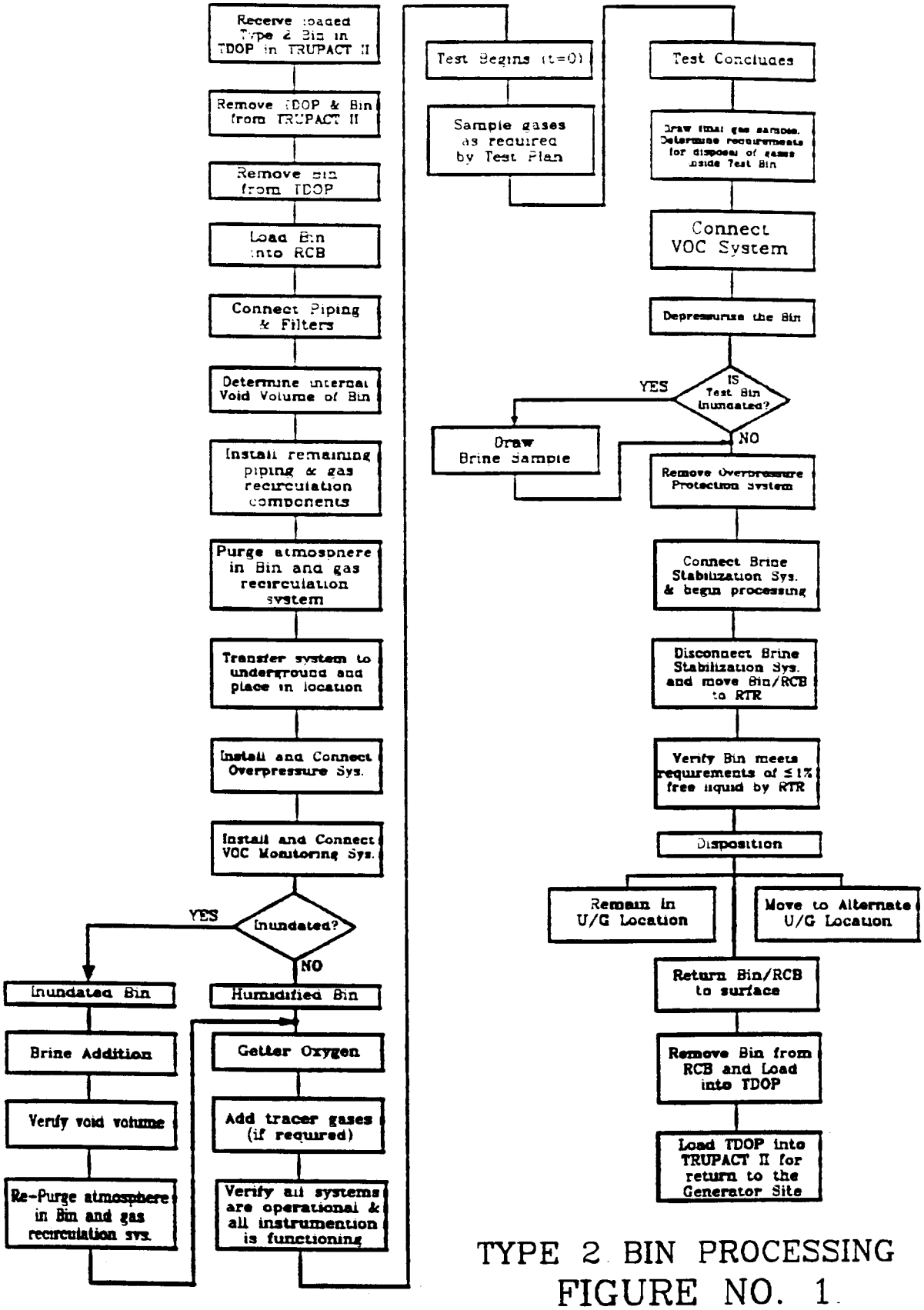
The event required to initiate the process at WIPP is the receipt of a Type 2 Bin loaded with TRU waste. The bin will be unloaded from the Transuranic Package Transporter II (TRUPACT II) and placed in an RCB. The High Efficiency Particulate Air (HEPA) type filters. isolation valves. Radiation Assessment Filters (RAF's) and the gas recirculation piping and pump would be connected. and the internal void volume in the bin will be determined: this operation is part of the technical requirements specified in section 3.1.13 (humid bin) or 3.6.13 (inundated bin) of the EDC. At this point the remainder of the gas recirculation system will be installed. the gas recirculation system would be purged, and the bin will be transported to its underground location.

After emplacement in the appropriate underground location, the remainder of the support systems specified in the EDC will be connected to the unit. Those Type 2 Bins which have been selected for the testing of inundated waste will have brine addition made to the contents of the bin, and those units which are to be tested with a humidified atmosphere will have the necessary component additions made. The bins will then require re-purging of the internal bin atmosphere. oxygen gettering will be initiated on those bins whose test schedule require such activity, and any tracer gases required by the EDC will be introduced. At this stage, the appropriate actions will be taken to verify that all requisite conditions have been met.

Throughout the duration of the test, no intervention will be required. Procedures will be written, verified, and put in place to ensure that the appropriate samples are taken as specified by the scientific advisor. At test termination final gas(es) and brine (for inundated bins only) samples will be taken.

After the final gas samples have been taken, the gases in the Type 2 Bin will be disposed of in accordance with all of the pertinent regulations governing such activities, the required liquid sample will be taken from all inundated bins, and the Type 2 Bin and its attendant RCB will be dispositioned in one of three alternative manners: 1) the Type 2 Bin and RCB will remain in the underground test area, 2) the Type 2 Bin and RCB will be transported to the surface for off-site shipping or temporary storage, or 3) the Type 2 Bin and RCB will be moved to an approved storage or disposal location within the WIPP underground area.
If disposition requires the removal of any free liquid within the bin, the gas recirculation system will be removed, and the bin will be connected to the Brine Stabilization system for liquid removal as specified in section 3.14.13 of the EDC.

After the liquid is removed, the bin will be inspected and compliance with the requirement for 1% free liquid by volume (or less) will be verified through the use of the Real Time Radiography (RTR) system. If the bin is to be shipped off-site, the bin and its associated RCB will be transported to the surface and moved to the CH Bay in the Waste Handling Building, and then packaged as required by the Waste Acceptance Criteria for off-site shipment. All of these activities will be conducted as described in the Waste Retrieval Plan for the Waste Isolation Pilot Plant.



TYPE 2 BIN PROCESSING
FIGURE NO. 1

2.0 REFERENCE DOCUMENTS

Equipment Design Criteria. Wet Waste Testing Program, Draft. WP 09-15, Revision 1, May 3, 1993

DOE/EM/48063-1, Appendix C2, Real Time Radiography and Radioscopy QA Objectives

DOE Pressure Safety Manual Draft, October, 1992

DOE/WIPP 89-022, Waste Retrieval Plan for the Waste Isolation Pilot Plant, Revision 1, March, 1993

American Society of Mechanical Engineers Standards

Boiler & Pressure Vessel Code, Section VIII, Divisions 1 & 2, and Division 1, Part UG-125

E 94-91 Standard Guide for Radiographic Testing

E 1441-91 Standard Guide for Computed Tomographic (CT) Imaging Systems

3.0 DESIGN CRITERIA

3.1 Type 2 Bin

3.1.1 Major EDC requirements for the Type 2 Bin

- Contain 36 ft^3 of payload volume
- Contain 2.675 pounds of payload weight
- Pressure: minimum = 0.2 psia, maximum = 700 psia
- Temperature: minimum -40°F, maximum = 200°F.
- Withstand detonation of flammable gas mixtures.
- Shipping configuration to WIPP and at retrieval (including RCB) must be compatible with a Ten Drum OverPack (TDOP)
- Comply with the requirements of the ASME Boiler & Pressure Vessel Code.
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium
- Meet the interface requirements of the Waste Characterization Chamber (WCC) at Argonne National Laboratory-West (ANL-W) and the Advanced Size Reduction Facility (ASRF) at the Rocky Flats Plant.
- Accommodate internal atmospheres which have relative humidity ranges from 0% to 100%.
- Accommodate internal atmospheres which contain mixtures of flammable gases, VOC's, etc.

3.1.2 Preconceptual description of the Type 2 Bin

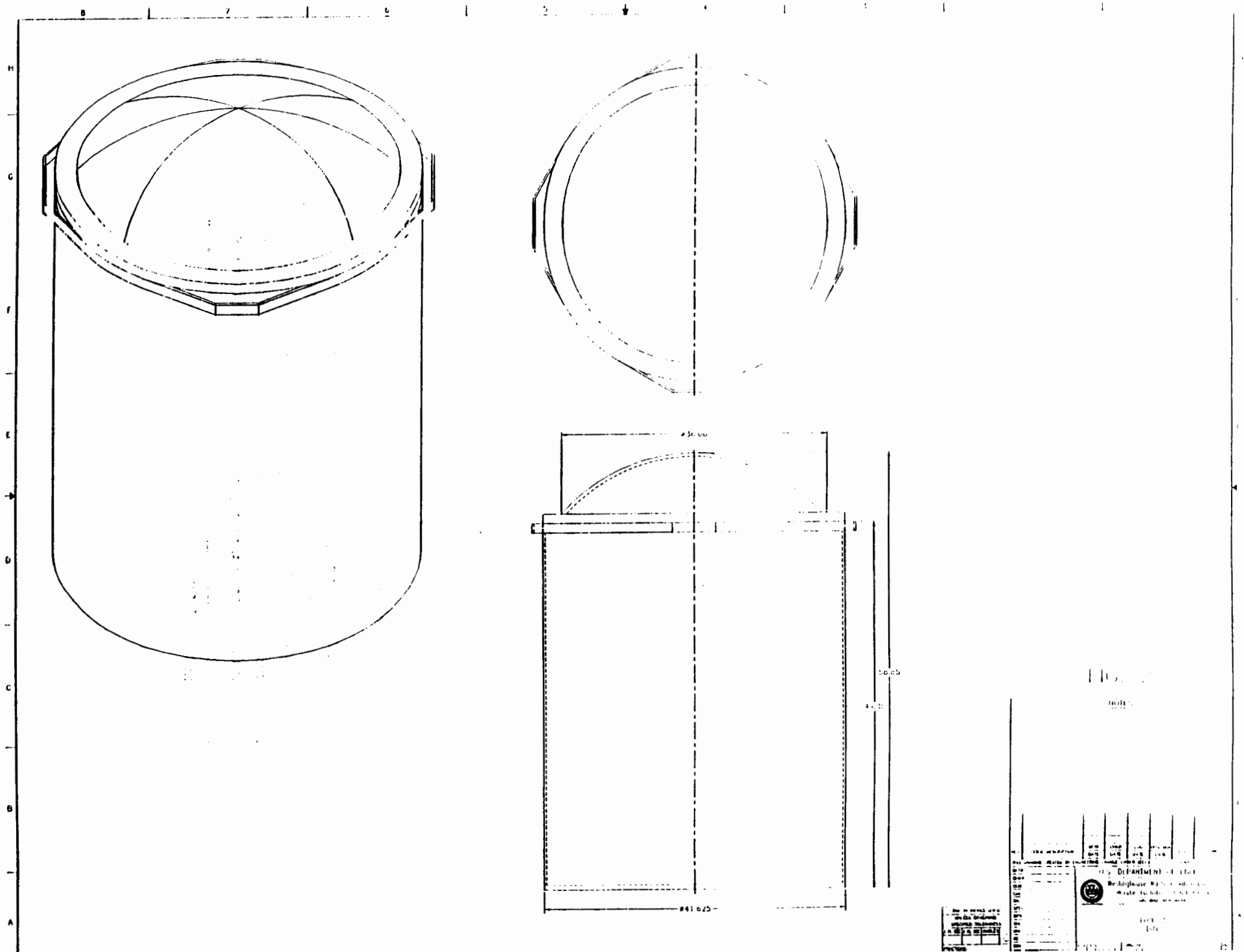
Figure 2 shows the preconceptual design for the Type 2 Bin based on the above requirements. It has an internal diameter of 41 inches and a height of 48.7 inches, providing an internal volume of 37.2 ft^3. This provides an additional volume of 1.2 ft^3 to accommodate the gas manifolds and other operational equipment which are required inside the bin. The bin design includes a torispherical head to provide 62.6 liters of headspace for gases, and a reduced total weight when compared with other geometrical head shapes.

The Type 2 Bin is designed for a maximum operational pressure of 700 psia and will comply with the requirements of the ASME Boiler & Pressure Vessel Code. The Type 2 Bin will be constructed from materials with the required physical properties for tensile strength, yield strength, resistance to corrosion due to ambient operational conditions (including stress) , and which are non-reactive to waste constituents. To comply with the Department of Energy (DOE) safety requirements as listed in the DOE Pressure Safety Manual Draft, October, 1992, the Type 2 Bin will be designed to provide a safety factor of four (4), based on the yield strength of the material.

The height of the Type 2 Bin is within the measurements allowed by Argonne National Laboratory - West (ANL-W) for interfacing with the Waste Characterization Chamber (WCC). The ANL-W also specifies that "the bin lid must be installed in the transfer room." and provides a maximum dimension for this operation: the preconceptual design of the Type 2 Bin fits within their dimension.

The concept for the Type 2 Bin and the current design drawing for the Advanced Size Reduction Facility (ASRF) at Rocky Flats are not compatible. The ASRF was based on a Type 2 Bin which will be similar to the Type 1 Dry Bin (rectangular). The requirements listed in the EDC duplicate the Bounding Conditions dated February 5, 1993, which were agreed to by WPSO, WPIO, SNL and the WID. The specification of a 36 ft^3 payload volume and a 2,675 pound payload weight mandate alterations in the shape and size of the Type 2 Bin.

Based on the Rocky Flats drawings available, there is 42 inches of vertical clearance for the Type 2 Bin beneath the ASRF. Modifying the design of the Type 2 Bin by reducing the height to comply with the ASRF specification will reduce the internal volume of the bin below the mandated payload volume as established in the EDC. Increasing the diameter of the bin to restore the volume capacity causes the weight of the Type 2 Bin to exceed the value required to ensure providing the required payload weight of 2,675 lb. However, the ASRF drawings indicate that it may be possible to modify the unit to provide the necessary space for the Type 2 Bin by either increasing the length of the support legs on the ASRF, or by placing an external riser beneath the legs to provide the additional height necessary for clearance of the Type 2 Bin. Additionally, changes to the size and shape of the Type 2 Bin are restricted due to the established geometry of the transportation packaging system.


DEPARTMENT

3.2 Radiological Control Boundary (RCB)

3.2.1 Major EDC requirements for the RCB

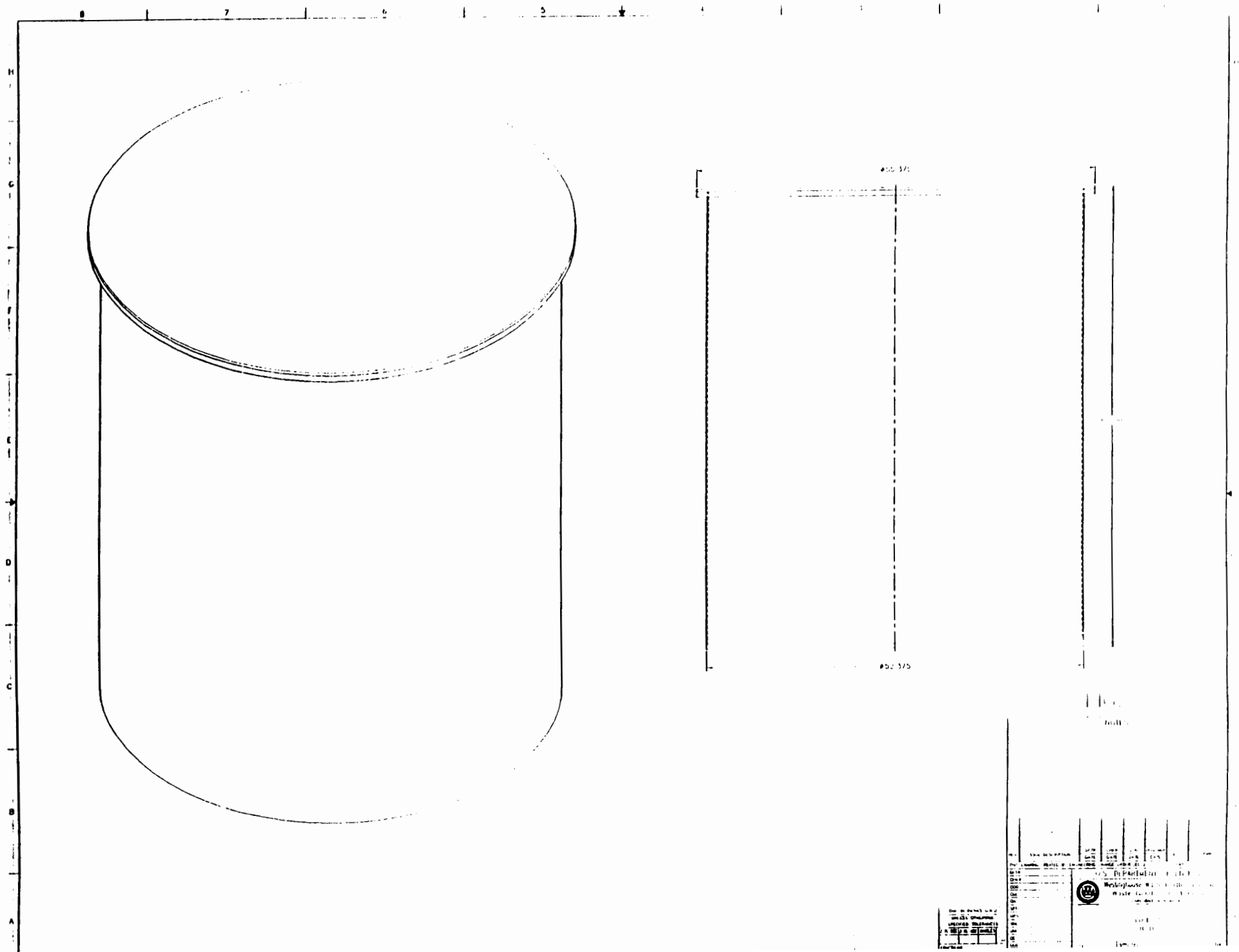
- Pressure: minimum = 0.2 psia. maximum = 20 psia
- Temperature: minimum -40°F. maximum = 200°F.
- Minimum of two filtered vents to prevent internal pressure build-up in the RCB if the primary boundary is compromised during the test. Two filters are required for redundancy.
- An internal free volume at least 110% of the total volume of the Type 2 Bin.
- The volume of the RCB will be sufficient to enclose the bin and equipment necessary to isolate the bin and filters.
- Construction such that the RCB will pass a bubble test when pressurized to 0.5-1.0 psig with compressed air.
- Bin liquid leakage must be contained within the associated RCB.

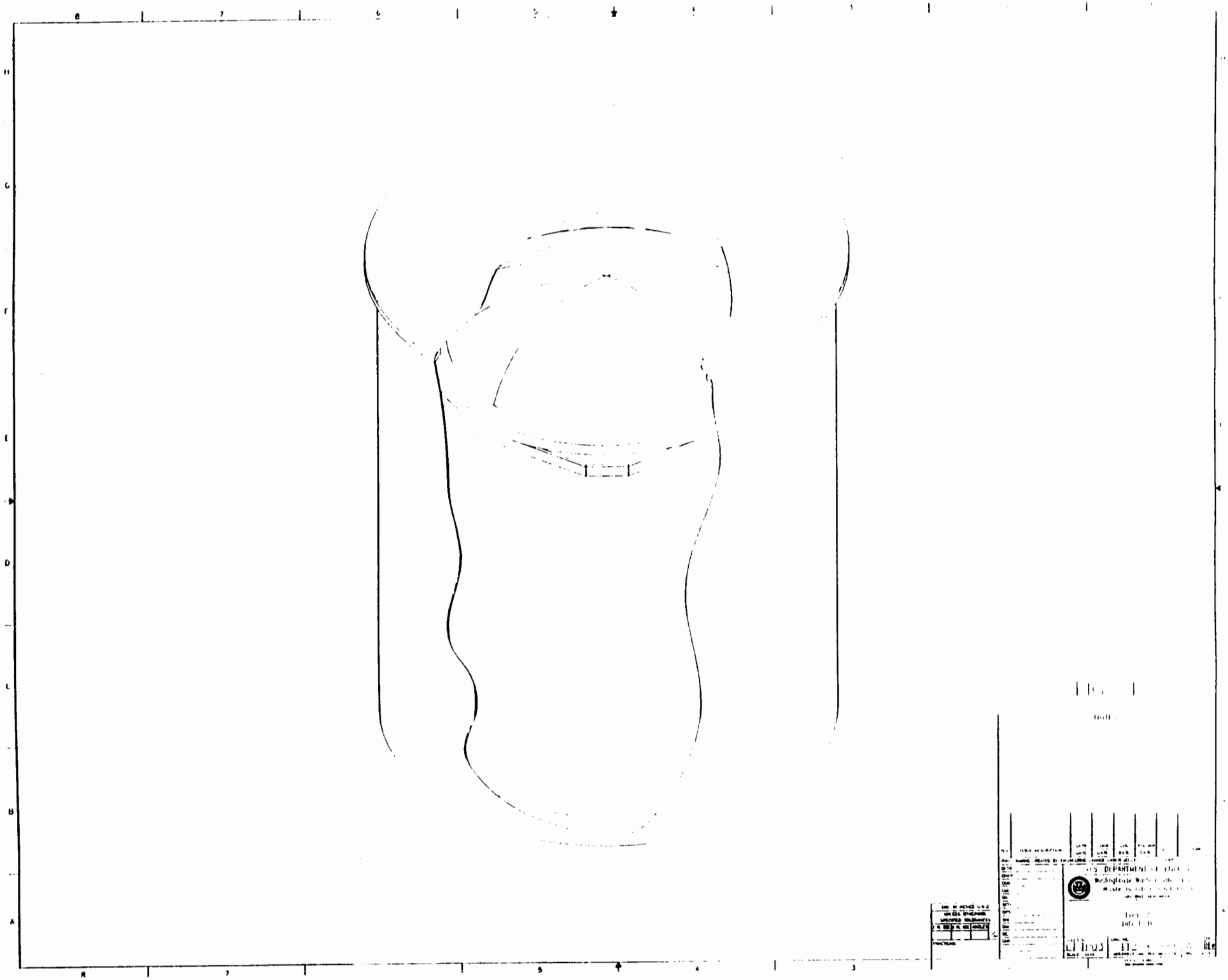
3.2.2 Preconceptual description of the RCB

Given the minimal payload envelope available for retrieval. a light weight RCB is required. To meet this condition. the preconceptual design of the RCB utilizes light-weight non-ferrous materials to reduce shipping weights. Attention will be given to selecting materials which will have the required physical properties. including mechanical strength as well as resistance to corrosion in a sodium chloride environment. The material selected will also be capable of withstanding internal negative pressures which could result from the requirement to brine stabilize a unit with a breached bin.

