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OPERATIONS OF THE LR56 RADIOACTIVE LIQUID CASK TRANSPORT SYSTEM AT U. S. DEPARTMENT OF ENERGY SITES

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ABSTRACT

The LR56 cask system is licensed for use in France under Certificate of Compliance F/309/B(U)F for transport of 4,000-liter volumes of radioactive liquids. Three LR56 cask systems (with modifications for use at Department of Energy [DOE] sites) have been purchased for delivery at the Hanford Site, Oak Ridge National Laboratory (ORNL), and Savannah River Site (SRS).

The LR56 cask systems will be used for on-site transfers of Type B quantities of radioactive liquid waste. The ORNL unit will also be used as a Type A packaging for transfers of radioactive liquids between DOE sites. This paper discusses LR56 operating features and the use of the cask system at the three DOE sites.

INTRODUCTION

Three DOE sites (Hanford, ORNL, and SRS) are obtaining one LR56 transporter system each through a teaming and cost savings arrangement among the sites. These units have been procured through a single contract between the Hanford operating contractor (Westinghouse Hanford Company [WHC]) and NUMATEC, Inc., the U.S. licensee of the LR56 design. The LR56 transporter system purchased by the DOE sites is a modification of the LR56 system designed by the French Atomic Energy Commission (CEA). Two LR56 units are currently operating as Type B(U)F packagings in France under the certificate of compliance received from the French Transport Ministry. The cask design was certified under French regulations consistent with the requirements established by the International Atomic Energy Agency (Regulations for, 1990).

The LR56 system is a shielded cask mounted on a trailer with auxiliary equipment provided on the trailer for loading and unloading operations. All auxiliary equipment is disconnected from the cask during transport; thus, only the cask is subject to the Type B(U) requirements. The cask consists of a primary containment tank surrounded by multiple layers consisting of a secondary containment vessel, lead biological shielding, a strength vessel, thermal and shock protection, and an outer mechanical protection layer. The combination of the lead biological shielding and the strength vessel provides shielding equivalent to 50 mm of lead. The inner vessel of the cask is constructed from stainless steel (type Z1 NCDU 25.20, ASTM B 625 UNS 08-904) for use with aggressive chemicals, including phosphoric, sulfuric, and hydrochloric acids.

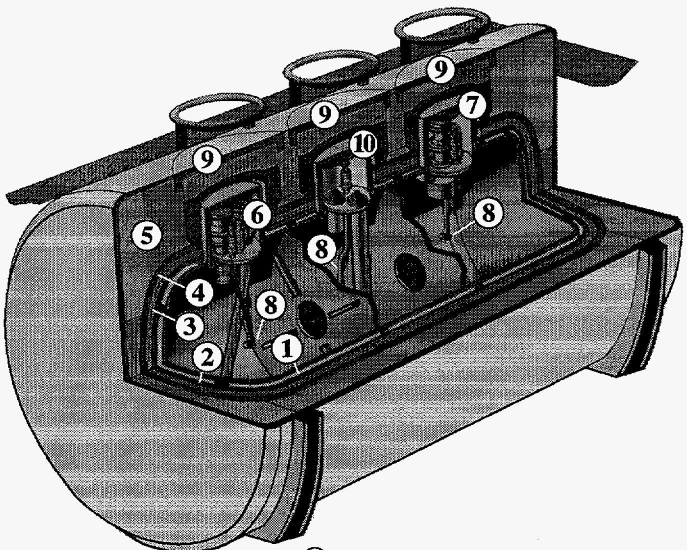
In early 1994, WHC initiated a sole source request for proposal (RFP) to purchase a modified LR56 system. At that time, no domestic DOE or U.S. Nuclear Regulatory Commission (NRC) certified Type B quantity packagings existed with the appropriate level of shielding for the transport of bulk quantities of radioactive liquids.

Independently, the operator of ORNL (now Lockheed Martin Energy Systems [LMES]) initiated steps to purchase an LR56 under a sole source procurement. DOE capital equipment funding for an ORNL unit was authorized in February 1994. In May of 1994, LMES entered into an agreement with WHC for a second LR56 unit to be added to the RFP for use at ORNL. The first unit was subsequently designated the LR56H and the second unit was designated the LR56M. Under the agreement between the two DOE sites, WHC and LMES were each responsible for the specification of technical requirements, performance of design reviews, and quality assurance activities for their respective unit. All contracting officer activities for the two units were performed by WHC. Whenever possible, the technical reviews and quality assurance surveillances for the two units were scheduled to achieve lower costs and enhanced results through this teaming and coordination approach. A combined detailed design review of the two units was conducted based upon the LR56H drawings. The mechanical drawings for the LR56M were subsequently accepted without additional comment. LMES conducted a quality assurance assessment of the design and fabrication activities during the early stages of the fabrication of the LR56H to provide confirmation to both LMES and WHC of the adequacy of the supplier's and fabricator's quality assurance program. LMES scheduled a fabrication progress review of the LR56M to coincide with the shielding test of the LR56H and witnessed the shielding test for WHC. During the functional testing of the LR56H, WHC provided LMES with information on the problems encountered during the testing, while also providing information on the status of the fabrication of the LR56M.