The RCB provides adequate radial and height clearances in an envelope capable of containing the Type 2 Bin and all required ancillary equipment. A preconceptual design of the RCB is shown in Figure 3.

The preconceptual design of the RCB includes consideration of the requirements to withstand both positive and negative internal pressures. and will comply with the applicable sections of the ASME code and with the safety requirements in the DOE Pressure Safety Manual Draft. To reduce costs and ease assembly at the WIPP, the preconceptual design routes all of the piping for gas recirculation to and from the Type 2 Bin through the lid of the RCB. A copy of the Bounding Conditions which list the derivation of the weights available for equipment has been supplied. Figure 4 provides a conceptual view of the Type 2 Bin inside the RCB.





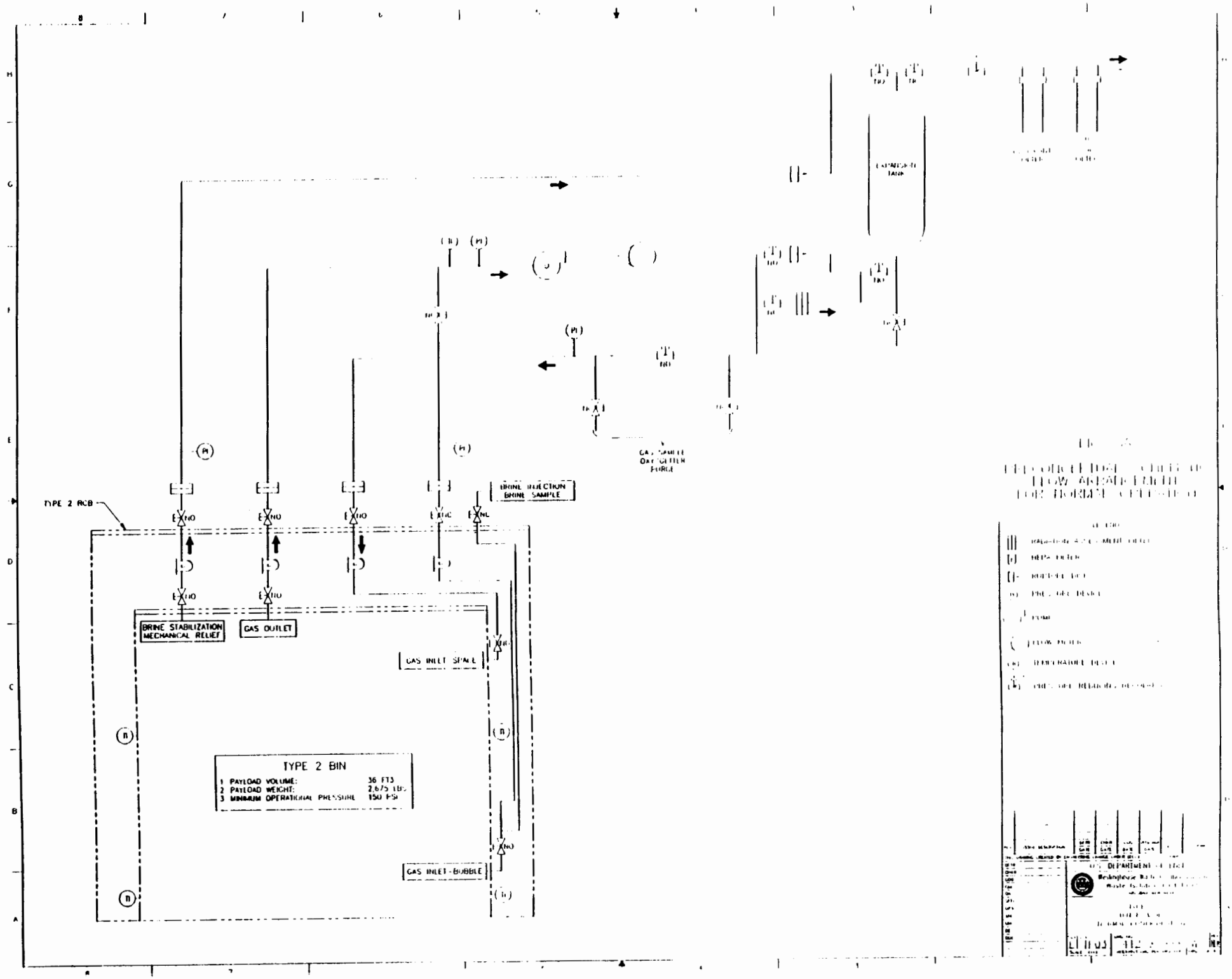
3.3 Gas Venting and Overpressure Protection

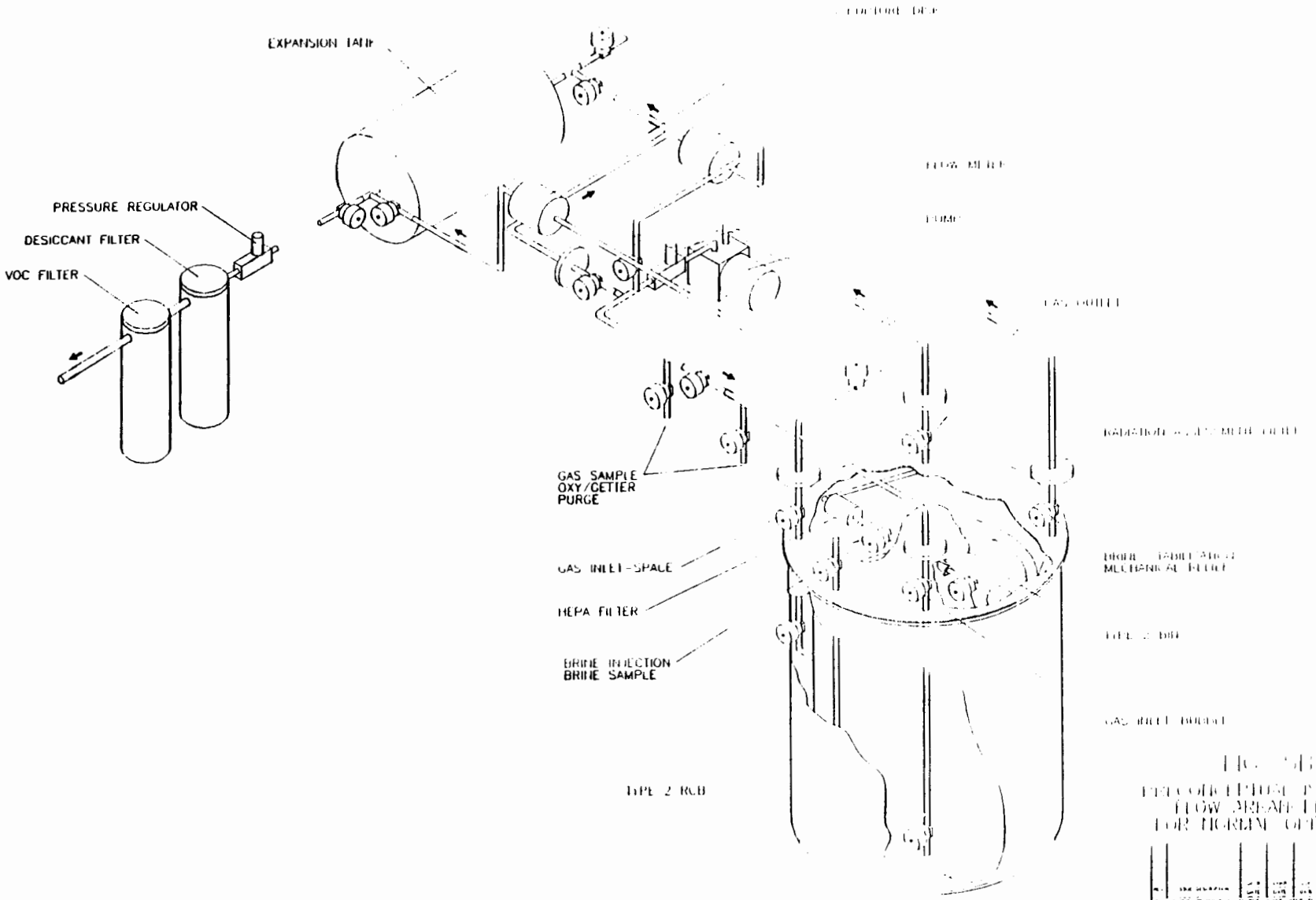
3.3.1 Major EDC requirements for Gas Venting & Overpressure Protection

- Pressure: minimum = 0.2 psia, maximum = 700 psia
- Temperature: minimum 65°F, maximum = 110°F.
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium
- Automatic operation for conditions in excess of bin design pressure.
- Protection shall be by a rupture disk with a maximum rupture pressure of 770 psia (110% of 700 psia).
- Function in a 50% to 100% relative humidity environment.
- Must vent the bin gases to a Volatile Organic Compound (VOC) Filtration and Monitoring System.
- Provide a manual method of operation for controlled venting of gas into the overpressure protection system.
- Provide for recording the amount of gas vented.

3.3.2 Preconceptual description of Gas Venting & Overpressure Protection

The preconceptual design approach to the Type 2 Bin Over-Pressure Protection system will provide redundant pressure safety relief by utilizing dual rupture disks and piping to provide an escape path if the system pressure reaches 110% of the design operating pressure of the system. Should an overpressure condition occur, the pressurized gas will be routed into the expansion tank module of the VOC Monitoring System. This tank has sufficient volume to reduce the overall system pressure to a value well below the design operating pressure. This preconceptual system will comply with the requirements of Section VIII of the **ASME Boiler & Pressure Vessel Code** which are applicable to underground operations of unfired pressure vessels, including UG-125; the values selected for use in the calculations are more conservative than those required by the ASME code. Two sketches are attached: Figure 5a shows the preconceptual gas flow schematic and Figure 5b shows a preconceptual gas flow isometric.


TYPE 2 RCB
BRINE STABILIZATION MECHANICAL RELIEF
GAS OUTLET
BRINE INJECTION BRINE SAMPLE
GAS INLET SPACE
GAS INLET-BUBBLE
TYPE 2 BIN
1 PAYLOAD VOLUME: 36 FT3
2 PAYLOAD WEIGHT: 2,675 LBS
3 MINIMUM OPERATIONAL PRESSURE 150 PSI
EXPANSION TANK
GAS SAMPLE OR GETTER PURGE


EXPANSION TANK
PRESSURE REGULATOR
DESICCANT FILTER
VOC FILTER
GAS SAMPLE
OXY/GETTER
PURGE
GAS INLET-SPACE
HEPA FILTER
BRINE INJECTION
BRINE SAMPLE
TYPE 2 RCB

3.4 VOC Monitoring System

3.4.1 Major EDC requirements for the VOC Monitoring System

Module 1 - Gas Collection

- Pressure: minimum = 0.2 psia, maximum = 700 psia
- Temperature: minimum -40°F, maximum = 200°F.
- Withstand detonation of flammable gas mixtures.
- Comply with the requirements of the ASME Boiler & Pressure Vessel Code.
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium
- Accommodate internal atmospheres which have relative humidity ranges from 0% to 100%.
- Accommodate internal atmospheres which contain mixtures of flammable gases, VOC's, etc.

Module 2 - Gas Filtration and Monitoring

- Temperature: minimum 65°F, maximum = 110°F.
- Leak rate: Less than 5% of design pressure in one hour.
- Required condition for incoming gases:

    1. Temperature between 77°F and 95°F.
    2. Relative humidity of 20% or less.

3.4.2 Preconceptual description of the VOC Monitoring System

The preconceptual design of the VOC Monitoring System provides a system which consists of two independent modules. The first module is an expansion tank which will accept gases vented from a Type 2 Bin, and retain them. The second module is a portable self-contained filtration and monitoring system which can be moved from bin to bin as required.

The expansion tank module is also a pressure vessel which is designed to the same ASME standards and operating conditions as the Type 2 Bin. The tank provides expansion volume for the gas if the rupture disk vents an overpressure condition. The expansion tank will be sized to provide a pressure reduction capability which meets the ASME requirements.

The preconceptual design of the expansion tank includes provisions for generating the appropriate alarm notification to operating personnel that an unanticipated gas discharge has occurred, as required by section 3.4.13 of the EDC.

When the decision is made to dispose of the gases from the internal atmosphere of a bin (either a planned venting, or disposal of gases from an unplanned occurrence), the gas filtration and monitoring module of the VOC Monitoring System will be connected to the expansion tank module's outlet port. The gas flow path in the filtration and monitoring module consists of a pressure-regulating valve, a desiccant assembly, and the filtration media.

The pressure regulating valve will reduce the pressure from that of the expansion tank down to a value which complies with the inlet requirements of the units in the gas filtration and monitoring module. The desiccant assembly will then remove any excessive moisture to protect the filtration media by conditioning the gas stream to a humidity level which is within its operating parameters. After leaving the desiccant assembly, the gas will pass through a filter bed of activated carbon, which will remove the VOCs entrained in the gas stream and condition the exhaust air to acceptable conditions for release to the underground ventilation system. Once connected to the expansion tank module on the Type 2 Bin, the gas treatment module will operate automatically. The system includes a flow totalizer to record the volume of gas released to the environment as specified in section 3.4.11 of the EDC. Refer to Figure 5a for the flow schematic and to Figure 5b for a pictorial representation.

3.5 Gas Mixing and Sampling

3.5.1 Major EDC requirements for Gas Mixing and Sampling

- Pressure: minimum = 0.2 psia, maximum = 700 psia
- Temperature: minimum 65°F, maximum = 110°F.
- Flow requirement: minimum = 0, maximum = 0.35 ft^3/hour
- Recirculation: Maximum = continuous
  Minimum of three (3) bin volumes recirculated within a 24 hour period before taking a gas sample.
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium
- Must have the capacity to route the gas into the gas headspace or into the brine.
- Double containment during any sampling operation.

3.5.2 Preconceptual description of Gas Mixing and Sampling

The preconceptual design of the Gas Mixing and Sampling system will include a means of recirculating the gases at the volumes required by section 3.5.5

of the EDC. which is based on the requirement for recirculation before sampling. and the maximum gas volume available. which will occur in a humid bin. The preconceptual design will also comply with the technical requirements listed for the recirculation and the re-entry of the gas.

Figure 5a shows the flow path. and figure 5b shows a pictorial view of the preconceptual design features. A flow device will monitor and totalize the recirculation flow to show and record that adequate flow has occurred before taking a gas sample. The design includes provision for the installation of HEPA type filters. a manual isolation valve. and a RAF on all gas recirculation paths (gas inlets and outlets); the HEPA type filter will be located inside the RCB to establish the secondary containment boundary before exiting the RCB, and the isolation valve and RAF will be located outside the RCB. The preconceptual design includes a method of obtaining a gas sample which complies with the requirements for representativeness. and will include provisions to operate at the specified design pressure. The sample vessel will be one that complies with the EDC requirements to be inert with respect to waste constituents. brine. and gases. One recirculation path returns the gas into the gas headspace. and the second route is through a manifold in the bottom of the bin to allow the gas to bubble through the brine.

The same figures show that the preconceptual design of the recirculation piping also includes provision for the transducers for gas pressure, gas temperature. and gas flow. In the case of retrieval due to a breached container. the Type 2 Bin and the RCB can be isolated by closing the isolation valves, disconnecting the piping, and plugging the port in the valve for shipment. Removal of the piping for the recirculation system will minimize the shipping weight.

3.6 Brine Addition and Sampling

3.6.1 Major EDC requirements for Brine Addition and Sampling

- Brine addition to be made at ambient pressure prior to start of test period.
- Temperature: minimum 65°F, maximum = 110°F.
- No visible leakage of brine while addition is in progress. Double containment as specified in 3.6.9 of the EDC.
- The internal void volume must be determined to the accuracy level specified in 3.6.13 of the EDC before the brine is added to the bin.
- The internal void volume must be determined to the accuracy level specified in 3.6.13 of the EDC after the brine is added to the bin.

3.6.2 Preconceptual description of Brine Addition and Sampling

The preconceptual design of the Brine Addition and Sampling system includes provisions for meeting all of the technical requirements listed in section 3.6 of the EDC. The regulations governing the transportation of hazardous waste containers containing more than 1% free liquid establish that the brine addition will take place after the test unit has been set in place in the underground test area.

The preconceptual design will give primary attention to the requirement that both brine addition before the test and the brine sample taken at the end of the test must be unfiltered liquid. As listed in 3.6.13 of the EDC, double containment of the sampling operation will be required. In order to meet the applicable safety requirements for the addition of liquid through an unfiltered opening, the method of adding the brine will include secondary containment around the connection point (see Figure 6), as well as the installation of a check valve in the brine supply line for backflow prevention.

The preconceptual design will also address the requirement for determining the internal gas volume in inundated bins as listed in section 3.6.13 of the EDC, which specifies that the internal gas volume must be measured both before and after brine addition, and specifies the level of accuracy required in these measurements.

A test vessel containing a known volume of an inert gas at a known pressure will be connected to the Type 2 Bin through a control valve, with all other valves closed. The isolation valve from the test vessel will be opened, and the resultant pressure in the system will be recorded. Since the initial pressure and volume of gas in the test vessel are known, and the final pressure in the system is also known, applying the Ideal Gas Law ($P_1V_1 = P_2V_2$) allows calculation of the volume in the total system. Subtraction of the required volume of gas head space yields the volume of brine required for addition to the individual bin. This process will then be repeated after brine addition to comply with the requirement for gas head space volume determination after brine addition.

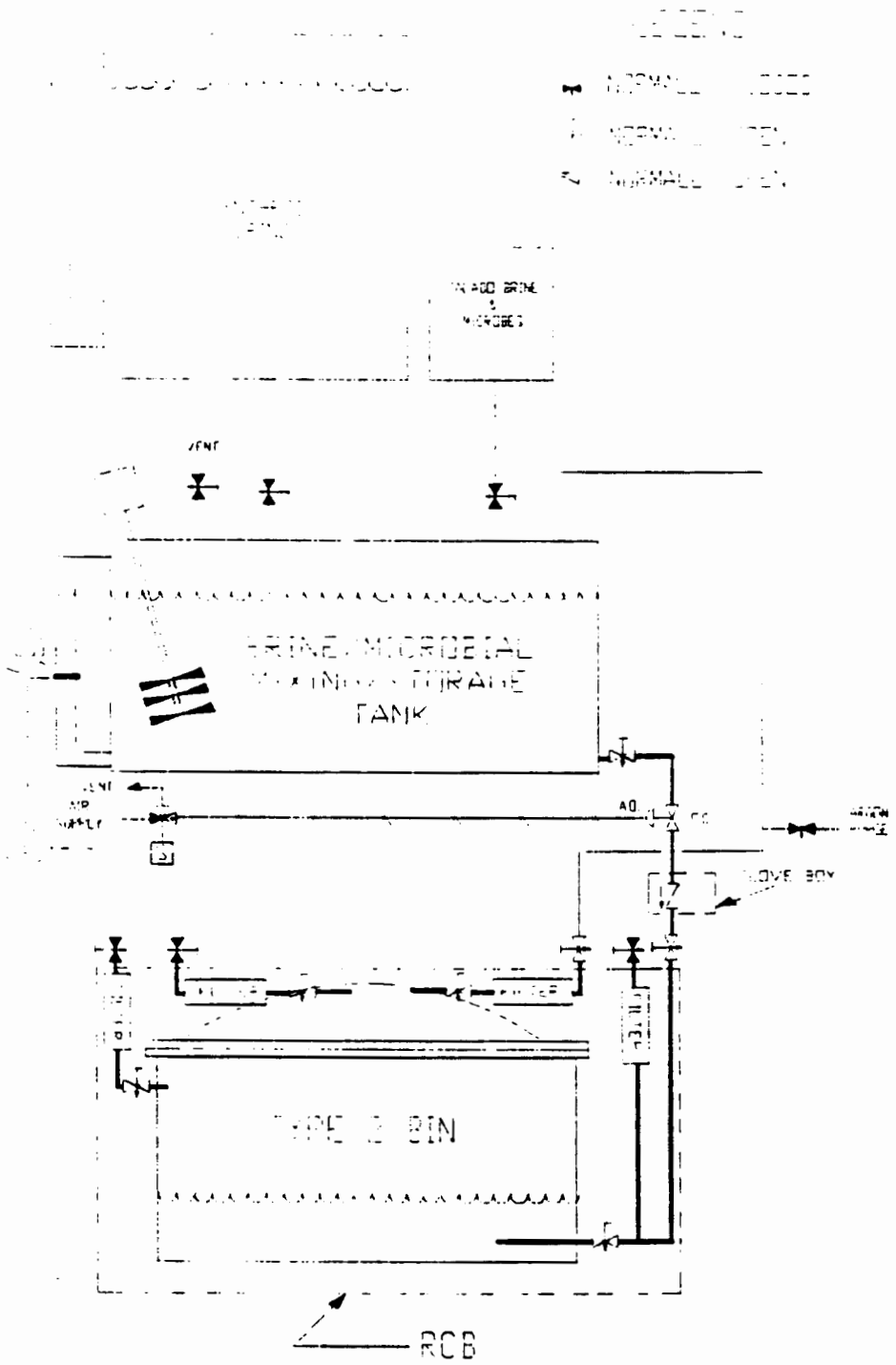


FIGURE NO. 6

BRINE ADDITION & MIXING

3.7 Microbe Addition

3.7.1 Major EDC requirements for Microbe Addition

- Pressure requirement: Addition to be done at ambient pressure (prior to start of test period).
- Temperature: minimum 65°F, maximum = 110°F.
- Maximum volume to be less than or equal to 10 liters.
- Addition of microbial material to be via an unfiltered pathway.
- No visible leakage of fluid while addition is in progress. Double containment required.

3.7.2 Preconceptual description of Microbe Addition

Section 3.7.13 of the EDC states that the Microbe inoculant will be premixed with the brine prior to the addition of the brine to the Type 2 Bin. Section 3.6.2 of this document describes the preconceptual system to be utilized for the addition of brine to the Type 2 Bin. Microbial mixing and addition will meet the same requirements as brine addition/mixing and will be an integral part of the brine system design as shown on Figure 6. The preconceptual design for Microbe Addition will comply with the technical requirements listed in section 3.7 of the EDC.

3.8 Gas Analyses

Section 3.8 of the EDC describes the requirements for the gases to be analyzed by the chemical laboratory. The analyses for the gases listed in this section of the EDC will be conducted by the existing analytical laboratory at WIPP, which is equipped to support the Type 1 Bin test program.

3.9 Sample Containment/Confinement

3.9.1 Major EDC requirements for Sample Containment/Confinement

- Pressure: minimum = 0.2 psia, maximum = 700 psia
- Temperature: minimum 65°F, maximum = 110°F.
- Flow: minimum = 0, maximum = 0.07 ft^3/min.
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium

3.9.2 Preconceptual description of Sample Containment/Confinement

The preconceptual design of the Sample Containment/Confinement system will comply with all of the technical specifications contained in section 3.9 of the EDC. A portable enclosure which will ensure compliance with the requirements for secondary containment will be installed around the sample port area (refer to Figure 5b), and an evacuated sample collection vessel will be connected to the sample port. The control valves will be operated to divert gas into the sample container, the valves will be closed, and the sample bottle will be disconnected. The sample vessel will be removed from the secondary containment and transported to the Gas Analysis Laboratory. The sample vessels will be suitably sized SUMMA canisters.

3.10 Gas Purging

3.10.1 Major EDC requirements for Gas Purging

- Pressure requirement: Gas Purging to be done with inert gas at ambient pressure prior to start of test period.
- Temperature: minimum 65°F, maximum = 110°F.
- Flow requirement: minimum = 0, maximum = 0.35 ft^3/minute
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium

3.10.2 Preconceptual description of Gas Purging

The preconceptual design of the Gas Purging system will employ a source of inert gas as specified in section 3.10.1 of the EDC, a pressure reducing valve to reduce the pressure of the inert gas supply to a value slightly above ambient, and a fitting suitable to connect to the inlet control valves on the gas recirculation system (refer to Figure 5b). Purging will be conducted by closing the bypass valve, opening the valve connected to the inert gas supply, and opening the second purge valve which allows the gas leaving the bin to pass through a HEPA type filter and exhaust to the VOC system. In this manner the atmosphere within the Type 2 Bin and its associated gas piping system will be removed and replaced by the inert purge gas.

The EDC states that purging is not anticipated after the beginning of the test, but it does not eliminate the possibility that purging may be required at some time after the beginning of the test. Therefore one of the considerations for the preconceptual design of this sub-system will be that gas purging will be required at pressures up to the design operating pressure of the system.

3.11 Gas Gettering

3.11.1 Major EDC requirements for Gas Gettering

- Pressure requirement: Gas Gettering to be done at ambient pressure prior to start of test period.
- Temperature: minimum = 65°F, maximum = 110°F.
- Flow requirement: minimum = 0, maximum = 0.35 ft^3/minute
- Must be able to produce internal bin atmospheres of 1 ppm of oxygen.

3.11.2 Preconceptual description of Gas Gettering

Gas gettering is the process of passing the internal atmosphere of a test bin over a chemical bed which utilizes specific chemical reactions to remove target gases from the gas flow. The preconceptual design of the Gas Gettering system will incorporate the requirements in section 3.11.1 of the EDC, which states that gettering may be required to remove oxygen from the internal atmosphere of a bin both before the start of the test period, and to maintain the specified anaerobic atmosphere throughout the test period.

The operation of the gettering process is similar to the process of purging described in section 3.10 of this document. The gettering material is contained within a canister which has an inlet and an outlet port arranged to direct the gas stream across the gettering material. To getter a bin, the inlet and outlet port of the gettering canister are connected to the access ports in the gas recirculation system on the bin, the bypass valve is closed, and the valves to the getter ports are opened (refer to Figure 5b). As the gas stream passes through the canister, the target gas(es) is removed.

3.12 Temperature Monitoring/Measuring

3.12.1 Major EDC requirements for Temperature Monitoring/Measuring

- Temperature: minimum = 32°F, maximum = 932°F.
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium
- Calibration required of all temperature transducers before installation.
- Transducer selection and acquisition to be made from a list of approved units furnished by SNL.
- Transducers must be capable of detecting a 0.9°C change within the bin despite any temperature fluctuations in the external environment.
- SNL will test 10% of all transducers; any failure of any transducer will require 100% inspection and calibration of all transducers by SNL.

3.12.2 Preconceptual description of Temperature Monitoring/Measuring

The preconceptual design of the Temperature Monitoring/Measuring system will utilize transducers from the list of units acceptable to SNL as specified in section 3.12.7 of the EDC. The design will also meet the requirements of section 3.12.13, which states the requirement to measure both gas and brine temperatures.

As shown on Figure 5a, the temperature sensor for the gases is located in the gas recirculation piping, and is protected from radiological contamination by the HEPA type filters. This provides the opportunity to reduce the quantity of (redundant) gas temperature sensors, since this area of the gas recirculation system is accessible for maintenance and/or replacement of equipment as required.

The brine temperature data will be sensed by transducers which are located at various positions and heights on the exterior walls of the Type 2 Bin. The data transmittal leads from the temperature sensors will pass through the lid of the RCB and on to the data acquisition system.

3.13 Pressure Monitoring/Measuring and Control

3.13.1 Major EDC requirements for Pressure Monitoring/Measuring and Control

- Pressure: minimum = -1.0 psig, maximum = 1,000 psig
- Temperature: minimum = 65°F, maximum = 110°F.
- Both local and remote readouts required
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium
- Minimum requirement of three (3) independent and redundant sealed pressure transducers per bin.
- Transducers must have 0.25% accuracy with calibration traceable to the National Institute of Standards and Technology.
- Transducers must be temperature compensated.

3.13.2 Preconceptual description of Pressure Monitoring/Measuring and Control

The preconceptual design of the Pressure Monitoring/Measuring and Control system as shown on Figure 5a, will comply with all of the technical requirements listed in section 3.13 of the EDC for selection and installation of pressure transducers, and the transducers will be selected to provide the level of

accuracy specified in section 3.13.11 of the EDC. The concept of the gas recirculation system includes provision for the installation of pressure transducers such that the HEPA type filter will isolate them from contamination by particulate radiological materials.

3.14 Brine Stabilization

3.14.1 Major EDC requirements for Brine Stabilization

- Pressure: minimum = 0.15 psia, maximum = 10 psig
- Temperature: minimum = 65°F, maximum = 200°F.
- Secondary confinement of all leakage is required.
- Surfaces are to be smooth nonsorbent materials for ease of decontamination after use.

3.14.2 Preconceptual description of Brine Stabilization

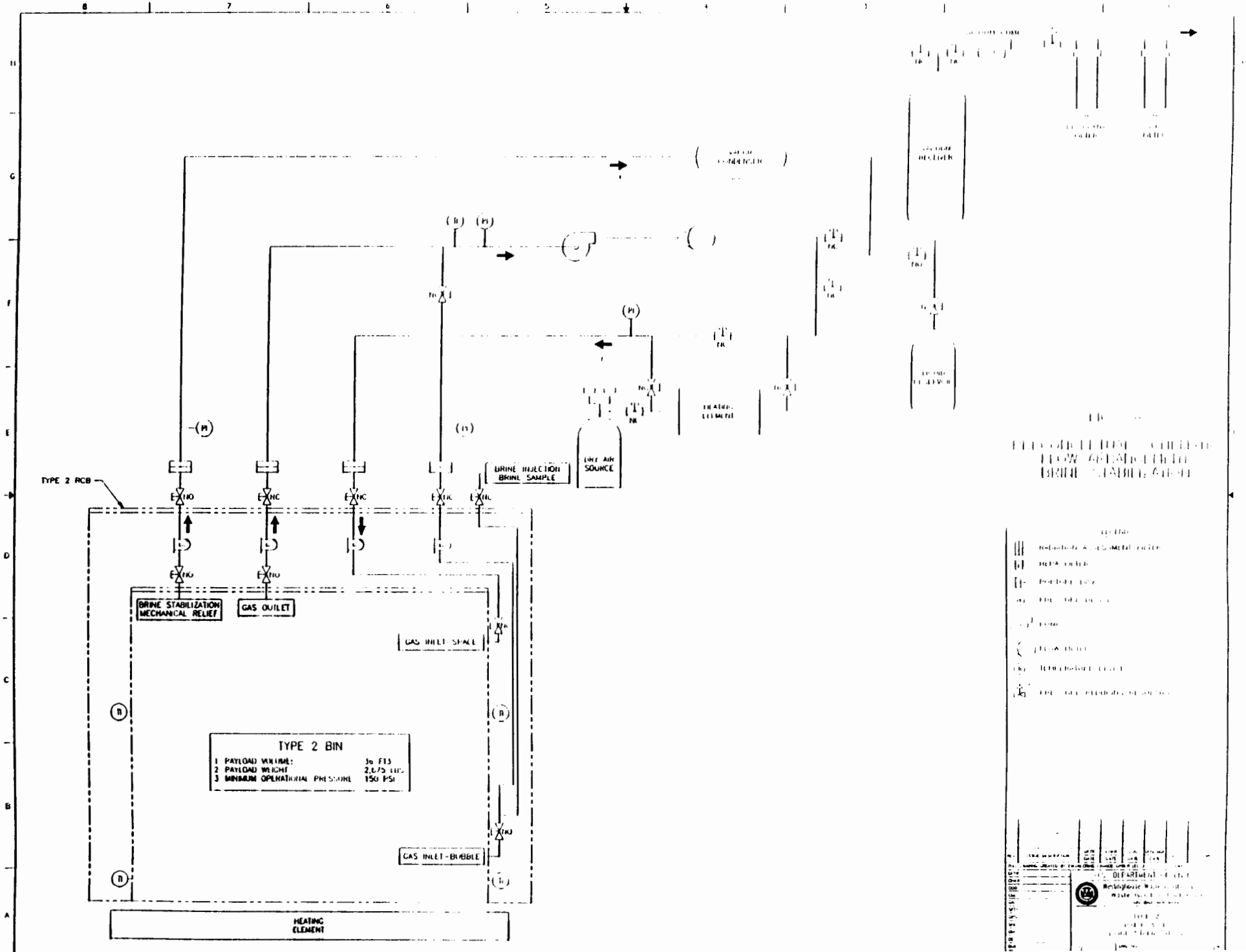
The preconceptual design of the Brine Stabilization system will conform to the technical requirements and specifications listed in section 3.14 of the EDC. This equipment will to remove the liquids that were added to a test bin and return that bin to a condition of less than 1% free liquid to comply with the Waste Acceptance Criteria requirements for transportation of waste.

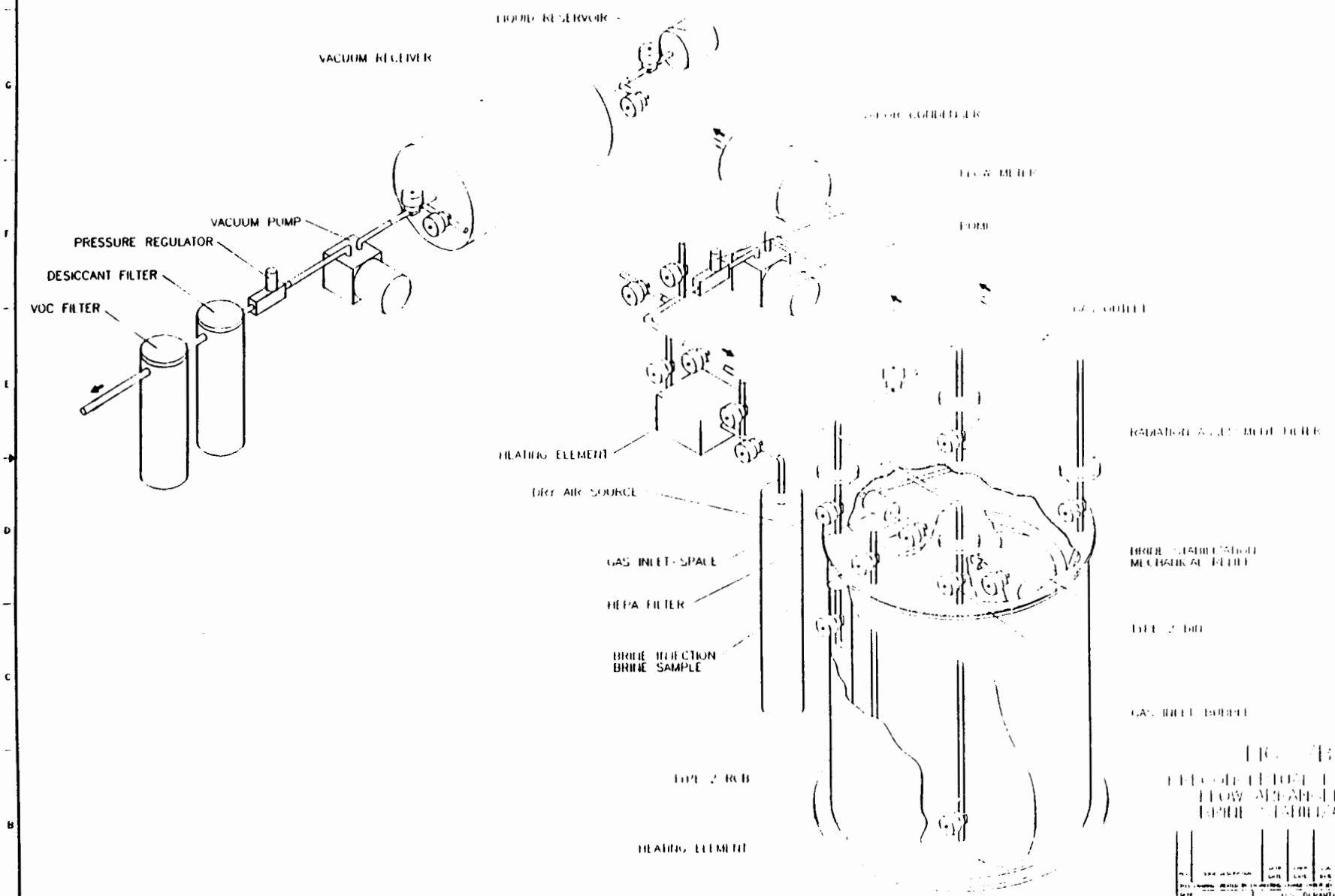
The system as currently outlined in the preconceptual design is of manual operation, modular components, and will be skid-mounted as required in section 3.14.9 and 3.14.13 of the EDC. The design will include secondary confinement for the entire Brine Stabilization system. The volume of the Brine Stabilization system is sufficient to contain the liquid content of an inundated bin. In addition, section 3.14 of the EDC requires that contamination of piping be avoided by assuring that all vapors pass through HEPA type filters which are as close as practical to the bin. The design will include secondary confinement and containment of piping to meet the requirements of DOE Order 6430.1a.

The discharge of the vapor stream from the exhaust of the vacuum pump will be monitored for the presence of VOC's and will be delivered to the VOC Monitoring System described in section 3.4 of the EDC. Any liquid removed from the test bin is hazardous waste by definition, and will be treated and handled as such in accordance with the regulations governing hazardous waste.

Preparing a Type 2 Bin for off-site shipment will require compliance with the Waste Acceptance Criteria requirements for transporting hazardous waste. These requirements specify that it is necessary to reduce the fluid in the test bin to less than 1% free liquid by volume. This will be accomplished by a combination of heating and vacuum drying. The preconceptual design applies this method to minimize site-generated TRU waste. By distilling the liquid out of the Type 2 Bin, any potentially TRU contaminated salts and compounds that are dissolved in the liquid will remain in the bin.

The preconceptual design of the brine stabilization system includes provision to collect all condensate from the process, and transfer this material to a hazardous waste container suitable for liquids. The collected waste material will be tested to verify that it is not radiologically contaminated. See the attached Figure 7a for a preconceptual flow schematic, and Figure 7b for a preconceptual isometric.


TYPE 2 RCB
BRINE STABILIZATION MECHANICAL RELIEF
GAS OUTLET
GAS INLET SPACE
TYPE 2 BIN
1 PAYLOAD VOLUME: 36 FT3
2 PAYLOAD WEIGHT 2,675 LBS
3 MINIMUM OPERATIONAL PRESSURE 150 PSI
GAS INLET-BUBBLE
HEATING ELEMENT
BRINE INJECTION BRINE SAMPLE
LIFT AIR SOURCE
HEATING ELEMENT


VACUUM RECEIVER
VACUUM PUMP
PRESSURE REGULATOR
DESICCANT FILTER
VOC FILTER
HEATING ELEMENT
DRY AIR SOURCE
GAS INLET-SPACE
HEPA FILTER
BRINE INJECTION
BRINE SAMPLE
HEATING ELEMENT
MECHANICAL REHEAT

3.15 Real Time Radiography (RTR)

3.15.1 Major EDC requirements for Real Time Radiography

- Capable of accepting the Type 2 Bin and RCB.
- Sufficient power and resolution to successfully examine Type 2 Bins filled with waste and determine compliance with the requirement for less than 1% free liquid by volume.
- No more than one (1) operator required for operation.
- Not more than two (2) waste handlers and one (1) health physics technician required to load/unload the equipment.

3.15.2 Preconceptual description of Real Time Radiography

The preconceptual design of the Real Time Radiography (RTR) system includes all of the pertinent equipment and sub-systems to determine the amount of free liquid within a Type 2 Bin/RCB combination, and to demonstrate that it complies with the criteria for transporting any solid hazardous waste (with or without TRU material). These criteria specify that a waste container cannot be shipped if it contains more than 1% free liquid by volume.

The equipment selected in the preconceptual design is commercially available, and has adequate spatial and contrast resolution to detect and quantify liquid volumes with sufficient accuracy to meet these technical requirements. Data is taken from multiple radiographic scans and is supplied to a computerized tomography system, which will generate a visual image of the contents of the bin on a Cathode Ray Tube (CRT). The computer program will provide animation of the image of the contents of the bin to allow internal container examination.

Data taken during tests of a bin mock-up indicate a maximum uncertainty region of 10% on volumetric readings. In order to ensure that waste containers being retrieved must meet transportation requirements, the results of the test will have to show that the subject container did not contain more than 0.9% free liquid by volume based on:

[1% free liquid/(100% + 10% possible error)].

If the RTR examination indicates free liquid in excess of this amount exists inside the bin, additional drying of the bin contents will be required, followed by radiographic re-examination.

The RTR equipment will be specified to operate in the underground environment, and will be mounted on a common base to provide the required rigidity during scanning of the test specimen. The positioning equipment is capable of handling a container with a 58 inch diameter and an overall height of 70 inches (RCB is 53 diameter x 62 high). The unit has five motion axes to provide a thorough and complete examination of the contents of the bin.

3.16 Container Handling Equipment

3.16.1 Major EDC requirements for the Container Handling Equipment

- Temperature: minimum = 40°F, maximum = 110°F.

3.16.2 Preconceptual description of the Container Handling Equipment

The preconceptual design of the Container Handling Equipment incorporates the functional characteristics as defined in section 3.16 of the EDC. This section requires that all existing handling equipment be evaluated in the light of the proposed design configurations and weights, and that any necessary modifications or new equipment be developed.

Moving the Type 2 Bin, the RCB, and the TDOP to the various locations will require material handling equipment designed specifically for the application. Adapters will be designed which will interface between these components and the existing material handling equipment such as the Adjustable Center of Gravity Lift Fixture (ACGLF). This approach will allow use of the lifting and handling equipment currently in service at both the generator site(s) and at the WIPP.

During the life of the test in the underground area, the test package will rest on the same model of support platform currently used for the Type 1 Bins. The support platform provides the capability of level compensation for up to twelve inches.

3.17 Brine Solution Composition

3.17.1 Major EDC requirements for Brine Solution Composition

- Comply with specifications provided by SNL.
- Brine requires sample analysis before introduction into a bin, and SNL approval of brine mixture.

3.17.2 Preconceptual description of Brine Solution Composition

The EDC covers the requirements for brine solution composition in section 3.17. This section defines the responsibilities of WIPP to formulate and mix the artificial brine and then compound this material with additions of G-Seep brine (actual brine collected from the underground area) and formulated inoculant material (containing microbes). Collection of G-Seep brine will be done under the direction of SNL.

As shown in Figure 6, the preconceptual design includes the necessary components for compounding or storing the material specified, measuring them into a tank which will be used to mix and store the completed brine. A sample will then be taken as prescribed by the requirements of section 3.17 of the EDC, and forwarded for analysis. SNL personnel must approve the actual solution before it is added to any bin. After approval is received, the brine will be added to the bin utilizing the methods and equipment listed earlier in section 3.6 of this document.

3.18 Backfill Composition

3.18.1 Major EDC requirements for Backfill Composition

- Utilize actual salt taken from underground mining operation.
- Backfill may be 100% salt, or 70% salt and 30% bentonite clay (MX-80) by weight.

3.18.2 Preconceptual description of Backfill Composition

Section 3.18 of the EDC lists the requirements for collecting the material required and making the required mixtures of backfill material. The preconceptual design will utilize the same equipment currently in existence to provide backfill material to the generator sites for use in the Type 1 Dry Bin and Type 1 Humid Bin applications.

The current equipment receives crushed salt which has been taken from the underground excavation operations and screens it to remove all particles larger than 0.25 inches. The screen-sized material is then packaged in the appropriate containers and shipped to the waste generator sites for loading into the designated test bins. The salt-bentonite clay mixture is prepared by blending screened salt with MX-80 Bentonite Clay in the existing blending plant at a ratio of 70% salt and 30% bentonite clay by weight. This mixture is then packaged and shipped to the generating site for inclusion in the designated test bins.

3.19 Liquid Level Determination

3.19.1 Major EDC requirements for Liquid Level Determination

- Ensure initial and continued inundation of the waste contained in the Type 2 Bin.
- Meet all restrictions due to configuration, retrievability requirements, safety requirements, and all interface configurations.

3.19.2 Preconceptual description of Liquid Level Determination

The specifications for Liquid Level Determination in section 3.19 of the EDC require a method of ensuring the initial and continued inundation of the contents of the Type 2 Bin. The preconceptual design will utilize the application of the Ideal Gas Law ($P_1V_1 = P_2V_2$) which was described in section 3.6.2 of this document. Once the internal void volume in the bin is known, the appropriate amount of brine can be added to the bin, and the test repeated to verify the actual gas headspace in the Type 2 Bin. The continued inundation is ensured by the fact that the liquid in the bin is not recirculated, and the only credible conditions that could lower the liquid level would be a leak.