In 1995, the operator of the SRS (Westinghouse Savannah River Company [WSRC]) entered into a similar agreement with WHC for the procurement of a third LR56 under the WHC contract.

LR56 Cask Modifications

The modifications of the LR56 cask design (Fig. 1) for use at the DOE sites include an internal rinsing system and additional sensors as required for use at the specific DOE sites (Clément and David, 1995). The rinsing system was added to the basic LR56 cask design to remove small insoluble particles that would remain in the interior of the cask following an unloading operation. Construction of the inner vessels was performed in accordance with the French code for unfired pressure vessels (CODAP, 1990). The quality assurance program for the construction was in accordance with the ISO 9000 series. The supplier of the LR56 has documented that the modifications to meet the DOE site requirements have not affected the ability of the design to satisfy the Type B(U) performance criteria. Furthermore, the supplier has provided a documentation package demonstrating that testing and engineering evaluation or comparative data show that the construction methods, packaging design, and materials of construction comply with Department of Transportation (DOT) Specification 7A requirements (Authorized Type, 1995).

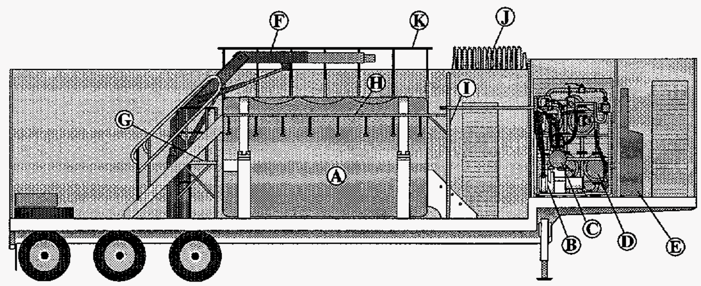


- ① **Primary Containment Vessel**
- ② **Secondary Containment Vessel**
- ③ **Lead Protection**
- ④ **Strength Vessel**
- ⑤ **Wood Thermal and Shock Protection**
- ⑥ **Loading and Unloading Connectors**
- ⑦ **Venting Connector**
- ⑧ **Rinsing Nozzles**
- ⑨ **Plugs**
- ⑩ **Well Lids**

Figure 1 - LR56 Cask Modified for U.S. Use

LR56 System Modifications

Modifications to the U.S. version of the LR56 system (Fig. 2) include mounting the cask on a longer (12.5 m [41 ft]) trailer manufactured to DOT standards, redesigning the air filtration system, and updating the control system to a programmable logic controller (PLC). The flat bed trailer was designed and manufactured in the U.S. to ensure compliance with DOT requirements. Each trailer was then shipped to France for fabrication of the trailer enclosure and installation of the cask, auxiliary, and control equipment. The gross weight of the trailer system is approximately 34,100 kg (75,200 lb) and will be operated using oversized (overweight) permits. Facility interfaces identified at the Hanford Site and ORNL limited the length of the trailer (and the corresponding impact on the concentration of axle loads) to 12.5 m and the height of the trailer to 4.1 m (13.5 ft). The air filtration system was redesigned to allow in-place filter testing and easy filter media replacement.



- Ⓐ **Cask**
- Ⓑ **Motor Driven Vacuum Pump**
- Ⓒ **Demister**
- Ⓓ **HEPA and Activated Charcoal Filters**
- Ⓔ **Control Panel**
- Ⓕ **Crane**
- Ⓖ **Crane Operating Station**
- Ⓗ **Walkway**
- Ⓘ **Ladder**
- Ⓙ **Rollback Cover**
- Ⓚ **Retractable Handrail**

Figure 2 - U.S. LR56 Cask Transporter

Cask Content Limitations

The contents to be transported in the cask may be limited by one or more of the following limits:

Cask Capacity.

Total volume	4,325 1 (1,142 gal)
Maximum allowable contents	3,800 1 (1,004 gal)

Dose Rate Limits. For normal transfers, the radiation field around the cask is limited to not exceed 2 mSv/h (200 mrem/h) at the surface of the vehicle and 0.1 mSv/h (10 mrem/h) at any point 2 m (6.6 ft) from the outer lateral surfaces of the vehicle. Expected radiation levels can be calculated based upon the specific activity of the radionuclide contents and the volume to be transported. The radiation level limits correspond to the following activity limits for a full cask:

gamma emitters < 0.8 meV	10.73×10^{11} Bq/m^3 (29 Ci/m^3)
gamma emitters < 1.3 meV	8.14×10^{10} Bq/m^3 (2.2 Ci/m^3)

Thermal Power. The maximum thermal power generated from radiological decay is limited to 10 W. Using transient thermal analysis, WHC has extended this capability to 438 W for a 21-hour period.