Preconceptual Design Description of
the Type 2 Bin and Systems
for Wet Waste Testing

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1.0 INTRODUCTION

1.1 OVERVIEW

This report on the Type 2 Bin design provides a preconceptual description of the physical equipment, the operational systems, and the sub-systems which are necessary to comply with the requirements which are defined in the **Equipment Design Criteria. Wet Waste Testing Program. Draft. WP 09-15. Revision 1. May 3. 1993**. The **Equipment Design Criteria** (EDC) document has been reviewed and approved by the Department of Energy/ WIPP Project Site Office (DOE/WPSO), Sandia National Laboratory (SNL) and the Waste Isolation Division (WID), and lists the technical criteria and requirements for the test vehicle and data acquisition systems required for collecting data on Contact Handled (CH) transuranic (TRU) waste interactions in either a high humidity or a brine-inundated environment at elevated pressures. The EDC incorporates the requirements of the approved Bounding Conditions dated February 5, 1993, which specify a 36 ft^3 payload volume and a 2,675 pound payload weight capability. A reference copy of the Bounding Conditions and the **Equipment Design Criteria. Wet Waste Testing Program. Draft. WP 09-15. Revision 1. May 3. 1993** are included.

The EDC lists nineteen (19) specific systems, equipment, and processes which are addressed in this report. The component of primary interest is the TRU waste container, or Type 2 Bin. The Type 2 Bin is a pressure vessel that will provide the payload volume and weight capacities and the operating conditions that meet the requirements listed in section 3.1 of the EDC. The EDC establishes the technical requirements and specifications for each of the major pieces of equipment, systems, and processes. This includes the operating pressure ranges, temperature ranges, flow requirements, material(s) for construction, instrumentation requirements, and functional characteristics.

Public and personnel safety are the primary considerations throughout the design, start-up, operation, and post-test phases considered in this preconceptual design process. The specific safety areas covered by government regulations and agencies such as OSHA, MSHA, RCRA, NEPA, NMD, and DOE Order 6430.1a will be incorporated in the design as applicable. The systems and sub-systems required to support the Wet Waste Test Program through the cycle of waste receipt, test preparation, emplacement, test conduct, and post-test activities include:

- The Type 2 Bin which will contain the TRU wastes and provide the test environment specified in section 3.1 of the EDC.

- The Radiological Control Boundary (RCB) which is required to provide the mandated level of confinement for TRU materials as specified in section 3.2 of the EDC.

- The Gas Venting and Overpressure Protection system which provides safety protection from pressure-related events and minimizes the potential for test disruption as specified in section 3.3 of the EDC.

- The Volatile Organic Compound (VOC) Monitoring System will accept all gas from controlled and uncontrolled releases. and collect samples for analysis as specified in section 3.4 of the EDC.

- The Gas Mixing and Sampling system will gather samples for identification and quantification of data for the test as specified in section 3.5 of the EDC.

- The Brine Addition and Sampling system will add the brine to the waste for those bins requiring an inundated or humid environment. and draw a brine sample as specified in section 3.6 of the EDC.

- The Microbe Addition system will comply with the requirements for adding microbial material to the appropriate test bins as specified in section 3.7 of the EDC.

- The Gas Analyses system will comply with the requirements for identifying and quantifying gas sample data as specified in section 3.8 of the EDC.

- The Sample Containment/Confinement system will provide the canisters to draw gas samples as outlined in section 3.9 of the EDC.

- The Gas Purging system will precondition the internal atmosphere in the test bins to the test requirements as specified in section 3.10 of the EDC.

- The Gas Gettering system will reduce the oxygen level of the internal bin atmosphere to the levels as specified in section 3.11 of the EDC.

- The Temperature Monitoring/Measuring system will meet the instrumentation and data recording requirements as specified in section 3.12 of the EDC.

- The Pressure Monitoring/Measuring and Control system will meet the requirements for the instrumentation and data recording as specified in section 3.13 of the EDC.

- The Brine Stabilization equipment will meet the requirements to remove free liquids from the test bin after the completion of testing as specified in section 3.14 of the EDC.

- The Real Time Radiography inspection equipment will meet the requirements to verify that any material retrieved from the Waste Isolation Pilot Plant (WIPP) site complies with the transportation requirements of the Waste Acceptance Criteria. and as specified in section 3.15 of the EDC.

- The Container Handling Equipment to transport the components through the various stages of receipt, testing, and post-test activities will meet the requirements as specified in section 3.16 of the EDC.

- The Brine Solution Composition will meet chemical compositions and mixture ratios as specified in section 3.17 of the EDC.

- Backfill Composition will meet the requirements as specified in section 3.18 of the EDC.

- The Liquid Level Determination system will meet the requirements as specified in section 3.19 of the EDC.

1.2 Process Description

This section describes the process flow for a Type 2 Bin, and identifies the preconceptual sequence of operations that will be required for the receipt, test preparation, emplacement, test conduct, and post-test activities. Figure No. 1 illustrates the activities required to support normal bin operations. Note that this is a **preconceptual** description of the possible sequence of events, and it is recognized at this stage of development that additional systems, equipment and processes may become necessary to achieve success. Further system details will be determined as part of the design process, and will incorporate the experience and knowledge gained from the design and implementation of readiness of the Type 1 Dry Bin and the Type 1 Humid Bin, and their respective operational and support systems.

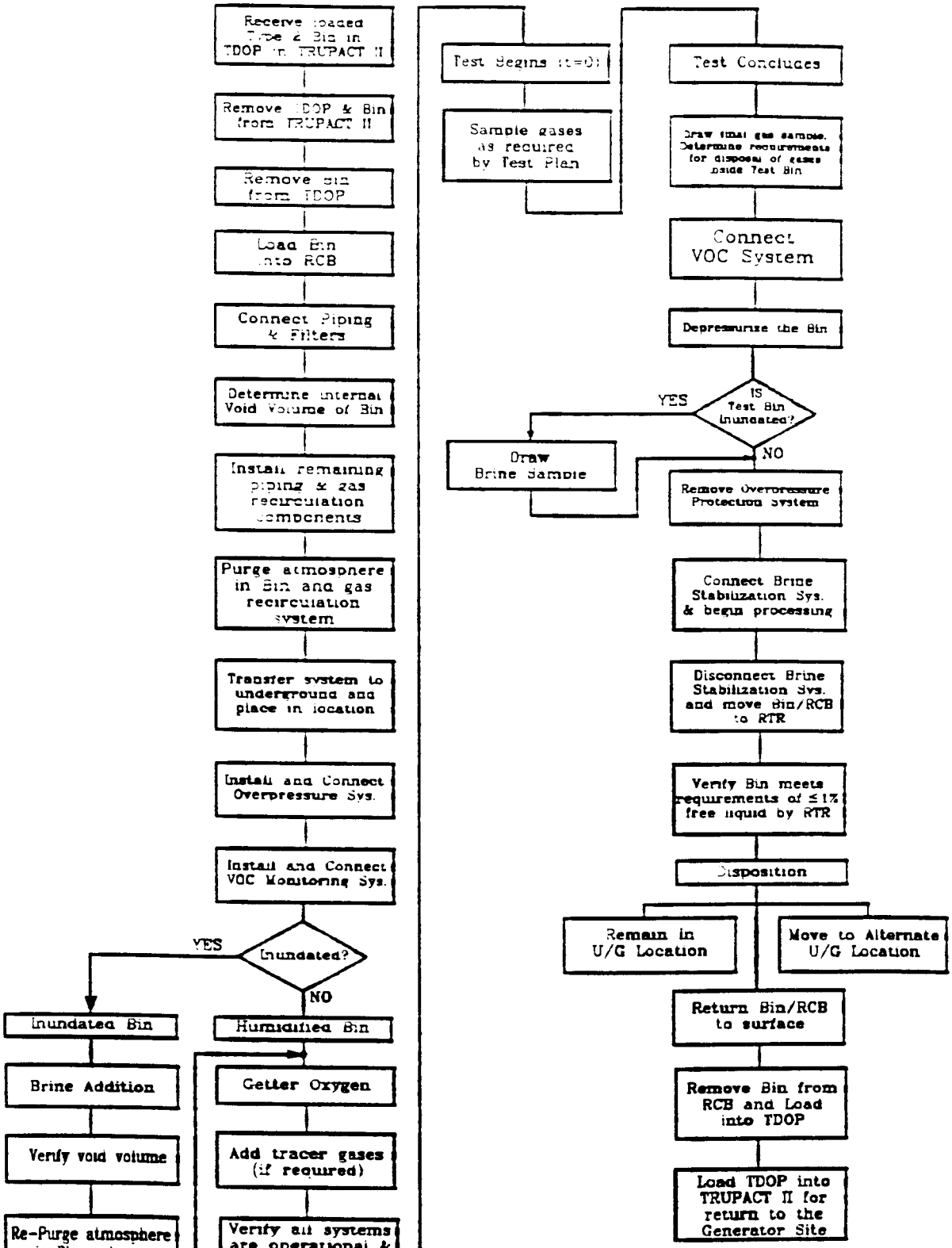
The event required to initiate the process at WIPP is the receipt of a Type 2 Bin loaded with TRU waste. The bin will be unloaded from the Transuranic Package Transporter II (TRUPACT II) and placed in an RCB. The High Efficiency Particulate Air (HEPA) type filters, isolation valves, Radiation Assessment Filters (RAF's) and the gas recirculation piping and pump would be connected, and the internal void volume in the bin will be determined: this operation is part of the technical requirements specified in section 3.1.13 (humid bin) or 3.6.13 (inundated bin) of the EDC. At this point the remainder of the gas recirculation system will be installed, the gas recirculation system would be purged, and the bin will be transported to its underground location.

After emplacement in the appropriate underground location, the remainder of the support systems specified in the EDC will be connected to the unit. Those Type 2 Bins which have been selected for the testing of inundated waste will have brine addition made to the contents of the bin, and those units which are to be tested with a humidified atmosphere will have the necessary component additions made. The bins will then require re-purging of the internal bin atmosphere, oxygen gettering will be initiated on those bins whose test schedule require such activity, and any tracer gases required by the EDC will be introduced. At this stage, the appropriate actions will be taken to verify that all requisite conditions have been met.

Throughout the duration of the test, no intervention will be required. Procedures will be written, verified, and put in place to ensure that the appropriate samples are taken as specified by the scientific advisor. At test termination final gas(es) and brine (for inundated bins only) samples will be taken.

After the final gas samples have been taken, the gases in the Type 2 Bin will be disposed of in accordance with all of the pertinent regulations governing such activities, the required liquid sample will be taken from all inundated bins, and the Type 2 Bin and its attendant RCB will be dispositioned in one of three alternative manners: 1) the Type 2 Bin and RCB will remain in the underground test area, 2) the Type 2 Bin and RCB will be transported to the surface for off-site shipping or temporary storage, or 3) the Type 2 Bin and RCB will be moved to an approved storage or disposal location within the WIPP underground area.
If disposition requires the removal of any free liquid within the bin, the gas recirculation system will be removed, and the bin will be connected to the Brine Stabilization system for liquid removal as specified in section 3.14.13 of the EDC.

After the liquid is removed, the bin will be inspected and compliance with the requirement for 1% free liquid by volume (or less) will be verified through the use of the Real Time Radiography (RTR) system. If the bin is to be shipped off-site, the bin and its associated RCB will be transported to the surface and moved to the CH Bay in the Waste Handling Building, and then packaged as required by the Waste Acceptance Criteria for off-site shipment. All of these activities will be conducted as described in the Waste Retrieval Plan for the Waste Isolation Pilot Plant.



TYPE 2 BIN PROCESSING
FIGURE NO. 1

2.0 REFERENCE DOCUMENTS

Equipment Design Criteria, Wet Waste Testing Program, Draft, WP 09-15, Revision 1, May 3, 1993

DOE/EM/48063-1, Appendix C2, Real Time Radiography and Radioscopy QA Objectives

DOE Pressure Safety Manual Draft, October, 1992

DOE/WIPP 89-022, Waste Retrieval Plan for the Waste Isolation Pilot Plant, Revision 1, March, 1993

American Society of Mechanical Engineers Standards

Boiler & Pressure Vessel Code, Section VIII, Divisions 1 & 2, and Division 1, Part UG-125

E 94-91 Standard Guide for Radiographic Testing

E 1441-91 Standard Guide for Computed Tomographic (CT) Imaging Systems

3.0 DESIGN CRITERIA

3.1 Type 2 Bin

3.1.1 Major EDC requirements for the Type 2 Bin

- Contain 36 ft^3 of payload volume
- Contain 2.675 pounds of payload weight
- Pressure: minimum = 0.2 psia, maximum = 700 psia
- Temperature: minimum -40°F, maximum = 200°F.
- Withstand detonation of flammable gas mixtures.
- Shipping configuration to WIPP and at retrieval (including RCB) must be compatible with a Ten Drum OverPack (TDOP)
- Comply with the requirements of the ASME Boiler & Pressure Vessel Code.
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium
- Meet the interface requirements of the Waste Characterization Chamber (WCC) at Argonne National Laboratory-West (ANL-W) and the Advanced Size Reduction Facility (ASRF) at the Rocky Flats Plant.
- Accommodate internal atmospheres which have relative humidity ranges from 0% to 100%.
- Accommodate internal atmospheres which contain mixtures of flammable gases, VOC's, etc.

3.1.2 Preconceptual description of the Type 2 Bin

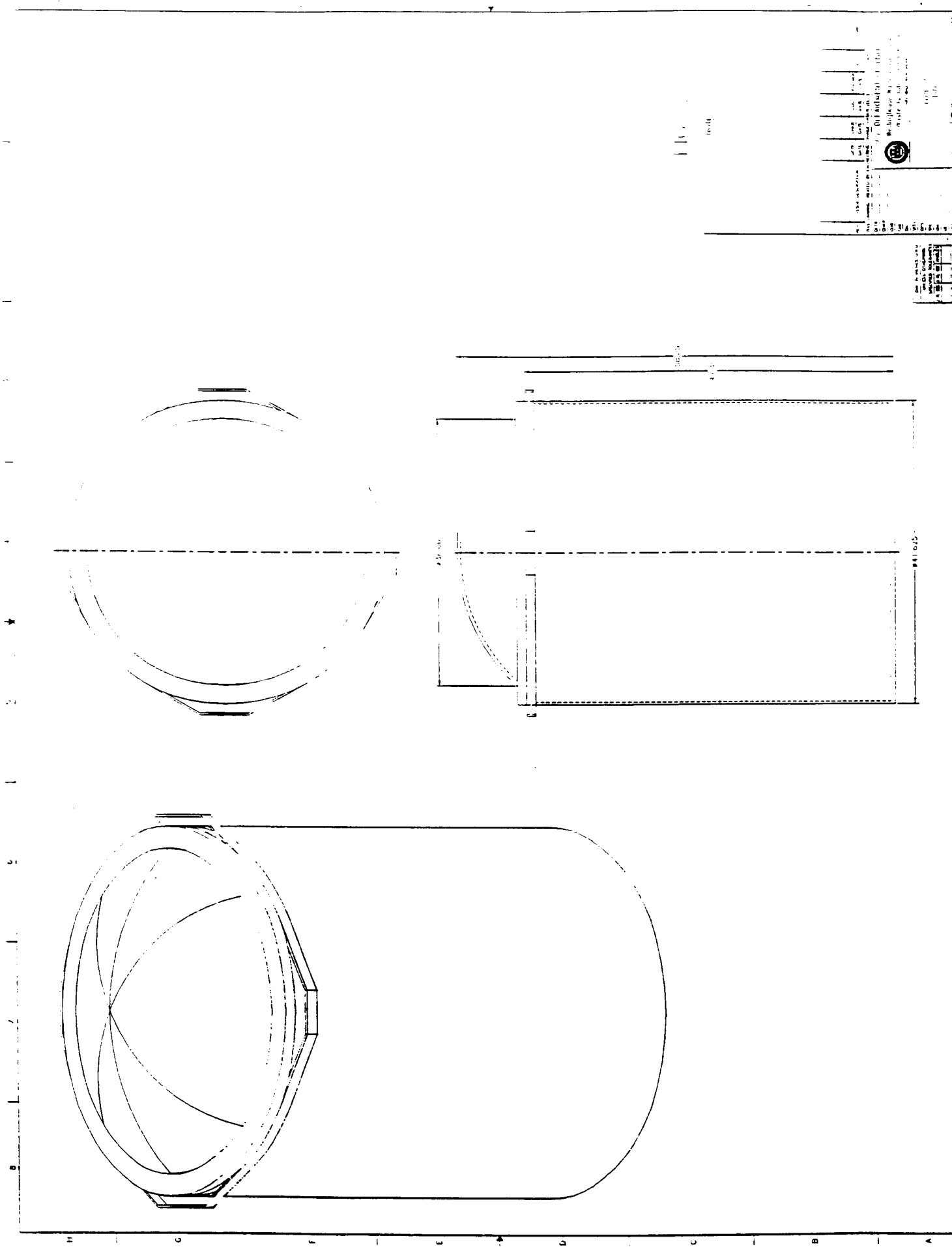
Figure 2 shows the preconceptual design for the Type 2 Bin based on the above requirements. It has an internal diameter of 41 inches and a height of 48.7 inches, providing an internal volume of 37.2 ft^3. This provides an additional volume of 1.2 ft^3 to accommodate the gas manifolds and other operational equipment which are required inside the bin. The bin design includes a torispherical head to provide 62.6 liters of headspace for gases, and a reduced total weight when compared with other geometrical head shapes.

The Type 2 Bin is designed for a maximum operational pressure of 700 psia and will comply with the requirements of the ASME Boiler & Pressure Vessel Code. The Type 2 Bin will be constructed from materials with the required physical properties for tensile strength, yield strength, resistance to corrosion due to ambient operational conditions (including stress) , and which are non-reactive to waste constituents. To comply with the Department of Energy (DOE) safety requirements as listed in the DOE Pressure Safety Manual Draft, October, 1992, the Type 2 Bin will be designed to provide a safety factor of four (4), based on the yield strength of the material.

The height of the Type 2 Bin is within the measurements allowed by Argonne National Laboratory - West (ANL-W) for interfacing with the Waste Characterization Chamber (WCC). The ANL-W also specifies that "the bin lid must be installed in the transfer room." and provides a maximum dimension for this operation: the preconceptual design of the Type 2 Bin fits within their dimension.

The concept for the Type 2 Bin and the current design drawing for the Advanced Size Reduction Facility (ASRF) at Rocky Flats are not compatible. The ASRF was based on a Type 2 Bin which will be similar to the Type 1 Dry Bin (rectangular). The requirements listed in the EDC duplicate the Bounding Conditions dated February 5, 1993, which were agreed to by WPSO, WPIO, SNL and the WID. The specification of a 36 ft^3 payload volume and a 2,675 pound payload weight mandate alterations in the shape and size of the Type 2 Bin.

Based on the Rocky Flats drawings available, there is 42 inches of vertical clearance for the Type 2 Bin beneath the ASRF. Modifying the design of the Type 2 Bin by reducing the height to comply with the ASRF specification will reduce the internal volume of the bin below the mandated payload volume as established in the EDC. Increasing the diameter of the bin to restore the volume capacity causes the weight of the Type 2 Bin to exceed the value required to ensure providing the required payload weight of 2,675 lb. However, the ASRF drawings indicate that it may be possible to modify the unit to provide the necessary space for the Type 2 Bin by either increasing the length of the support legs on the ASRF, or by placing an external riser beneath the legs to provide the additional height necessary for clearance of the Type 2 Bin. Additionally, changes to the size and shape of the Type 2 Bin are restricted due to the established geometry of the transportation packaging system.



3.2 Radiological Control Boundary (RCB)

3.2.1 Major EDC requirements for the RCB

- Pressure: minimum = 0.2 psia. maximum = 20 psia
- Temperature: minimum -40°F. maximum = 200°F.
- Minimum of two filtered vents to prevent internal pressure build-up in the RCB if the primary boundary is compromised during the test. Two filters are required for redundancy.
- An internal free volume at least 110% of the total volume of the Type 2 Bin.
- The volume of the RCB will be sufficient to enclose the bin and equipment necessary to isolate the bin and filters.
- Construction such that the RCB will pass a bubble test when pressurized to 0.5-1.0 psig with compressed air.
- Bin liquid leakage must be contained within the associated RCB.

3.2.2 Preconceptual description of the RCB

Given the minimal payload envelope available for retrieval. a light weight RCB is required. To meet this condition. the preconceptual design of the RCB utilizes light-weight non-ferrous materials to reduce shipping weights. Attention will be given to selecting materials which will have the required physical properties. including mechanical strength as well as resistance to corrosion in a sodium chloride environment. The material selected will also be capable of withstanding internal negative pressures which could result from the requirement to brine stabilize a unit with a breached bin.

The RCB provides adequate radial and height clearances in an envelope capable of containing the Type 2 Bin and all required ancillary equipment. A preconceptual design of the RCB is shown in Figure 3.

The preconceptual design of the RCB includes consideration of the requirements to withstand both positive and negative internal pressures. and will comply with the applicable sections of the ASME code and with the safety requirements in the DOE Pressure Safety Manual Draft. To reduce costs and ease assembly at the WIPP, the preconceptual design routes all of the piping for gas recirculation to and from the Type 2 Bin through the lid of the RCB. A copy of the Bounding Conditions which list the derivation of the weights available for equipment has been supplied. Figure 4 provides a conceptual view of the Type 2 Bin inside the RCB.

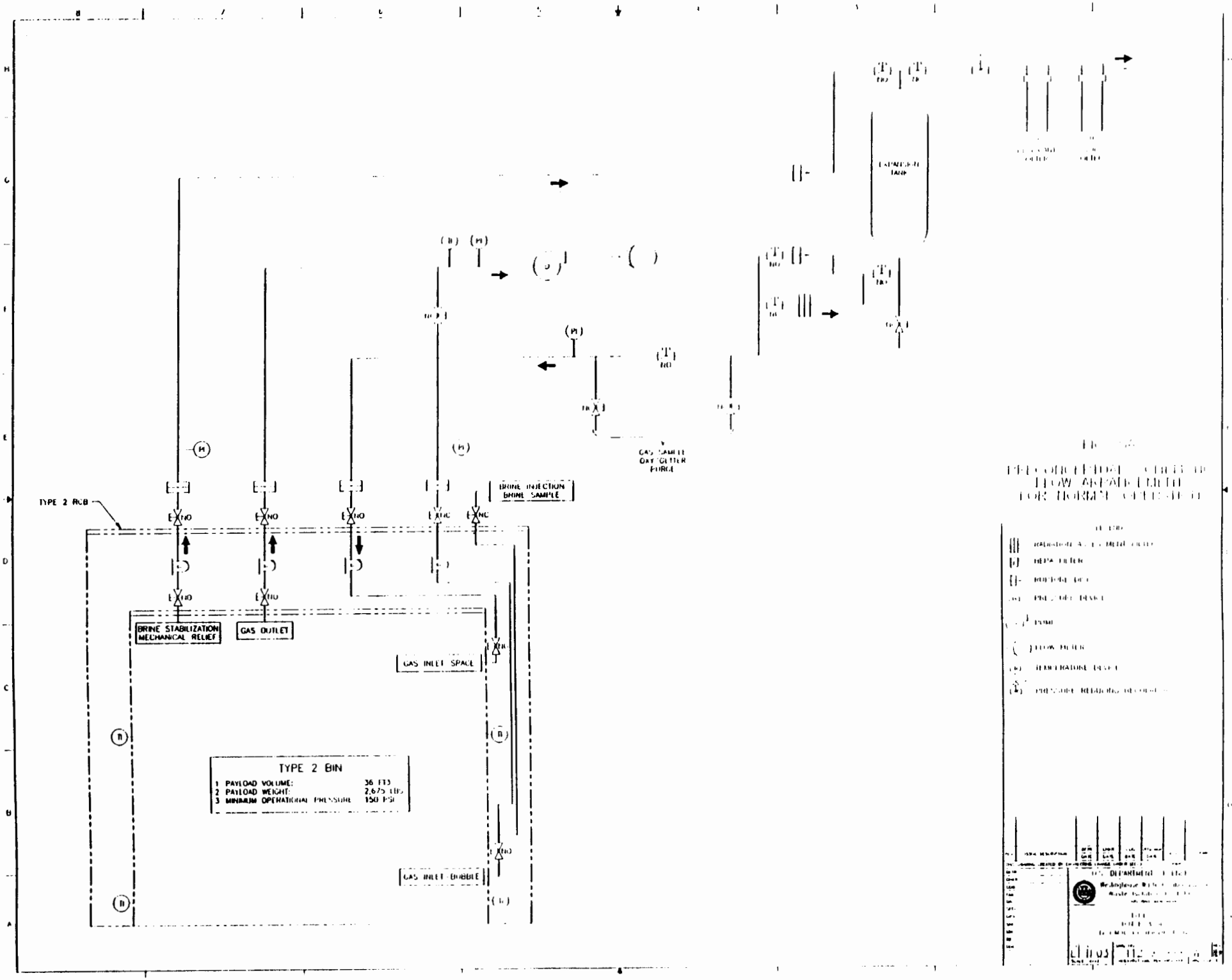
3.3 Gas Venting and Overpressure Protection

3.3.1 Major EDC requirements for Gas Venting & Overpressure Protection

- Pressure: minimum = 0.2 psia, maximum = 700 psia
- Temperature: minimum 65°F, maximum = 110°F.
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium
- Automatic operation for conditions in excess of bin design pressure.
- Protection shall be by a rupture disk with a maximum rupture pressure of 770 psia (110% of 700 psia).
- Function in a 50% to 100% relative humidity environment.
- Must vent the bin gases to a Volatile Organic Compound (VOC) Filtration and Monitoring System.
- Provide a manual method of operation for controlled venting of gas into the overpressure protection system.
- Provide for recording the amount of gas vented.

3.3.2 Preconceptual description of Gas Venting & Overpressure Protection

The preconceptual design approach to the Type 2 Bin Over-Pressure Protection system will provide redundant pressure safety relief by utilizing dual rupture disks and piping to provide an escape path if the system pressure reaches 110% of the design operating pressure of the system. Should an overpressure condition occur, the pressurized gas will be routed into the expansion tank module of the VOC Monitoring System. This tank has sufficient volume to reduce the overall system pressure to a value well below the design operating pressure. This preconceptual system will comply with the requirements of Section VIII of the **ASME Boiler & Pressure Vessel Code** which are applicable to underground operations of unfired pressure vessels, including UG-125; the values selected for use in the calculations are more conservative than those required by the ASME code. Two sketches are attached: Figure 5a shows the preconceptual gas flow schematic and Figure 5b shows a preconceptual gas flow isometric.


TYPE 2 RCB
BRINE STABILIZATION MECHANICAL RELIEF
GAS OUTLET
BRINE INJECTION BRINE SAMPLE
GAS INLET SPACE
GAS INLET BUBBLE
TYPE 2 BIN
1 PAYLOAD VOLUME: 36 FT3
2 PAYLOAD WEIGHT: 2,675 LBS
3 MINIMUM OPERATIONAL PRESSURE 150 PSI
EXPANSION TANK
GAS SAMPLE OUT GETTER PURGE

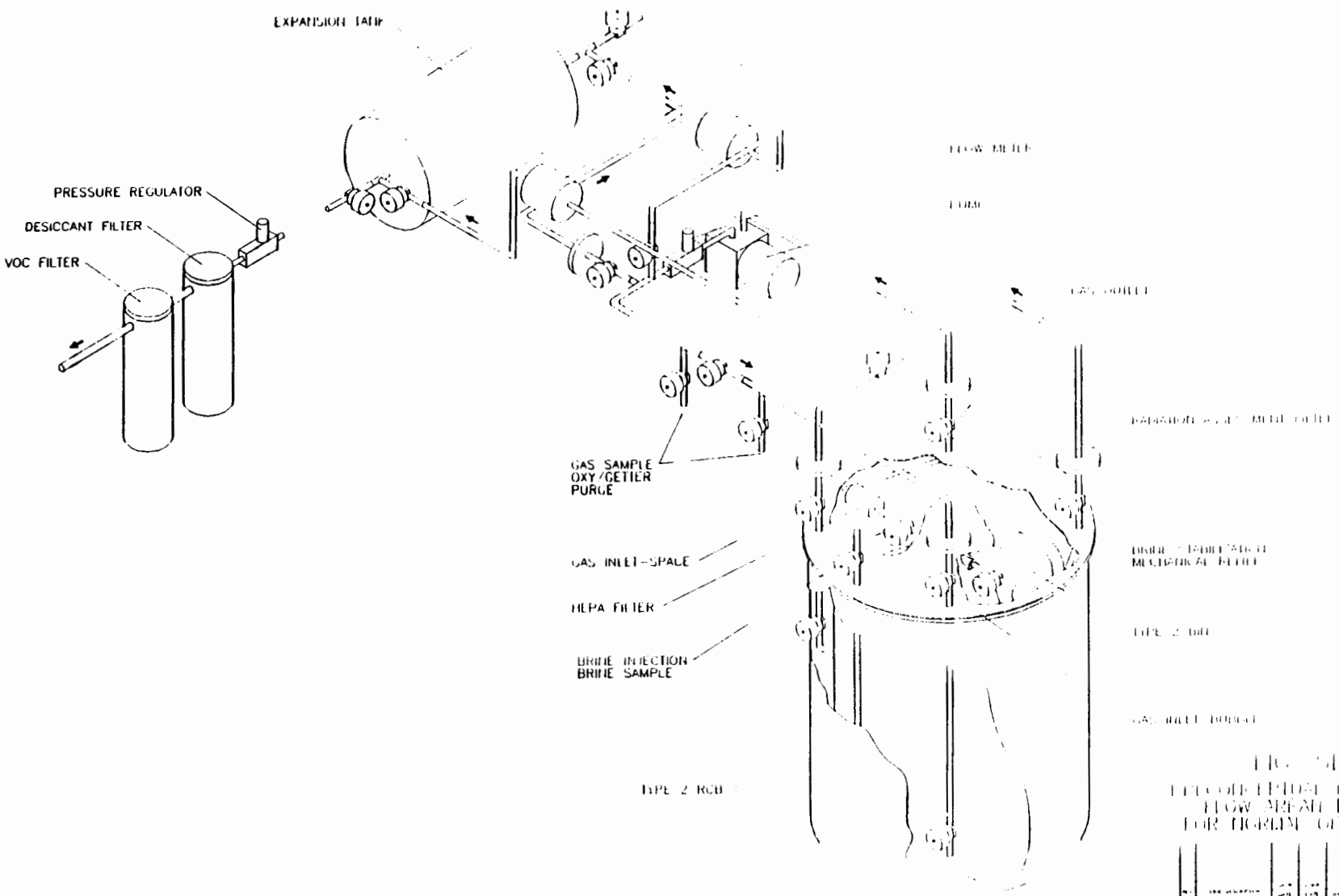


FIG. [illegible]
[illegible]
FLOW AREAS [illegible]
FOR [illegible]

3.4 VOC Monitoring System

3.4.1 Major EDC requirements for the VOC Monitoring System

Module 1 - Gas Collection

- Pressure: minimum = 0.2 psia, maximum = 700 psia
- Temperature: minimum -40°F, maximum = 200°F.
- Withstand detonation of flammable gas mixtures.
- Comply with the requirements of the ASME Boiler & Pressure Vessel Code.
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium
- Accommodate internal atmospheres which have relative humidity ranges from 0% to 100%.
- Accommodate internal atmospheres which contain mixtures of flammable gases, VOC's, etc.

Module 2 - Gas Filtration and Monitoring

- Temperature: minimum 65°F, maximum = 110°F.
- Leak rate: Less than 5% of design pressure in one hour.
- Required condition for incoming gases:

    1. Temperature between 77°F and 95°F.
    2. Relative humidity of 20% or less.

3.4.2 Preconceptual description of the VOC Monitoring System

The preconceptual design of the VOC Monitoring System provides a system which consists of two independent modules. The first module is an expansion tank which will accept gases vented from a Type 2 Bin, and retain them. The second module is a portable self-contained filtration and monitoring system which can be moved from bin to bin as required.

The expansion tank module is also a pressure vessel which is designed to the same ASME standards and operating conditions as the Type 2 Bin. The tank provides expansion volume for the gas if the rupture disk vents an overpressure condition. The expansion tank will be sized to provide a pressure reduction capability which meets the ASME requirements.

The preconceptual design of the expansion tank includes provisions for generating the appropriate alarm notification to operating personnel that an unanticipated gas discharge has occurred, as required by section 3.4.13 of the EDC.

When the decision is made to dispose of the gases from the internal atmosphere of a bin (either a planned venting, or disposal of gases from an unplanned occurrence), the gas filtration and monitoring module of the VOC Monitoring System will be connected to the expansion tank module's outlet port. The gas flow path in the filtration and monitoring module consists of a pressure-regulating valve, a desiccant assembly, and the filtration media.

The pressure regulating valve will reduce the pressure from that of the expansion tank down to a value which complies with the inlet requirements of the units in the gas filtration and monitoring module. The desiccant assembly will then remove any excessive moisture to protect the filtration media by conditioning the gas stream to a humidity level which is within its operating parameters. After leaving the desiccant assembly, the gas will pass through a filter bed of activated carbon, which will remove the VOCs entrained in the gas stream and condition the exhaust air to acceptable conditions for release to the underground ventilation system. Once connected to the expansion tank module on the Type 2 Bin, the gas treatment module will operate automatically. The system includes a flow totalizer to record the volume of gas released to the environment as specified in section 3.4.11 of the EDC. Refer to Figure 5a for the flow schematic and to Figure 5b for a pictorial representation.

3.5 Gas Mixing and Sampling

3.5.1 Major EDC requirements for Gas Mixing and Sampling

- Pressure: minimum = 0.2 psia, maximum = 700 psia
- Temperature: minimum 65°F, maximum = 110°F.
- Flow requirement: minimum = 0, maximum = 0.35 ft^3/hour
- Recirculation: Maximum = continuous
  Minimum of three (3) bin volumes recirculated within a 24 hour period before taking a gas sample.
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium
- Must have the capacity to route the gas into the gas headspace or into the brine.
- Double containment during any sampling operation.

3.5.2 Preconceptual description of Gas Mixing and Sampling

The preconceptual design of the Gas Mixing and Sampling system will include a means of recirculating the gases at the volumes required by section 3.5.5

of the EDC, which is based on the requirement for recirculation before sampling, and the maximum gas volume available, which will occur in a humid bin. The preconceptual design will also comply with the technical requirements listed for the recirculation and the re-entry of the gas.

Figure 5a shows the flow path, and figure 5b shows a pictorial view of the preconceptual design features. A flow device will monitor and totalize the recirculation flow to show and record that adequate flow has occurred before taking a gas sample. The design includes provision for the installation of HEPA type filters, a manual isolation valve, and a RAF on all gas recirculation paths (gas inlets and outlets); the HEPA type filter will be located inside the RCB to establish the secondary containment boundary before exiting the RCB, and the isolation valve and RAF will be located outside the RCB. The preconceptual design includes a method of obtaining a gas sample which complies with the requirements for representativeness, and will include provisions to operate at the specified design pressure. The sample vessel will be one that complies with the EDC requirements to be inert with respect to waste constituents, brine, and gases. One recirculation path returns the gas into the gas headspace, and the second route is through a manifold in the bottom of the bin to allow the gas to bubble through the brine.

The same figures show that the preconceptual design of the recirculation piping also includes provision for the transducers for gas pressure, gas temperature, and gas flow. In the case of retrieval due to a breached container, the Type 2 Bin and the RCB can be isolated by closing the isolation valves, disconnecting the piping, and plugging the port in the valve for shipment. Removal of the piping for the recirculation system will minimize the shipping weight.

3.6 Brine Addition and Sampling

3.6.1 Major EDC requirements for Brine Addition and Sampling

- Brine addition to be made at ambient pressure prior to start of test period.
- Temperature: minimum 65°F, maximum = 110°F.
- No visible leakage of brine while addition is in progress. Double containment as specified in 3.6.9 of the EDC.
- The internal void volume must be determined to the accuracy level specified in 3.6.13 of the EDC before the brine is added to the bin.
- The internal void volume must be determined to the accuracy level specified in 3.6.13 of the EDC after the brine is added to the bin.

3.6.2 Preconceptual description of Brine Addition and Sampling

The preconceptual design of the Brine Addition and Sampling system includes provisions for meeting all of the technical requirements listed in section 3.6 of the EDC. The regulations governing the transportation of hazardous waste containers containing more than 1% free liquid establish that the brine addition will take place after the test unit has been set in place in the underground test area.

The preconceptual design will give primary attention to the requirement that both brine addition before the test and the brine sample taken at the end of the test must be unfiltered liquid. As listed in 3.6.13 of the EDC, double containment of the sampling operation will be required. In order to meet the applicable safety requirements for the addition of liquid through an unfiltered opening, the method of adding the brine will include secondary containment around the connection point (see Figure 6), as well as the installation of a check valve in the brine supply line for backflow prevention.

The preconceptual design will also address the requirement for determining the internal gas volume in inundated bins as listed in section 3.6.13 of the EDC, which specifies that the internal gas volume must be measured both before and after brine addition, and specifies the level of accuracy required in these measurements.

A test vessel containing a known volume of an inert gas at a known pressure will be connected to the Type 2 Bin through a control valve, with all other valves closed. The isolation valve from the test vessel will be opened, and the resultant pressure in the system will be recorded. Since the initial pressure and volume of gas in the test vessel are known, and the final pressure in the system is also known, applying the Ideal Gas Law ($P_1V_1 = P_2V_2$) allows calculation of the volume in the total system. Subtraction of the required volume of gas head space yields the volume of brine required for addition to the individual bin. This process will then be repeated after brine addition to comply with the requirement for gas head space volume determination after brine addition.

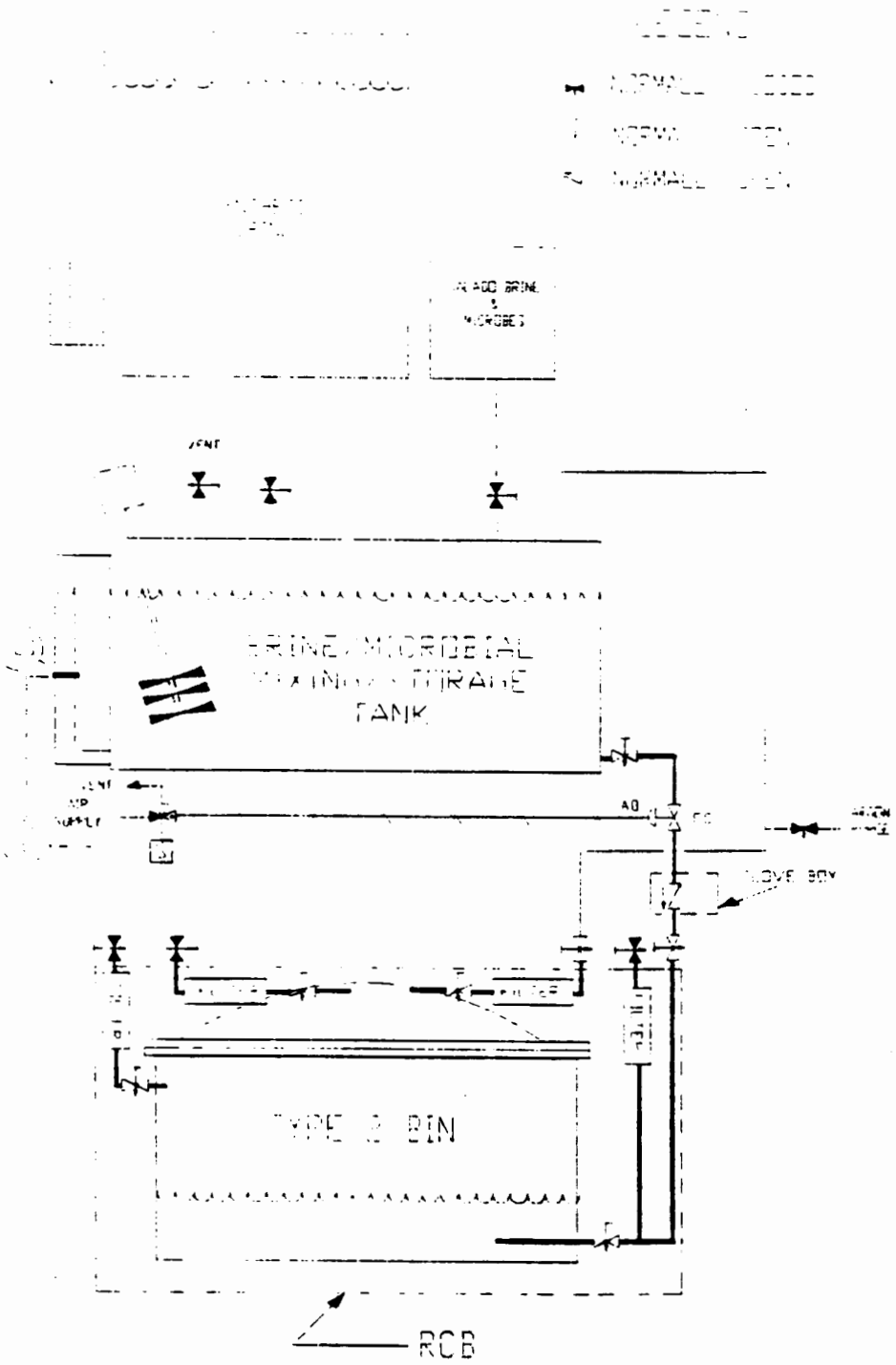


FIGURE NO. 6
BRINE ADDITION & MIXING

3.7 Microbe Addition

3.7.1 Major EDC requirements for Microbe Addition

- Pressure requirement: Addition to be done at ambient pressure (prior to start of test period).
- Temperature: minimum 65°F. maximum = 110°F.
- Maximum volume to be less than or equal to 10 liters.
- Addition of microbial material to be via an unfiltered pathway.
- No visible leakage of fluid while addition is in progress. Double containment required.

3.7.2 Preconceptual description of Microbe Addition

Section 3.7.13 of the EDC states that the Microbe inoculant will be premixed with the brine prior to the addition of the brine to the Type 2 Bin. Section 3.6.2 of this document describes the preconceptual system to be utilized for the addition of brine to the Type 2 Bin. Microbial mixing and addition will meet the same requirements as brine addition/mixing and will be an integral part of the brine system design as shown on Figure 6. The preconceptual design for Microbe Addition will comply with the technical requirements listed in section 3.7 of the EDC.

3.8 Gas Analyses

Section 3.8 of the EDC describes the requirements for the gases to be analyzed by the chemical laboratory. The analyses for the gases listed in this section of the EDC will be conducted by the existing analytical laboratory at WIPP, which is equipped to support the Type 1 Bin test program.

3.9 Sample Containment/Confinement

3.9.1 Major EDC requirements for Sample Containment/Confinement

- Pressure: minimum = 0.2 psia, maximum = 700 psia
- Temperature: minimum 65°F, maximum = 110°F.
- Flow: minimum = 0, maximum = 0.07 ft^3/min.
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium

3.9.2 Preconceptual description of Sample Containment/Confinement

The preconceptual design of the Sample Containment/Confinement system will comply with all of the technical specifications contained in section 3.9 of the EDC. A portable enclosure which will ensure compliance with the requirements for secondary containment will be installed around the sample port area (refer to Figure 5b), and an evacuated sample collection vessel will be connected to the sample port. The control valves will be operated to divert gas into the sample container, the valves will be closed, and the sample bottle will be disconnected. The sample vessel will be removed from the secondary containment and transported to the Gas Analysis Laboratory. The sample vessels will be suitably sized SUMMA canisters.

3.10 Gas Purging

3.10.1 Major EDC requirements for Gas Purging

- Pressure requirement: Gas Purging to be done with inert gas at ambient pressure prior to start of test period.
- Temperature: minimum 65°F, maximum = 110°F.
- Flow requirement: minimum = 0, maximum = 0.35 ft^3/minute
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium

3.10.2 Preconceptual description of Gas Purging

The preconceptual design of the Gas Purging system will employ a source of inert gas as specified in section 3.10.1 of the EDC, a pressure reducing valve to reduce the pressure of the inert gas supply to a value slightly above ambient, and a fitting suitable to connect to the inlet control valves on the gas recirculation system (refer to Figure 5b). Purging will be conducted by closing the bypass valve, opening the valve connected to the inert gas supply, and opening the second purge valve which allows the gas leaving the bin to pass through a HEPA type filter and exhaust to the VOC system. In this manner the atmosphere within the Type 2 Bin and its associated gas piping system will be removed and replaced by the inert purge gas.

The EDC states that purging is not anticipated after the beginning of the test, but it does not eliminate the possibility that purging may be required at some time after the beginning of the test. Therefore one of the considerations for the preconceptual design of this sub-system will be that gas purging will be required at pressures up to the design operating pressure of the system.

3.11 Gas Gettering

3.11.1 Major EDC requirements for Gas Gettering

- Pressure requirement: Gas Gettering to be done at ambient pressure prior to start of test period.
- Temperature: minimum = 65°F, maximum = 110°F.
- Flow requirement: minimum = 0, maximum = 0.35 ft^3/minute
- Must be able to produce internal bin atmospheres of 1 ppm of oxygen.