Radionuclide Limits. Regulatory limits are imposed on the radionuclide contents and fissile materials for Type A packages. Criticality analyses are required for the fissile contents for Type B shipments.

Chemical Contents. The maximum chemical contents of the basic LR56 cask have been specified by the supplier to include:

nitric acid	30%, 5.5N
sulfuric acid	50%, 7N
Cl^- anions	1 g/l
F^- anions	0.1 g/l

Particulate Matter. The transfer of liquids containing insoluble particles will be evaluated on a case-by-case basis to ensure that the particulate can be subsequently removed from the cask. Although a rinsing system has been provided, some types of particulate matter may be difficult to remobilize or may become trapped within the cask. When particulate matter is anticipated in the waste to be transported, the cask supplier has recommended that the liquid be filtered prior to loading the LR56.

Status

In December 1995, the first unit (the LR56H) was delivered to Hanford. The second unit (the LR56M) was delivered to Oak Ridge in March 1996. Following delivery of each of these units, the supplier conducted on-site functional testing and operator training. Fabrication of the third unit (the LR56S) was initiated in April 1996.

GENERAL SITE OPERATING REQUIREMENTS

The requirements for transportation of radioactive liquid wastes at Hanford, ORNL, and SRS are derived from current environmental regulations and ensure that these activities are in compliance with all applicable regulations. Numerous upgrades and replacements in the radioactive waste systems at these sites are underway to meet the requirements of a federal facility agreement (FFA) or tri-party agreement established at these sites. The FFA is an agreement established between DOE, the Environmental Protection Agency (EPA), and the respective state agency regarding implementation of the requirements of the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) and the *Resource Conservation and Recovery Act* (RCRA), as amended by the *Hazardous and Solid Waste Amendments of 1984* (HWSA).

Hanford

The primary requirement for transportation of radioactive liquid waste at the Hanford Site is to provide a mechanism for the removal of liquid wastes from the single-shell storage tanks if a leak in any of these tanks occurs. Emergency transfer operations would be initiated to limit the liquid quantity of waste released to the environment if one of the single shell on-site tanks were to leak (Smith, 1995). A potential location for the generation of a leak in these tanks is at the supernatant-to-air interface. Following the detection of a leak, the LR56H would be used to transfer sufficient supernatant from the tank to lower the tank level below the leak location. Special applications of the LR56H may include the transfer of liquid waste in support of characterization, final storage development purposes, or underground storage tank remediation.

The LR56H will be used primarily to transport radioactive liquids within the Hanford Site. Although off-site transportation of Type B quantities of radioactive waste requires a certificate of compliance, DOE directives (Packaging and, 1995) allow on-site transfers of Type B quantities under a DOE-approved transportation safety document. A transportation safety document may include administrative requirements which result in a level of safety equivalent to that provided by a certified Type B packaging. An on-site safety analysis report for packaging (SARP) has been prepared to document the ability of the LR56H to meet Type B equivalent requirements.

Operation offsite on public highways will be allowed for reduced radioactive contents meeting the requirements for a Type A package. Due to the requirement for emergency operations to remove radioactive liquids from a leaking tank, potential LR56H off-site transport operations (as a Type A packaging) will be limited to the local Richland, Washington area.

ORNL

Numerous upgrades in the low level liquid radioactive waste (LLLW) system are underway to meet the requirements of the *Oak Ridge Reservation Federal Facility Agreement*. Permanently installed portions of ORNL's LLLW system have been upgraded by the installation of new tank systems, installation of new double-contained piping, and installation of tank monitoring systems. Single-wall piping systems are either being replaced with double-contained piping systems or are being removed from service, and the radioactive waste is being transported to the LLLW central waste collection system. Generators of very small quantities of LLLW will collect the liquid in bottles to be placed in an overpack for transport to the LLLW central waste collection system. Other LLLW may be collected in generator facility tanks for bulk transfers to the waste collection system by the LR56M. It is expected that the majority of the LR56M operations within the ORNL site will be performed within the constraints of a Type A container. On-site transportation safety documentation will be prepared to permit operation of the LR56M with Type B quantities within the site boundary.