3.11.2 Preconceptual description of Gas Gettering

Gas gettering is the process of passing the internal atmosphere of a test bin over a chemical bed which utilizes specific chemical reactions to remove target gases from the gas flow. The preconceptual design of the Gas Gettering system will incorporate the requirements in section 3.11.1 of the EDC, which states that gettering may be required to remove oxygen from the internal atmosphere of a bin both before the start of the test period, and to maintain the specified anaerobic atmosphere throughout the test period.

The operation of the gettering process is similar to the process of purging described in section 3.10 of this document. The gettering material is contained within a canister which has an inlet and an outlet port arranged to direct the gas stream across the gettering material. To getter a bin, the inlet and outlet port of the gettering canister are connected to the access ports in the gas recirculation system on the bin, the bypass valve is closed, and the valves to the getter ports are opened (refer to Figure 5b). As the gas stream passes through the canister, the target gas(es) is removed.

3.12 Temperature Monitoring/Measuring

3.12.1 Major EDC requirements for Temperature Monitoring/Measuring

- Temperature: minimum = 32°F, maximum = 932°F.
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium
- Calibration required of all temperature transducers before installation.
- Transducer selection and acquisition to be made from a list of approved units furnished by SNL.
- Transducers must be capable of detecting a 0.9°C change within the bin despite any temperature fluctuations in the external environment.
- SNL will test 10% of all transducers; any failure of any transducer will require 100% inspection and calibration of all transducers by SNL.

3.12.2 Preconceptual description of Temperature Monitoring/Measuring

The preconceptual design of the Temperature Monitoring/Measuring system will utilize transducers from the list of units acceptable to SNL as specified in section 3.12.7 of the EDC. The design will also meet the requirements of section 3.12.13, which states the requirement to measure both gas and brine temperatures.

As shown on Figure 5a, the temperature sensor for the gases is located in the gas recirculation piping, and is protected from radiological contamination by the HEPA type filters. This provides the opportunity to reduce the quantity of (redundant) gas temperature sensors, since this area of the gas recirculation system is accessible for maintenance and/or replacement of equipment as required.

The brine temperature data will be sensed by transducers which are located at various positions and heights on the exterior walls of the Type 2 Bin. The data transmittal leads from the temperature sensors will pass through the lid of the RCB and on to the data acquisition system.

3.13 Pressure Monitoring/Measuring and Control

3.13.1 Major EDC requirements for Pressure Monitoring/Measuring and Control

- Pressure: minimum = -1.0 psig, maximum = 1,000 psig
- Temperature: minimum = 65°F, maximum = 110°F.
- Both local and remote readouts required
- Leak rate: Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium
- Minimum requirement of three (3) independent and redundant sealed pressure transducers per bin.
- Transducers must have 0.25% accuracy with calibration traceable to the National Institute of Standards and Technology.
- Transducers must be temperature compensated.

3.13.2 Preconceptual description of Pressure Monitoring/Measuring and Control

The preconceptual design of the Pressure Monitoring/Measuring and Control system as shown on Figure 5a, will comply with all of the technical requirements listed in section 3.13 of the EDC for selection and installation of pressure transducers, and the transducers will be selected to provide the level of

accuracy specified in section 3.13.11 of the EDC. The concept of the gas recirculation system includes provision for the installation of pressure transducers such that the HEPA type filter will isolate them from contamination by particulate radiological materials.

3.14 Brine Stabilization

3.14.1 Major EDC requirements for Brine Stabilization

- Pressure: minimum = 0.15 psia, maximum = 10 psig
- Temperature: minimum = 65°F, maximum = 200°F.
- Secondary confinement of all leakage is required.
- Surfaces are to be smooth nonsorbent materials for ease of decontamination after use.

3.14.2 Preconceptual description of Brine Stabilization

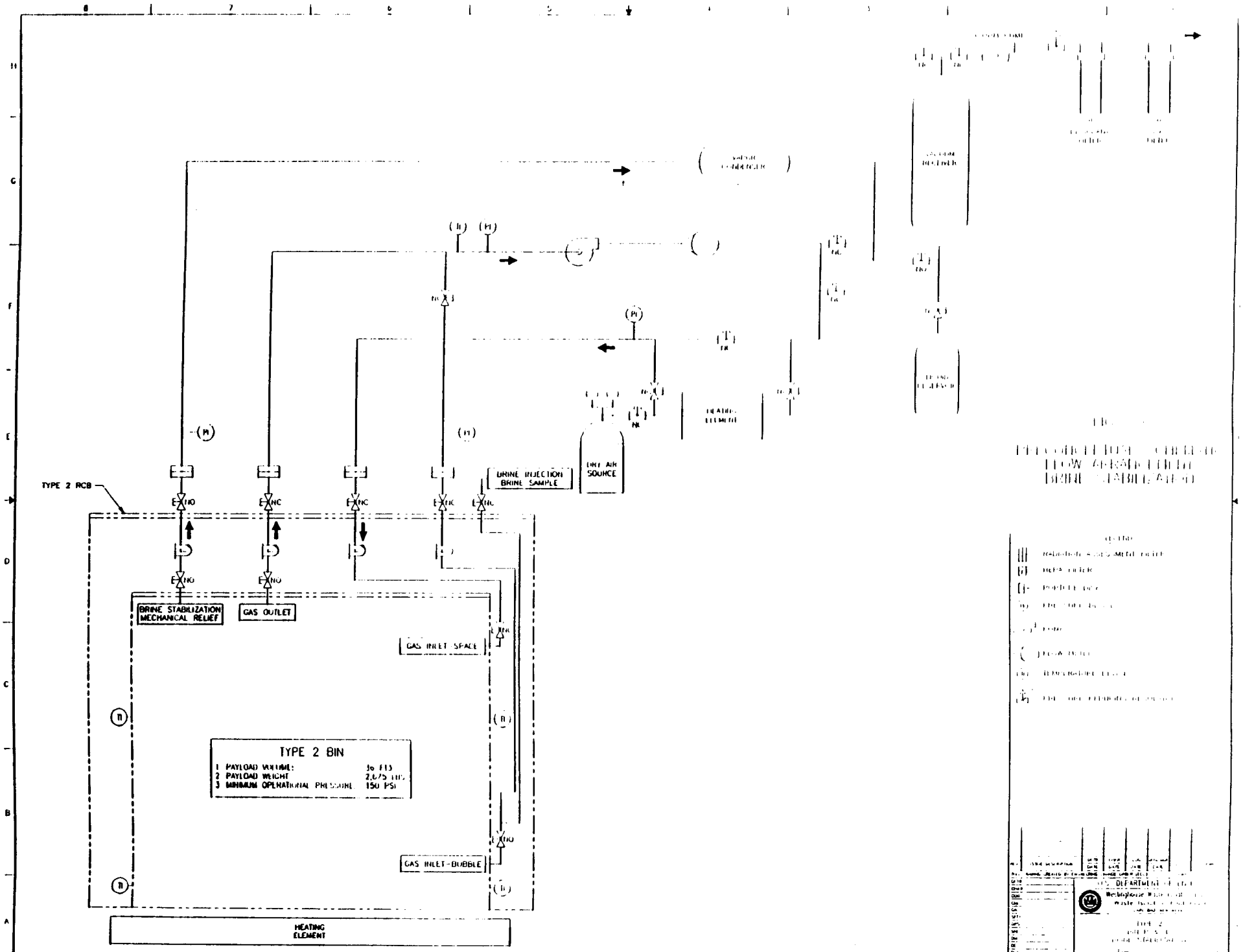
The preconceptual design of the Brine Stabilization system will conform to the technical requirements and specifications listed in section 3.14 of the EDC. This equipment will to remove the liquids that were added to a test bin and return that bin to a condition of less than 1% free liquid to comply with the Waste Acceptance Criteria requirements for transportation of waste.

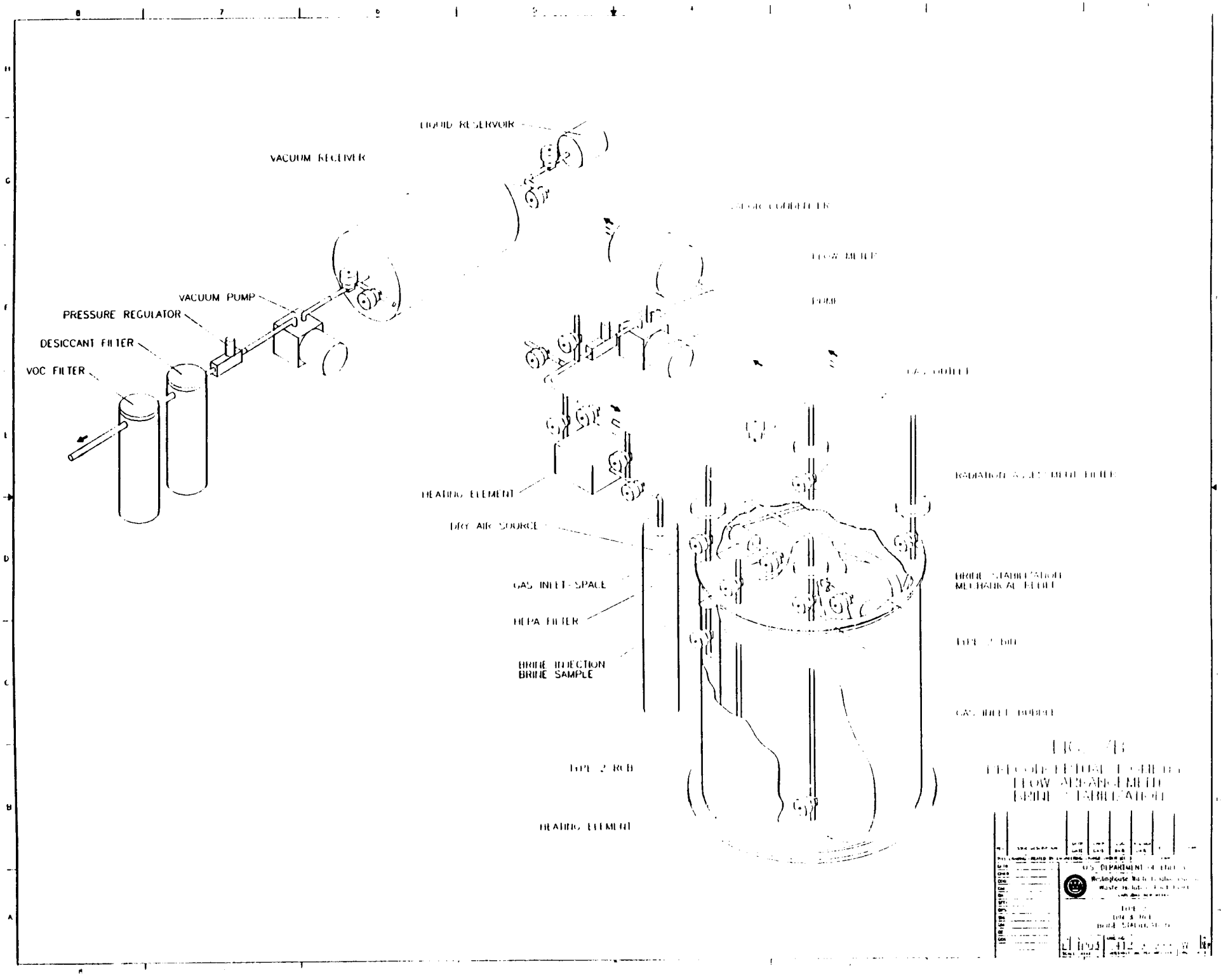
The system as currently outlined in the preconceptual design is of manual operation, modular components, and will be skid-mounted as required in section 3.14.9 and 3.14.13 of the EDC. The design will include secondary confinement for the entire Brine Stabilization system. The volume of the Brine Stabilization system is sufficient to contain the liquid content of an inundated bin. In addition, section 3.14 of the EDC requires that contamination of piping be avoided by assuring that all vapors pass through HEPA type filters which are as close as practical to the bin. The design will include secondary confinement and containment of piping to meet the requirements of DOE Order 6430.1a.

The discharge of the vapor stream from the exhaust of the vacuum pump will be monitored for the presence of VOC's and will be delivered to the VOC Monitoring System described in section 3.4 of the EDC. Any liquid removed from the test bin is hazardous waste by definition, and will be treated and handled as such in accordance with the regulations governing hazardous waste.

Preparing a Type 2 Bin for off-site shipment will require compliance with the Waste Acceptance Criteria requirements for transporting hazardous waste. These requirements specify that it is necessary to reduce the fluid in the test bin to less than 1% free liquid by volume. This will be accomplished by a combination of heating and vacuum drying. The preconceptual design applies this method to minimize site-generated TRU waste. By distilling the liquid out of the Type 2 Bin, any potentially TRU contaminated salts and compounds that are dissolved in the liquid will remain in the bin.

The preconceptual design of the brine stabilization system includes provision to collect all condensate from the process, and transfer this material to a hazardous waste container suitable for liquids. The collected waste material will be tested to verify that it is not radiologically contaminated. See the attached Figure 7a for a preconceptual flow schematic, and Figure 7b for a preconceptual isometric.


TYPE 2 RCB
BRINE STABILIZATION MECHANICAL RELIEF
GAS OUTLET
GAS INLET SPACE
GAS INLET-BUBBLE
HEATING ELEMENT
BRINE INJECTION BRINE SAMPLE
DRY AIR SOURCE
TYPE 2 BIN
1 PAYLOAD VOLUME: 36 FT3
2 PAYLOAD WEIGHT 2,675 LBS
3 MINIMUM OPERATIONAL PRESSURE 150 PSI


VACUUM RECEIVER
VACUUM PUMP
PRESSURE REGULATOR
DESICCANT FILTER
VOC FILTER
HEATING ELEMENT
DRY AIR SOURCE
GAS INLET SPACE
HEPA FILTER
BRINE INJECTION
BRINE SAMPLE
HEATING ELEMENT

3.15 Real Time Radiography (RTR)

3.15.1 Major EDC requirements for Real Time Radiography

- Capable of accepting the Type 2 Bin and RCB.
- Sufficient power and resolution to successfully examine Type 2 Bins filled with waste and determine compliance with the requirement for less than 1% free liquid by volume.
- No more than one (1) operator required for operation.
- Not more than two (2) waste handlers and one (1) health physics technician required to load/unload the equipment.

3.15.2 Preconceptual description of Real Time Radiography

The preconceptual design of the Real Time Radiography (RTR) system includes all of the pertinent equipment and sub-systems to determine the amount of free liquid within a Type 2 Bin/RCB combination, and to demonstrate that it complies with the criteria for transporting any solid hazardous waste (with or without TRU material). These criteria specify that a waste container cannot be shipped if it contains more than 1% free liquid by volume.

The equipment selected in the preconceptual design is commercially available, and has adequate spatial and contrast resolution to detect and quantify liquid volumes with sufficient accuracy to meet these technical requirements. Data is taken from multiple radiographic scans and is supplied to a computerized tomography system, which will generate a visual image of the contents of the bin on a Cathode Ray Tube (CRT). The computer program will provide animation of the image of the contents of the bin to allow internal container examination.

Data taken during tests of a bin mock-up indicate a maximum uncertainty region of 10% on volumetric readings. In order to ensure that waste containers being retrieved must meet transportation requirements, the results of the test will have to show that the subject container did not contain more than 0.9% free liquid by volume based on:

[1% free liquid/(100% + 10% possible error)].

If the RTR examination indicates free liquid in excess of this amount exists inside the bin, additional drying of the bin contents will be required, followed by radiographic re-examination.

The RTR equipment will be specified to operate in the underground environment, and will be mounted on a common base to provide the required rigidity during scanning of the test specimen. The positioning equipment is capable of handling a container with a 58 inch diameter and an overall height of 70 inches (RCB is 53 diameter x 62 high). The unit has five motion axes to provide a thorough and complete examination of the contents of the bin.

3.16 Container Handling Equipment

3.16.1 Major EDC requirements for the Container Handling Equipment

- Temperature: minimum = 40°F, maximum = 110°F.

3.16.2 Preconceptual description of the Container Handling Equipment

The preconceptual design of the Container Handling Equipment incorporates the functional characteristics as defined in section 3.16 of the EDC. This section requires that all existing handling equipment be evaluated in the light of the proposed design configurations and weights, and that any necessary modifications or new equipment be developed.

Moving the Type 2 Bin, the RCB, and the TDOP to the various locations will require material handling equipment designed specifically for the application. Adapters will be designed which will interface between these components and the existing material handling equipment such as the Adjustable Center of Gravity Lift Fixture (ACGLF). This approach will allow use of the lifting and handling equipment currently in service at both the generator site(s) and at the WIPP.

During the life of the test in the underground area, the test package will rest on the same model of support platform currently used for the Type 1 Bins. The support platform provides the capability of level compensation for up to twelve inches.

3.17 Brine Solution Composition

3.17.1 Major EDC requirements for Brine Solution Composition

- Comply with specifications provided by SNL.
- Brine requires sample analysis before introduction into a bin, and SNL approval of brine mixture.

3.17.2 Preconceptual description of Brine Solution Composition

The EDC covers the requirements for brine solution composition in section 3.17. This section defines the responsibilities of WIPP to formulate and mix the artificial brine and then compound this material with additions of G-Seep brine (actual brine collected from the underground area) and formulated inoculant material (containing microbes). Collection of G-Seep brine will be done under the direction of SNL.

As shown in Figure 6, the preconceptual design includes the necessary components for compounding or storing the material specified, measuring them into a tank which will be used to mix and store the completed brine. A sample will then be taken as prescribed by the requirements of section 3.17 of the EDC, and forwarded for analysis. SNL personnel must approve the actual solution before it is added to any bin. After approval is received, the brine will be added to the bin utilizing the methods and equipment listed earlier in section 3.6 of this document.

3.18 Backfill Composition

3.18.1 Major EDC requirements for Backfill Composition

- Utilize actual salt taken from underground mining operation.
- Backfill may be 100% salt, or 70% salt and 30% bentonite clay (MX-80) by weight.

3.18.2 Preconceptual description of Backfill Composition

Section 3.18 of the EDC lists the requirements for collecting the material required and making the required mixtures of backfill material. The preconceptual design will utilize the same equipment currently in existence to provide backfill material to the generator sites for use in the Type 1 Dry Bin and Type 1 Humid Bin applications.

The current equipment receives crushed salt which has been taken from the underground excavation operations and screens it to remove all particles larger than 0.25 inches. The screen-sized material is then packaged in the appropriate containers and shipped to the waste generator sites for loading into the designated test bins. The salt-bentonite clay mixture is prepared by blending screened salt with MX-80 Bentonite Clay in the existing blending plant at a ratio of 70% salt and 30% bentonite clay by weight. This mixture is then packaged and shipped to the generating site for inclusion in the designated test bins.

3.19 Liquid Level Determination

3.19.1 Major EDC requirements for Liquid Level Determination

- Ensure initial and continued inundation of the waste contained in the Type 2 Bin.
- Meet all restrictions due to configuration, retrievability requirements, safety requirements, and all interface configurations.

3.19.2 Preconceptual description of Liquid Level Determination

The specifications for Liquid Level Determination in section 3.19 of the EDC require a method of ensuring the initial and continued inundation of the contents of the Type 2 Bin. The preconceptual design will utilize the application of the Ideal Gas Law ($P_1V_1 = P_2V_2$) which was described in section 3.6.2 of this document. Once the internal void volume in the bin is known, the appropriate amount of brine can be added to the bin, and the test repeated to verify the actual gas headspace in the Type 2 Bin. The continued inundation is ensured by the fact that the liquid in the bin is not recirculated, and the only credible conditions that could lower the liquid level would be a leak.

BOUNDING CONDITIONS FOR TYPE 2 CONTAINER
February 5, 1993

1. The gas generation processes are allowed to naturally evolve to flammable condition. Individual test bins will not be purged or vented once the test has begun.

2. The design provides protection from the "worst case" pressure-pulse resulting from a rapid burn of generated gas.

3. Test bins will withstand five to seven years continuous external exposure to dry sodium chloride and internal exposure to brine.

4. There will be a maximum of 2 parts per million per year of oxygen ingress for the total system.

5. Packaging configuration(s) must meet retrieval requirements using the payload capability of the Ten Drum OverPack (TDOP) and must meet the WACC load limits for the TRUPACT II shipping container.

a. Maximum TRUPACT II payload (WIPP-DOE-069, Rev. 4.0, December 1991, Section 3.4.1.2)	19,250 lbs (8,730 Kg)
b. Maximum weight of TRUPACT II units in inventory (TRUPACT II s/n 136)	- 13,140 lbs (5,959 Kg)
c. Maximum available payload weight	6,110 lbs (2,771 Kg)
d. Approximate TDOP weight (empty) (reference EDT: E93-018)	- 1,700 lbs (771 Kg)
e. Maximum expected weight of waste from viewgraph presented by F. T. Mendenhall of SNL	- 2,675 lbs (1,213 Kg)
f. Weight available for the pressure vessel, secondary radiological control boundary, and all piping, manifolds, instrument fittings, etc.	1,735 lbs (787 Kg)

6. The minimum free volume available will be 36 ft^3 (1.02 m^3), based on 6 drum equivalents at 6 ft^3 (0.169 m^3) per drum of waste.

7. The design will minimize the impact on the generator sites.

8. <u>No</u> impact on the transportation system. Utilize the existing TRUPACT II, SWB, and TDOP without any changes.

9. Meet the requirements of the **Equipment Design Criteria, Wet Waste Testing Program, WP-09-15, Rev. 0**, dated 12/23/92.

May 3, 1993

EQUIPMENT DESIGN CRITERIA
WET WASTE TESTING PROGRAM
DRAFT
WP 09-15, Rev. 1

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EQUIPMENT DESIGN CRITERIA
WET WASTE TESTING PROGRAM
DRAFT
WP 09-15, REV. 1

Change History

Revision/PCN No.	Reason for Revision/Change
0	Initial procedure issue
1	Update procedure to reflect changed design criteria 02274

List of Acronyms

ANL-W - Argonne National Laboratory-West
ASFR - Advanced Size Reduction Facility
DOT - Department of Transportation
GISS - Generator/Interim Storage Site
INEL - Idaho National Engineering Laboratory
ISC - Integrated System Checkout
PA - Performance Assessment
PCDR - Pre-Conceptual Design Review
PI - Principal Investigator
RCB - Radiological Control Boundary
RTDC - Radioactive Test Design Compendium
RTR - Real-Time Radiography
SNL - Sandia National Laboratory
SWB - Standard Waste Box
TBD - To Be Determined
TDOP - Ten Drum Overpack
TRUPACT-II - Transuranic Package Transporter-II
VOC - Volatile Organic Compound
WAC - Waste Acceptance Criteria
WCC - Waste Characterization Chamber
WID - Waste Isolation Division
WIPP - Waste Isolation Pilot Plant
WPIO - WIPP Project Integration Office
WPSO - WIPP Project Site Office
WWC - Wet Waste Container
WWTP - Wet Waste Test Program

1.0 INTRODUCTION

This Design Criteria has been documented using the Draft Radioactive Test Design Compendium (RTDC), Issue 0.03 and, where the RTDC does not address specific parametric values or processes, experience gained from the Dry Bin-Scale Integrated System Checkout (ISC) program: the September 9, 1992, memo from D. R. Schafer to P. Higgins, "Preliminary Type 2 Bin Engineering Requirements": the D. R. Schafer to P. Higgins memo dated November 25, 1992, "Additional Type 2 Bin Engineering Requirements": the December 1992 Revision 0, DOE/WPIO 001-92, Gas Generation and Source-Term Programs: Technical Needs Assessment for the Waste Isolation Pilot Plant (WIPP) Test Phase: results of discussions at the January 13, 1993 and January 20, 1993 Pre-conceptual Design Reviews (PCDR) for the Type 2, (Phase 1) Bin: results of discussions at the March 5, 1993 Type 2 Bin Design Assessment meeting; and the D. R. Schafer to P. J. Higgins memo of March 10, 1993, "Type 2 Bin Engineering Requirements." During the January 20, 1993 review, the SNL Principle Investigator (PI) stated that the primary scientific design priority was that gas generation processes be allowed to naturally evolve to flammable conditions.

In the November 10, 1992 letter to A. E. Hunt (WD:92:00337, Accelerated Wet Waste Design Schedule with Optimized Test Criteria), A. L. Trego described a phased approach to the design of wet waste equipment. The first phase was to design a container of moderate pressure capability which will:

- Maximize design pressure within weight and geometry constraints
- Maximize volume in integer drum equivalents, plus adequate gas head space
- Provide a configuration that fits the current Department of Transportation (DOT) approved shipping container (i.e., standard waste box {SWB})
- Adhere to current waste transportation weight limitations (container + waste + SWB $\leq$ 4,000 pounds)

The January 1993 PDCRs reviewed and approved the design concept addressing this criteria. However, the January 20, 1993 PCDR established new bounding conditions which included the use of the Ten Drum Overpack (TDOP). The meeting also provided more detailed waste recipes that established higher potential waste weights than had been established for the initial design concept (i.e., >2600 lbs vs 700 lbs.). The PI also stressed the need to be able to load at least 5 drum equivalents of waste in each bin and up to 1 drum equivalent of backfill in some bins. In addition, he stressed that there would be a clear advantage in advocating the validity of the data derived from the Bin-Scale Test Program if the program included testing at lithostatic pressure. This information resulted in the development of a revised set of bounding conditions to apply to the Type 2 Bin design. After approval of the revised bounding conditions by DOE, SNL, and WID these new conditions were incorporated into a revised conceptual Type 2 Bin design. On March 5, 1993 a Design Assessment meeting was held for the purpose of approving the design concept and establishing the payload weight, payload volume, and operating pressure parameters applicable to the Type 2 Bin. At this meeting, SNL established that the minimum operating pressure should not be less than 150 psia and that the design should include a 2675

pound payload and 36 ft^3 of payload volume. Agreement was reached on the design concept and parameter values to be used. This design concept employs a right circular cylinder configuration for the Type 2 Bin. The top and bottom configurations await finalization of stress considerations developed during the detailed design effort.

Revision 1 to the Equipment Design Criteria addresses these approved design parameters and the design concept. The criteria also defines the design requirements for equipment which is currently anticipated to be required to support the Wet Waste Test Program's (WWTP) Type 2 Bin. It is recognized at this stage of defining requirements that additional systems, equipment, and processes may become necessary to achieve a successful Test Program for the gas generation data required to determine experimentally the reduction in uncertainty in the predictions of the gas-generation model.

An additional result of the March 5, 1993 meeting was the elimination of brine recirculation and brine sampling at pressure requirement and the requirement to establish a high (greater than 1 psi) initial bin test pressure. A single brine sample is required at the end of the bin test after the bin has been de-pressurized. Revision 1 reflects these design requirement changes.

DOE/WPIO 001-92 Revision 0, Gas Generation and Source-Term Programs: Technical Needs Assessment for the Waste Isolation Pilot Plant Test Phase, December 1992 describes two test configuration aspects which are important to data validity. The data validity will impact the usefulness of the Bin-Scale Test Program in experimentally determining "the reduction in uncertainty in the predictions of the gas-generation model." The first aspect is that individual bins will include "as many of the known waste-matrix materials as possible that are expected to play a significant role in gas generation". The second aspect of important test configuration is that "at least for initial testing of CH-TRU wastes at the bin-scale, the contents of whole drums of waste will be used". Thus "the bin tests will, at least initially, have the constraint that the contents of only integral drums of waste can be placed into each bin." These configuration conditions are imposed to "maximize the opportunity for interactions among the sets of waste materials that are expected to have impact on gas generation".

Material specifications, where listed, are based upon the experience gained from the Dry Bin-Scale program and are not necessarily the most appropriate for the design of the Type 2 bin and its support systems. Where appropriate, these specifications will be up-dated upon issue of SNL's Wet Waste Test Plan anticipated for the spring/summer of 1993. Other specifications (i.e., flow, temperature ranges, pressure ranges) may be the result of previous design information or best estimates for the current level of requirements definition. The design engineers should use their experience, good engineering practices, and cost effective material and/or equipment selection options in determining whether the design criteria specification identified for a particular system is adequate for meeting operational needs.

1.1 Purpose

This design criteria document has been developed to assist the assigned engineers in their development of concepts to address the systems and hardware requirements of that portion of the WWTP which will utilize the Type 2 Bin. The program philosophy with respect to complex systems or equipment is to design and fabricate mockup and/or prototype assemblies and test

their operational features against the overall system requirements. From the results of this testing, design modifications will be made and the final production designs developed for procurement and integrated testing.

1.2 Operational Description

A Type 2 Bin will be loaded with CH TRU mixed waste at INEL and shipped to WIPP. The shipping configuration will utilize the Ten Drum Overpack (TDOP) and the TRUPACT-II container. The bin will be removed from its TDOP and TRUPACT-II containers and placed inside a Radiological Control Boundary (RCB) for emplacement in the underground. Interconnections between the bin and the RCB will permit support systems and components to be installed external to the RCB and communicate with the bin internal environment. These systems will provide for one or more of the following functions:

- Establish and maintain a humid environment within the bin
- Recirculate the gas within the bin free gas space or bubble it through the brine contained within an inundated bin and provide for drawing gas samples
- Permit introduction of brine and microbes prior to T=0 and tracer gas at any time.
- Permit the monitoring and recording of temperature, and pressure
- Assure overpressure protection of the bin is maintained and provide for recording of the volume of gas released through the overpressure protection system
- Permit the manual burping of a bin prior to exceeding the design operating pressure and record the gas volume released
- Permit the purging and oxygen gettering of the bin prior to T=0
- Permit the removal of a free liquid sample from an inundated bin upon depressurizing the bin at the end of the test

The bin environment will be altered by purging with an inert gas and, when required, oxygen gettered to establish the specified oxygen concentration. Some bins are tested under anaerobic conditions and some under aerobic conditions. Subsequent to emplacement, support system components are attached, evacuated, backfilled with an inert gas and valved into the associated bin system. Brine is then added to designated bins to establish an inundated condition including, where required, microbe addition. An engineered method will be provided to ensure inundation indication. A humidification system is installed on each humid bin and the bin is humidified. The bin test is started at atmospheric pressure. An initial gas sample is taken and analyzed. After the gas analysis results are evaluated, the PI will make a decision to declare the bin operational (T=0) or provide direction for additional operational preparations.

With gas recirculation in progress, the bin will remain in operation until the PI or other authority directs that the bin be removed from operation. During the operating period, periodic gas

samples will be taken as directed by the PI. An operating premise for the Type 2 bin is that each bin gas generation process will be allowed to naturally evolve to the full bin operating design pressure without purging or venting unless otherwise directed by the PI. No oxygen gettering will be implemented over and above that required for initial emplacement without authorization from the PI unless the Operations Department Manager deems it necessary for safety concerns and directs such action in writing.

Upon the completion of any individual experiment, as determined by the PI, an inundated bin will be depressurized; a liquid sample will be drawn from the bin; and the bin within its RCB shall be dispositioned as directed. If the free liquid is to be removed, the bin will undergo vacuum drying. Humidified bins may not require brine removal. The dispositioning action for individual bins will be conducted after removing the support systems. The disposition of inundated and humid bins may be one of three alternatives, 1) the bin and RCB will remain in the Room, 2) the bin and RCB will be transported to the surface for off-site shipping or temporary storage, or 3) the bin and RCB will be moved to an approved storage or disposal location within the underground.

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2.0 APPLICABLE DOCUMENTS

The following documents are pertinent to describing how the WWTP test is to be conducted and establishing requirements for the test. It is anticipated that upon publication of a test plan by SNL, a WID implementation plan will be developed which provides operational information and will be included as a part of the documentation providing support and direction for successfully conducting the test:

Accelerated Wet Waste Design Schedule with Optimized Test Criteria,
A. L. Trego to A. E. Hunt letter WD:92:00337 dated November 10, 1992

Clarifications on the Technical Justifications Position Paper for Separate/ Combined Solubility/Leaching and "Wet" Bin Test Programs:
A. R. Lappin, et al, December 1991

D. R. Schafer to P. J. Higgins memo dated September 9, 1992, Preliminary Type 2 Bin Engineering Requirements

D. R Schafer to P. J. Higgins memo dated November 25, 1992, Additional Type 2 Bin Engineering Requirements

D. R. Schafer to P. J. Higgins memo dated March 10, 1993, Type 2 Bin Engineering Requirements

DOE Order 5480.5, Safety of Nuclear Facilities

DOE Order 6430.1A, General Design Criteria

DOE/WIPP 91-015, Test Phase Management Plan, August 1991

DOE/WPIO 001-92 Revision 0, Gas Generation and Source-Term Programs: Technical Needs Assessment for the Waste Isolation Pilot Plant Test Phase, December 1992

Draft Technical, Operational, and Safety Requirements For "Wet" Bin Tests: A. Lappin, et al, September 1991

High-Level Technical Test Requirements for Wet Waste Tests and CH TRU Waste Source Term Tests: A. Lappin, et al, November 1991

Initial Draft of Compendium of Proposed Design Criteria or Guidelines for Modified "Bin" Tests With CH TRU Wastes: A. R. Lappin, September 1991

Radioactive Test Design Compendium Draft, January 1992

SAND90-1974, TEST PLAN: WIPP Bin-Scale CH TRU Waste Tests, January 1990

SAND90-2082, Test Plan Addendum #1: Waste Isolation Pilot Plant Bin-Scale CH TRU Waste Tests, December 1990

SAND90-0266, Test Plan for Laboratory and Modeling Studies of Repository and Radionuclide Chemistry for the Waste Isolation Pilot Plant, January 1990

SAND83-0516, A Comparison of Brines Relevant to Nuclear Waste Experimentation , May 1983

ASME Boiler and Pressure Vessel Code, Section VIII

C. C. Dwight to P. J. Higgins letter dated February 5, 1993, ANL-W Restraints on Receiving, Shipping and Loading Type II Bins

G. A. O'Leary to J. J. Garcia letter dated March 8, 1993, Advanced Size Reduction Facility (ASRF) Critical Design Features For Type 2 Bin Design - GAO-003-93

D. R. Schafer to J. J. Garcia memo dated April 28, 1993, Type 2 Bin Brine and Inoculant Mixtures

3.0 DESIGN CRITERIA

NOTE: All systems and hardware addressed in the following criteria must be designed to operate in an underground environment having adverse salt dust conditions. Although the temperature and pressure conditions are reasonably stable, the dust conditions will be detrimental to unprotected components requiring clean surfaces for proper operation (i.e., electrical contacts or mechanical moving parts).

3.1 Type 2 Bin

1. Pressure requirement: Maximum operating pressure: ≥165 psia consistent with a 36 ft^3 payload volume and a 2675 lb. payload weight within the overall weight constraints identified below Minimum pressure: 0.2 psia (29.5" Hg vacuum).

   Design must account for the pressure pulse associated with a hydrogen detonation using the following assumptions:

   - Maximum gas generation at 23.7 ft^3 (670 liters) per year per bin.
   - Five (5) year test duration
   - All generated gas is hydrogen
   - Sufficient oxygen present to burn all hydrogen
   - An ignition source is present
   - Combustion occurs at the maximum design operating pressure

   The bin must remain shippable in a Ten Drum Overpack [TDOP] configuration while containing 6 drum equivalents of waste including backfill. The total shipping weight including the TDOP cannot exceed the 7265 lb. TRUPACT-II payload weight limit (approximate weight of an empty TDOP is 1700 lbs. and the maximum Type 2 Bin payload weight is 2675 lbs. which includes backfill) nor the 19,250 lb. limit which includes the weight of the TRUPACT-II specified in the WAC. The goal is a bin capable of operating at a minimum pressure of 165 psia and up to a maximum of 700 psia. During the vacuum drying process, the bin may be subjected to pressures as low as 0.2 psia.

   The bin shall comply with the ASME Boiler and Pressure Vessel Code Section VIII Division 1 or Division 2 pressure vessel requirements.

   NOTE: This specification will change to reflect the final operational design pressure requirement prior to issuing the procurement specification.

2. Temperature requirement: Minimum -40 °F--Maximum 200 °F.

3. Flow requirement: $>0<0.35$ ft^3/min (10 liters/min)
4. Pressure drop requirement: NA

5. Preconditions:

1) Must provide at least two filtered paths for venting during transportation.

2) At the time of loading a bin at the Generator/Interim Storage Site (GISS), steel corrodant materials may be added to replace the original drum material and backfill may also be added. WIPP has no capability to load solid material into a bin.

6. Leak rate:

- Maximum through material and fittings 10^{-8} scc/sec helium
- Maximum through internal barrier (e.g., valves) 10^{-8} scc/sec helium
- Overall Type 2 Bin system leak rate maximum is 10^{-7} scc/sec helium
- Oxygen ingress $\leq$2ppm/year into the entire Wet Waste system

7. Fabrication material: Material must be chemically inert to waste constituents, brine, and gases and be compatible with other interface systems.

8. Flow characteristics: Flow distribution shall be as uniform as possible to enhance representative gas sampling. The flow rate of the GISS sampling system is limited to 1.5 liters/minute.

9. Operating characteristics: The volume of the bin shall be sufficient to contain 36 ft^3 of payload (five drums of waste and one drum of backfill) plus an adequate excess capacity to accommodate internal manifolds, liner material, steel corrodant material, and head space. This represents an integer number of drum equivalents of $\leq$six (6) drums with an average of 6 ft^3 of waste or backfill per drum. Waste filled drums are assumed to have a 50% void space according to SAND90-1974, UC-721, TEST PLAN: WIPP Bin-Scale CH TRU Waste Tests, January 1990. If significant cost reduction can be achieved through small volume reductions, SNL is willing to accept up to a 10% volume reduction. The bin configuration including its associated RCB and support equipment shall fit within a TDOP. The shipping configuration will include at least two filters and fittings providing for the connection of the generating/interim storage site sampling apparatus. In addition:

- Any bin shall provide for isolation on all inlet/outlet ports.
- The bin or appropriate support system shall provide for external temperature sensor mountings.
- The bin external valves should have locks.

- The bin shall interface with the Waste Characterization Chamber (WCC) at ANL-W and with the Advanced Size Reduction Facility (ASFR) at Rocky Flats Plant.

- The bin gasket material shall be compatible with all Table 1 gases: be inert to waste constituents including microbes, brines, and gases: and function at -40°F to 200°F. Normal operating temperature is 65°F to 110°F.

- The bin liquid leakage to be contained within its associated RCB.

- The Type 2 Bin System must be amenable to monitoring for leakage of waste

- The bin must interface with all external support equipment.

- The bin must operate with mixtures of flammable gases.

- Humidity range: Internal from near 0%-100%

- Compatible with being heated to 200°F for vacuum drying

- Compatible with having the gas space recirculated to obtain representative gas samples

- Retrievable at end of test or when required for facility needs

10. Data recording: This is an SNL responsibility.

11. Instrumentation requirements: Temperature monitoring by externally mounted temperature transducers and pressure monitoring with redundant pressure transducers for recording.

    NOTE: SNL is responsible for providing a list of acceptable transducers to WID for use in acquiring and recording data.

    NOTE: The test requirement is that the bin internal gas and brine temperature be reliably measured. The number and location of temperature sensors is left to the design engineer.

    - The entire bin system and instrument array should be as maintenance-free as possible following emplacement.

    - All gages in control systems (if used) will be redundant. The range of gages should be such that the expected operating range falls within the 25%-75% span of the gage.

- All bin pressure transducers, temperature transducers, and oxygen content sensors will be monitored periodically as specified in the SNL test plan and the WID implementation plan/procedures.

- A means to ensure inundation will be provided.

- All instrumentation transducers subject to the bin internal environment must operate in a 50%-100% RH and/or in an inundated environment.

- The internal headspace gas volume of a bin must be determined to an accuracy of ±5% both before and after brine is initially added.

12. Isolation requirements: Single valve

13. Functional characteristics: Upon receipt of a bin and prior to transporting the bin underground, the bin gas void volume shall be determined to within ± 5% by volume. The bin must be emplaced in a single layer such that access is afforded to all portions of the bin for connect, disconnect, routine monitoring, sampling, spiking, etc. Operation of the bin must allow generated gases to evolve without any purging activities. This includes flammable gases attaining flammable mixture conditions.

3.2 Radiological Control Boundary (RCB)

1. Pressure requirement: Minimum 0.2 psia (29.5" Hg vacuum)--Maximum 5.0 psig.

2. Temperature requirement: -40°F to 200°F.

3. Flow requirement: NA.

4. Pressure drop requirement: NA.

5. Preconditions: NA.

6. Leak rate: The RCB will be sufficiently tight to exhibit no evidence of leakage during a bubble test when the RCB is pressurized to 0.5-1.0 psig with air. All gases released from the bin into the RCB will pass through the RCB HEPA filters for release to the Room environment.

7. Fabrication material: Material must be chemically inert to waste constituents, brine, and gases and be compatible with other interface systems.

8. Flow characteristics: NA.

9. Operating characteristics:

- Manual operation.
- Removable installation.
- Normal expected operating temperature range 65°F to 110°F-up to 200°f for brine stabilization.
- Normal expected operating pressure range - Normally vented through carbon composite filter.
- The volume of the RCB will be sufficient to enclose the bin and equipment necessary to isolate the bin and filter the bin gas discharge and return paths.
- The RCB free volume must be at least 110% of the total volume of the Type 2 Bin
- The RCB configuration must fit within a TDOP

10. Data recording: NA.

11. Instrumentation requirements: NA.

12. Isolation requirements: Single valve.

13. Functional characteristics: The RCB may contain the penetrations and isolation valves as required to connect the bin internals to all of the support equipment and instrumentation needed to prepare and place the bin into operation. The RCB will be vented to the storage room environment through at least two carbon composite filters.

14. Environmental Requirements: None.

3.3 Gas Venting and Overpressure Protection

1. Pressure requirement: Consistent with the bin design pressure. See NOTE for 3.1.1

2. Temperature requirement: 65°F-110°F.

3. Flow requirement: NA

4. Pressure drop requirement: NA

5. Preconditions: NA

6. Leak rate:

- Maximum through material and fittings 10^{-8} scc/sec helium
- Maximum through internal barrier (e.g., valves) 10^{-8} scc/sec helium
- Oxygen ingress $\leq$2ppm/year into the entire Wet Waste system.

7. Fabrication material: Material must be chemically inert to waste constituents. brine. and gases and be compatible with other interface systems.

8. Flow characteristics: NA

9. Operating characteristics:

- Automatic for overpressure protection operation.
- Manual for any required controlled venting (burping)
- Removable installation.
- Single containment of leakage.
- Normal operating temperature range of the test environment should be to 77°F to 95°F.
- Normal expected operating pressure consistent with the bin operating pressure. See NOTE for 3.1.1.
- Volume NA.
- Rupr disc maximum pressure for a bin is +10% above the maximum bin design operating pressure.

10. Data recording: Manual or Automatic

11. Instrumentation requirements:

- Gas flow measuring and recording for overpressure protection gas releases and controlled venting gas releases.
- Calibration frequency semi-annual.
- Accuracy $\pm$ 1% of range
- Flowmeter sensitivity 0.02 ft^3/min (0.5 liter/min)
- Flowmeter Range 0-0.7 ft^3/min (0-20 liters/min) for venting system. Overpressure protection gas flowmeter range is to be determined by the cognizant engineer with consideration given to protection system design capacity and characteristics.

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- Operate in a 50%-100% RH environment

- Flow may be determined by means other than a flowmeter. If another means is to be used. engineering must define the alternate means.

12. Isolation requirements: Single valve.

13. Functional characteristics: The Gas Venting and Overpressure Protection System will be designed to vent the bin gases to the VOC Monitoring System. Provisions shall be made within the system to provide both overpressure protection and controlled venting capability.

3.4 VOC Monitoring System

1. Pressure requirement: The modular VOC system for each bin shall be designed to accept the blowdown release from an overpressure incident and from controlled venting of its associated bin.

2. Temperature requirement: 65°F-110°F.

3. Flow requirement: Provide for the overpressure release of gas in accordance with ASME Boiler and Pressure Vessel Code. Section VIII. UG 125.

4. Pressure drop requirement: The design pressure drop shall not inhibit the timely release of the bin gas.

5. Preconditions: NA.

6. Leak rate: When pressurized to the system design pressure. the pressure will not decay by more than 5% of design pressure over a one hour period.

7. Fabrication material: Material must be chemically inert to waste constituents. brine. and gases and be compatible with other interface systems.

8. Flow characteristics: NA

9. Operating characteristics:

   - Single containment

   - Blowdown gas must be de-humidified prior to entering the gas filtration system

10. Data recording: Manual or Automatic on a media which is easily reproduced and stored

11. Instrumentation requirements:

- Flow Totalizer

NOTE: Total gas flow released to the environment must be recorded.

12. Isolation requirements: Single valve.

13. Functional characteristics: The VOC Monitoring System for the Wet Waste Test Program shall be an emission control and monitoring system. This system shall be designed to safely accept moist gas released from Type 2 bins in the Wet Waste Test Program. The emission control and monitoring system shall include a gas filtration system, a monitor or sampler, and other devices necessary to meet the requirements identified in 3.4.1 through 3.4.12 above. The VOC manifold shall be designed as a modular system with each bin supported by its own VOC collection and pressure surge subsystem. Individual VOC manifolds shall exhaust through a common gas filtration and sampling system. Within the modular subsystem capabilities, the VOC system shall be designed to accept the discharge from its associated bin during either an overpressure release incident or controlled venting during normal operations and test termination. The subsystem shall provide the pressure reduction capability to protect the gas filtration and sampling system. Alarm indication shall be provided to the Central Monitoring Room in the event of an unanticipated release of bin gas to the system.

3.5 Gas Mixing and Sampling

1. Pressure requirement: Consistent with the bin design pressure. See NOTE for 3.1.1.

2. Temperature requirement: Minimum 65 °F--Maximum 110 °F.

3. Flow requirement: Maximum ≤ 3.5 ft^3/hr (≤ 100 liters/hr).

4. Pressure drop requirement: To be determined by the design engineer.

5. Preconditions:

   Maximum recirculation: Continuous.

   A minimum of three (3) bin volumes shall be recirculated within a 24 hour period prior to taking a sample to ensure representativeness.

6. Leak rate:

   - Maximum through material and fittings 10^{-8} scc/sec helium

   - Maximum through internal barrier (e.g., valves) 10^{-8} scc/sec helium

- Oxygen ingress $\leq$2ppm/year into the entire Wet Waste system.

7. Fabrication material: Material must be chemically inert to waste constituents. brine. and gases and be compatible with other interface systems.

8. Flow characteristics: Turbulent flow.

   Flow distribution shall be as uniform as possible to enhance representative sampling.

9. Operating characteristics:

   - Manual operation.

   - Removable installation.

   - Normal operating temperature range of the test environment should be held to 77°F to 95°F.

   - Normal expected operating pressure consistent with the bin operating pressure

   - Volume - Design volume should be consistent with economical design practices and ease of assembly\disassembly.

   - Flow Path - Design should provide the option to flow gas through the brine or only in the headspace via a manually operated selector valve.

10. Data recording: Manual or Automatic

11. Instrumentation requirements:

    - Calibration frequency semi-annual.
    - Accuracy $\pm$ 1% of range
    - Flowmeter sensitivity 0.02 ft^3/min (0.5 liter/min)
    - Flowmeter Range 0-0.2 ft^3/min (0- 5 liters/min)
    - Operate in a 50%-100% RH environment

12. Isolation requirements: Single valve

    - Due to the potential for condensation during gas sampling, the sample manifold to system connections must be doubly contained to collect any liquid leakage prior to disconnecting the sample manifold.

3.6 Brine Addition and Sampling

1. Pressure requirement: Brine addition will occur at atmospheric pressure prior to T=0 for actual test initiation. The Type 2 Bin System shall be engineered to

ensure continued inundation of the waste subsequent to the brine addition for the life of the individual bin test.

2. Temperature requirement: 65°F-110°F.

3. Flow requirement: NA

4. Pressure drop requirement: Maximum 5.0 psi.

5. Preconditions: NA

6. Leak rate: There shall be no visible leaking of brine during the addition of brine to a bin with the bin vented to atmosphere through a HEPA filter.

7. Fabrication material: Material must be chemically inert to waste constituents, brine, and gases and be compatible with other interface systems.

8. Flow characteristics: Brine addition flow shall be controlled in the range of 0-0.35 ft^3/min (0-10 liters /min).

9. Operating characteristics:

   - Manual operation.
   - Removable installation.
   - Double containment of brine leakage at the connection points prior to breaking the connections after brine addition is complete.
   - Normal operating temperature range of the test environment should be 77°F to 95°F.
   - Normal expected operating pressure is atmospheric
   - Volume: NA.

10. Data recording: Manual on WP Form or logbook.

11. Instrumentation requirements:

   - Calibration frequency semi-annual.
   - Accuracy $\pm$ 1% of range
   - Flowmeter sensitivity 0.02 ft^3/min (0.5 liter/min)
   - Flowmeter Range 0-0.7 ft^3/min (0- 20 liters/min)

NOTE: The design engineer may consider an alternate means of accurately determining the quantity of brine added to a bin. However, any alternate means must have the criterion to determine the quantity of brine added to an accuracy of ±3 vol%.

12. Isolation requirements: Single valve.

13. Functional characteristics: The Brine Addition System will be used to fill those bins required to be operated in an inundated condition. The internal gas volume of a bin must be determined to an accuracy of ±5% both before and after brine is initially added. The exact quantity of brine added shall be measured to within ±3 vol % of the total brine added. At the end of an individual inundated bin test a liquid sample will be taken from the bin prior to initiating vacuum drying. No filtering of the sample is permitted. Double containment of any potential leakage path will be required during the sampling process. The PI will prescribe the volume of the sample to be taken. The samples must be collected in a manner not to affect the brine composition through sorption. The brine sample will be taken as a depressurized sample. Contact with air must be minimized and the sample must be stored in a gastight vessel. Exposure to light must also be minimized. The sample must be analyzed within the specified analysis time (TBD).

3.7 Microbe Addition

1. Pressure requirement: Addition will be done at atmospheric pressure.

2. Temperature requirement: 65°F-110°F.

3. Flow requirement: NA.

4. Pressure drop requirement: NA

5. Preconditions: NA

6. Leak rate: No visible leakage during the addition process

7. Fabrication material: Material must be chemically inert to waste constituents, brine, and gases and be compatible with other interface systems.

8. Flow characteristics: NA

9. Operating characteristics:

   - Manual operation.
   - Removable installation.
   - Double containment of leakage.

- Normal expected operating pressure is atmospheric

- Volume ≤ 0.35 ft^3 (≤ 10 liter)

10. Data recording: Manual in logbook or WP Form.

11. Instrumentation requirements: None

12. Isolation requirements: Single valve with double containment for leakage if addition is directly to a bin containing CH TRU waste.

13. Functional characteristics: The Microbe inoculant shall be premixed with the Brine A and G-Seep brine prior to addition to the bins. The microbe addition volume will be prepared in accordance with the J. B Gillow and A. J. Francis to M. Molecke memorandum of March 30, 1993, DETAILS OF THE PREPARATION OF A MIXED INOCULUM FOR THE BIN TESTS.

3.8 Gas Analyses

1. Functional Requirements: It is intended that routine analyses be conducted for gas samples drawn from the bin.
Attached is Table 1, REVISED WIPP TEST GASES REQUIRED TO BE QUANTIFIED, which is a copy of Table A1.11 of the Test Plan Addendum #1: Waste Isolation Pilot Plant Bin-Scale CH TRU Waste Tests, SAND90-2082. This table identifies all gases which are to be analyzed in the bin routine gas samples. In addition, the WIPP Lab is required to be capable of detecting all gases at levels of 1 ppm or greater. The levels of specific gases must be monitored regularly enough to identify any bin vessel failures, large gas generation events, etc. In addition, the WIPP lab will be required to conduct gas analyses for flammable gases Hydrogen, Methane, and flammable VOCs. The tracer gases Xenon and Krypton will also be analyzed to assure that the proper concentrations are spiked in each bin. As a part of verifying the proper bin internal environment, Oxygen will also be an on-site required analysis.

3.9 Sample Containment/Confinement

1. Pressure requirement: Consistent with the bin design pressure. See NOTE for 3.1.1.

2. Temperature requirement: 65°F-110°F.

3. Flow requirement: 0-0.07 ft^3/min (0-2 liters/min)

4. Pressure drop requirement: Maximum 5 psi.

5. Preconditions: NA

6. Leak rate:

   - Maximum through material and fittings 10^{-8} scc/sec helium
   - Maximum through internal barrier (e.g., valves) 10^{-8} scc/sec helium
   - Oxygen ingress $\leq$2ppm/year into the entire Wet Waste system.

7. Fabrication material: Material must be chemically inert to waste constituents. brine. and gases and be compatible with other interface systems.

8. Flow characteristics: NA

9. Operating characteristics:

   - Manual.
   - Removable installation.
   - Single containment

   - Normal expected operating temperature range:

     Surface: 40°F to 105°F
     Underground: 77°F to 95°F.

   - Normal expected operating pressure consistent with the bin operating pressure. See NOTE for 3.1.1.
   - The bin gas sample containers will vary in size

10. Data recording: Manual in logbook.

11. Instrumentation requirements: NA

12. Isolation requirements: Single valve.

3.10 Gas Purging

1. Pressure requirement: Purging operations will occur at atmospheric pressure with an inert gas (Argon or Nitrogen). No bin purging is anticipated after T=0.

2. Temperature requirement: 65°F-110°F.

3. Flow requirement: 0-0.35 ft^3/min (0-10 liters/min)

4. Pressure drop requirement: Consistent with bin pressure at a maximum 0.35 ft^3/min (10 liter/min) flow.

5. Preconditions: NA

6. Leak rate:

   - Maximum through material and fittings 10^{-8} scc/sec helium
   - Maximum through internal barrier (e.g., valves) 10^{-8} scc/sec helium
   - Oxygen ingress $\leq$2ppm/year into the entire Wet Waste system.

7. Fabrication material: Material must be chemically inert to waste constituents, brine, and gases and be compatible with other interface systems.

TABLE 1 REVISED WIPP TEST GASES REQUIRED TO BE QUANTIFIED
(at levels of ≥ 1 ppm vol., except as noted)

Hydrogen *	Argon
Oxygen *	Water Vapor *
Carbon Dioxide *	(for humidity, 100 ppm)
Carbon Monoxide *	Hydrogen Chloride
Methane *	Ammonia
Krypton (Tracer) *	H_2S/SO_2 (Total Sulfur)
Xenon (Tracer) *	Nitrogen Oxides
(& tracer isotopic ratios)	Radon
Nitrogen	Others, as detectable

[* = major gas, generated or other]

VOCs:

Acetone (100 ppm)	4-Methyl-2-Pentanone (100 ppm)
Benzene	1,1,2,2-Tetrachloroethane
Bromoform	Tetrachloroethene
Butanol (100 ppm)	Toluene
2-Butanone (100 ppm)	1,1,1-Trichloroethane
Carbon Tetrachloride	Trichloroethene
Chlorobenzene	1,1,2-Trichloro-
Chloroform	1,2,2-Trifluoroethane
Cyclohexane (100 ppm)	1,3,5-Trimethylbenzene (100 ppm)
1,1-Dichloroethane	1,2,4-Trimethylbenzene (100 ppm)
1,2-Dichloroethane	m-Xylene (100 ppm)
1,1-Dichloroethane	o-Xylene (100 ppm)
cis-1,2-Dichloroethene	p-Xylene (100 ppm)
Ethyl Benzene (100 ppm)	----------
Ethyl Ether (100 ppm)	Formaldehyde (LANL)
Methanol (100 ppm)	Hydrazine (ORNL, SRP) (TBD ppm)
Methylene Chloride	Nitrobenzene (INEL sludge) (")

Others, as detectable (at ≥ 1 ppm)

8. Flow characteristics: NA

9. Operating characteristics:

- Manual.
- Removable installation.
- Single containment of leakage.
- Normal expected operating temperature range:

  Surface: 40°F to 105°F
  Underground: 77°F to 95°F.

- Local readout.

10. Data recording: Manual in Logbook and WP Form.

11. Instrumentation requirements: Calibration frequency - Semi-annual.

- Accuracy: 1% of range

12. Isolation requirements: Single valve.

3.11 Gas Gettering

1. Pressure requirement: Gas gettering operations will occur prior to T=0 and at atmospheric conditions. However, consideration should be given to the possibility that operating error with an anaerobic bin at pressure might cause oxygen contamination of several tens or hundreds of ppm. Under these conditions, the PI may want to getter oxygen and continue operating the affected bin.

2. Temperature requirement: 65°F-110°F.

3. Flow requirement: 0-$\leq$0.35 ft^3/min (0-$\leq$10 liters/min)

4. Pressure drop requirement: Maximum 5 psi.

5. Preconditions: NA

6. Leak rate:

- Maximum through material and fittings 10^{-8} scc/sec helium
- Maximum through internal barrier (e.g., valves) 10^{-8} scc/sec helium

7. Fabrication material: Material must be chemically inert to waste constituents, brine, and gases and be compatible with other interface systems.

8. Flow characteristics: NA

9. Operating characteristics: Manual.
   - Removable installation.
   - Single containment of leakage.
     - Normal expected operating temperature range Surface: 40°F to 105°F and Underground: 77°F to 95°F.
     - Normal expected operating pressure range consistent with the bin design pressure.
   - Local readout.

10. Data recording: Manual in Logbook and WP Form.

11. Instrumentation requirements: Calibration frequency - Semi-annual.
    - Accuracy: ±1% of range.
    - Operate in a 0%-100% RH environment

12. Isolation requirements: Single valve.

13. Functional characteristics: Oxygen gettering to attain anaerobic conditions from 1000 ppm O_2 to 1 ppm O_2 will normally be accomplished using the Oxygen Gettering System. Once the required O_2 concentration has been established for a given test, oxygen gettering should not be used to compensate for O_2 ingress. To achieve the initial O_2 level, oxygen gettering canisters may be used when outgassing results in a lengthy gettering process at low levels of O_2 concentration. These canisters should be rated for greater than the rupture disc set point pressure. No O_2 gettering operations will be permitted on tests in transition from oxic to anoxic conditions. Other gases may be gettered as directed by the Principle Investigator. The use of the Oxygen Gettering System or canisters filled with gettering material for gettering gases other than oxygen will be determined by the Principle Investigator. Oxygen concentrations of up to 21% may be established for individual tests of Type 2 bins.

3.12 Temperature Monitoring/Measuring

1. Pressure requirement: NA for external installation

2. Temperature requirement: Minimum 32°F (0°C)

Maximum 932°F (500°C)
Operating Environment 65°F-110°F

3. Flow requirement: NA

4. Pressure drop requirement: NA

5. Preconditions: NA

6. Leak rate: NA for external installation

7. Fabrication material: SNL is responsible for providing a list of acceptable temperature transducers to WID for use in acquiring and recording data.

8. Flow characteristics: NA

9. Operating characteristics: To be established subsequent to making temperature transducer selection from the list described in item 7 above.

10. Data recording: Automatic on magnetic medium

11. Instrumentation requirements: Calibration frequency-All temperature transducers are to be calibrated prior to installation.

    Accuracy: TBD
    Resolution: TBD
    Range: TBD

    Type 2 Bins must be capable of detecting a 0.9°C (1.6°F) rise within the bin in the presence of external ambient temperature fluctuations
    For Type 2 bins 10% of all temperature transducers will be tested in the SNL calibration laboratory. If any fail, all will be tested.

12. Isolation requirements: NA

13. Functional characteristics: The temperature monitoring and recording must be able to reliably measure bin gas and brine temperature. SNL is responsible for providing a list of acceptable transducers to WID for use in acquiring and recording data. The number and location of temperature transducers is a design engineer responsibility. The signal outputs will be monitored and recorded. If SNL's temperature requirements can be met by installation of a single dual element thermocouple installed in the gas recirculation system allowing access for replacement during operation, this alternate design characteristic will be the preferred method of temperature monitoring.

3.13 Pressure Monitoring/Measuring and Control

1. Pressure requirement: Minimum: -1.0 psig

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Maximum: 1000 psig

2. Temperature requirement: Operating Environment 65°F-110°F

3. Flow requirement: NA

4. Pressure drop requirement: NA

5. Preconditions: NA

6. Leak rate: Maximum through material and fittings 10^{-8} scc/sec helium.

   Maximum through internal barrier (e.g., valves) 10^{-8}scc/sec helium

7. Fabrication material: Material must be chemically inert to waste constituents, brine, and gases and be compatible with other interface systems.

8. Flow characteristics: NA

9. Operating characteristics: Automatic operation. Removable installation Single containment of leakage. Normal expected operating temperature range 65°F to 110°F.

   Local and remote readout.
   Redundant pressure transducers

10. Data recording: Automatic on magnetic medium

11. Instrumentation requirements: Calibration frequency: semi-annual.

    Each bin will have three independent and redundant sealed pressure trandsducers. Accuracy will be better than 1% of the measured value. Range -1.0 psig to 1000 psig with 2X overpressure capacity. Calibration by manufacturer traceable to NIST with 0.25% accuracy. Temperature compensated over 32°F-158°F. Readout: Local and remote. Operate in a 50%-100% RH environment

12. Isolation requirements: Single valve

13. Functional characteristics: The pressure monitoring instrumentation must be redundant for each bin. Construction of individual bin instrument transducers shall be sealed and suitable for harsh environments with a documented history of performance. Local readout must be available for operating personnel to control placing the bin into operation and periodic manual monitoring of internal pressure

conditions. Remote readout must be provided to the data recording instrumentation and for control of depressurization when required (e.g., at retrieval, or placing the bin out of service). Overpressure protection for the bin will be provided by redundant rupture discs.

3.14 Brine Stabilization

1. Pressure requirement: Minimum 0.15 psia(29.6" Hg vacuum)
   Maximum 10 psig.

2. Temperature requirement: Minimum 65°F--Maximum 200°F.

3. Flow requirement: As determined by the design engineer.

4. Pressure drop requirement: NA

5. Preconditions: Prior to initiating the vacuum drying process a brine sample shall be withdrawn from the bin. The PI will prescribe the volume of the sample.

6. Leak rate: System operationally tested to ensure that a 0.2 psia vacuum can be achieved.

7. Fabrication material: Material must be chemically inert to waste constituents, brine, and gases and be compatible with other interface systems.

8. Flow characteristics: NA.

9. Operating characteristics:

   - Manual operation.
   - Modular components for ease of disassembly and transport.
   - Secondary confinement of liquid leakage for the entire system with secondary confinement of leakage up to the HEPA filter
   - Collect all liquid leakage for sampling, appropriate treatment, and disposal.
   - Normal expected operating temperature range 125°F to 200°F.
   - Normal expected operating pressure range 0.2 psia to 4.0 psia.

- Volume-Sufficient to contain the liquid content of an inundated bin for vacuum drying.

10. Data recording: Manual and Automatic on magnetic media, WP Form, and in logbook.

11. Instrumentation requirements:

    - Calibration frequency semi-annual

    - Accuracy: ±1% of range

    - Sensitivity:
      Vacuum-0.1 psia.
      Pressure-0.01 psi.
      Flow-0.2 ft^3/min (5 liter/min)
      Temperature-0.5°F.

    - Range:
      Vacuum-0.0 psia-15.0 psia.
      Pressure-0.0 psig-15.0 psig.
      Flow - 0.0-1.8 ft^3/min (0.0-50.0 liters/min)
      Operate in a 50%-100% RH environment

12. Isolation requirements: Single valve.

13. Functional characteristics: The Vacuum Drying System will remove water vapor from the bin to ensure that the free liquid content is less than 1% of the bin volume. Water vapor will pass through a HEPA filter installed as close to the bin as practical to minimize potential contamination of downstream equipment. Secondary containment of the bin and connecting piping is required up to the HEPA filter. Secondary confinement of leakage is required of the entire system for RCRA compliance. The system will be skid mounted (i.e..portable) for operation in the underground or on the surface.

14. Environmental requirements: The discharge of the vapor stream must be monitored for the presence of VOCs and radioactive particulate material and should be piped into the VOC Monitoring System. All leakage from the process must be collected and monitored prior to a disposal decision being made. All waste derived from the brine stabilization process including condensed waste vapor is hazardous waste by definition if it originated from within the mixed waste container.

3.15 Real Time Radiography

1. Functional requirements: To meet the TRUPACT-II shipping requirements, no free liquid exceeding 1% volume of the container may be present. To ensure that this requirement is met prior to shipping retrieved waste from the WIPP, each bin

may be inspected. If an inspection is required, it will be conducted through the utilization of radiographic techniques. Real time is desired to minimize the degree of handling required and to allow immediate additional brine stabilization processing if required for a specific container. The Real-Time Radiography (RTR) system must be capable of accepting the bin configuration. The RTR source must be of sufficient strength so as to adequately examine container content through metal container walls sufficiently thick to meet the pressure design criteria for the bin and filled with waste consisting of metallic, glass, paper, and/or rubber/plastic materials. The system should be skid mounted and only require power from the site. Shielding shall be provided by the underground salt and RTR room configuration. Upon placing the system into operation, not more than one operator should be required for monitoring proper operation. Loading and unloading of the bin into/from the Brine Stabilization System should not require more than two Waste Handling Technicians with a Health Physics Technician in attendance.

3.16 Container Handling Equipment

1. Functional characteristics: Due to the requirement that the bin must be able to contain gases without purging or venting, it is anticipated that the bin cylindrical configuration and weight will be significantly different from the dry bin configuration. In addition, the Type 2 bin RCB will also result in configuration changes different from the RCB used for dry bins. As a result, handling equipment design will be required to address these new container configurations. In addition, handling equipment must also be developed to manipulate the 10 drum overpack and the Type 2 Bin/RCB in the underground where headroom is limited in the unlikely event that a Type 2 Bin leaks into its associated RCB. This unlikely event would require using the TDOP as the secondary container for transporting the Type 2 Bin/RCB from the underground to the surface.

2. Environmental requirements: The handling equipment will be utilized on the surface primarily in the Waste Handling Building.

   Temperature will vary from 40°F in the winter to 105°F in the summer. In the underground, the temperature range will be 65°F to 110°F.

3.17 Brine Solution Composition

1. The brine solution to be added to a bin will be prepared in accordance with the requirements of the D. R. Schafer to J. J. Garcia memo dated April 28, 1993, Type 2 Bin Brine and Inoculant Mixtures. This memo prescribes the formulation of artificial brine with additions of G-Seep brine and formulated inoculants. Collection of brine from the mine (G-Seep brine) will be made under the direction of SNL to assure the collected brine is representative of the required storage area. Immediately prior to addition of the brine to a specific Type 2 Bin, a sample of the mixture should be taken. The sample should be subjected to the same analysis as that prescibed for the inoculant. Addition to the bin will not be implemented until SNL has approved the results of the sample analysis.

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3.18 Backfill Composition

1. Functional characteristics: Salt for backfill material will be taken from the WIPP mining operations and mechanically screened to remove all particles larger than 0.25 inches. Some of the screened salt will be mixed with bentonite clay (MX-80) to form a salt/bentonite backfill additive. The mixture will be comprised of 70% salt and 30% bentonite clay by weight. The quantities of backfill to be added to the bins will be determined after the final design volume is established. For reference, the original 35.3 ft^3 (1000 liter) bin was to receive 3 ft^3 of backfill. Some bins will receive a backfill of screened salt only with no bentonite additive.

3.19 Liquid Level Determination

1. Functional charactertistics: A test requirement is that the design provide a means of ensuring the initial and continued inundation of the waste. To meet this requirement, a means of determining that inundation has been accomplished must be provided. It is left to the design engineer to review the available technology and select that technology most economically suitable to meet this requirement. Any design must accommodate the restrictions inherent in the bin/RCB configuration, retrievability requirements, maintenance related health physics requirements, and other support systems interfacing configurations.