Early planning for the LR56M included the transportation of radioactive liquids between DOE sites on the Oak Ridge Reservation. These sites are separated by public highways; therefore, transportation of radioactive waste between these sites will conform fully to the requirements of DOT for DOT Type A packagings. Operating plans for the radioactive waste generators at ORNL have been revised, and the availability of the LR56M for use in transporting radioactive liquids between DOE sites has increased. ORNL has received numerous inquiries from other sites on the capabilities of the LR56M and its availability for use by these DOE sites. It is expected that the LR56M will be used extensively within the DOE complex for the transport of radioactive liquids between sites and will also be used within the boundaries of other DOE sites.

Savannah River Plant

The primary requirement for transportation of radioactive liquids at the SRS is to provide a mechanism for transporting liquids between facilities for treatment. SRS is considering the consolidation of processing into one facility, the F Canyon. The inventory of intermediate production state solutions presently held in other separations facilities would be transported to F Canyon for treatment to a stable waste form. These solutions are chemically aggressive, radioactive, and contain fissile materials. The LR56S is expected to operate fulltime in the transfer between these SRS facilities and will not be available for off-site shipments.

WSRC will prepare an on-site SARP to meet the DOE requirements for an on-site transportation safety document. Administrative controls for the transport of the LR56S will be included in the SARP. Roads between the facilities will be closed and the LR56S will be escorted to reduce the risks associated with traffic accidents. The route selected will not cross water courses to reduce the possibility of immersion. Fuel inventory on the tractor will be limited to minimize the duration of a potential fire.

LR56 SYSTEM OPERATION

The U.S. version of the LR56 system will permit operation within enclosed buildings by the modification of the basic LR56 design to replace the diesel-powered hydraulic pump and air pump with electrically driven pumps powered from 460-volt, three-phase AC power. The maximum electrical power required for the system is 20 kw. Auxiliary systems on the trailer include a hydraulically operated arm (crane) to move the cask plugs to the set-down rings located adjacent to the cask, a nitrogen station to purge the cask, an air pump to generate a vacuum or pressure in the cask to transfer the cask contents, an air filtration system, and a control console.

Normal operations of the LR56H may be controlled from the console in the front cabin of the trailer. If an abnormally high radiation level is anticipated during the transfer (as in the case of emergency operations), the LR56H unit has a remote console which performs the same functions as the local console, but which can be located in an area of lower background radiation during transfers. Two 30-m long umbilical cables are used to connect the remote console to the LR56H trailer.

Transfer operations of the U.S. version of the LR56 may be controlled from the console in the front cabin of the trailer or may be controlled at the loading or unloading facility through the use of control signals exchanged between the trailer and the transfer station. Once the operating console has been aligned for a transfer process with control signals exchanged between the LR56 and the transfer station, the actual transfer operation can be initiated and terminated from the transfer station. This feature permits remote operation if required for personnel protection. The LR56 control system can also be operated with no control signals exchanged with a loading or unloading facility.

The following discussion of the operating modes is specific to the LR56M. The operating modes and controls are similar for the LR56H and the LR56S.

Preparation for Transfer

Access to the cask and control cabins of the trailer is through normally locked roll up doors. Removable stairs provide access to the trailer bed and are transported with the trailer. Once the operator has entered the cask cabin, the trailer cover (a roll-back cover which goes over the cask cabin only) is manually slid forward along the tracks on the sides of the trailer to provide free access to the top of the cask. Electrical power is then connected to the left side of the trailer.

The plugs for the front and rear wells of the cask are removed for loading and unloading operations using the onboard crane or a facility overhead crane. Where available, the use of an overhead crane is preferred due to its simple vertical lift of the plugs from the cask. The plug for the center well must also be removed for unloading operations when the interior of the cask is to be rinsed. Each plug is stored on a setdown ring adjacent to the cask during the transfer operations. Once the plugs are stored, the well lids (which are part of the inner vessel containment barrier) are opened.

Vacuum Loading

The vacuum loading mode (Fig. 3) is the preferred loading mode when permitted by the elevation of the tank from which the radioactive liquid will be transferred. In this mode, the hose and connections will be below atmospheric pressure, so any leakage at a connector would be inleakage rather than a leak to the environment.

A 50-mm inside diameter hose (transported with the LR56M) with a special self-sealing connector (Clément and David, 1995) is mated with the fill line receiver in the rear well, and the jumper hose is installed between the venting connector in the forward well and the piping from the cask area to the auxiliary equipment cabin. The self-sealing connector (based on a standard design used for refueling commercial aircraft) has two mechanically interlocked devices to ensure the connector and receiver are latched together prior to the opening of internal sealing valves. Valves in the auxiliary equipment room are realigned from the control console, and the air pump is started to draw a vacuum on the moisture separator tank and the cask volume. The air pump discharges the air through two sets of HEPA and activated charcoal filters. Once the pressure has been reduced to an operational setpoint, the fill line isolation valve in the rear well is manually opened, and vacuum loading commences.

To stop loading, the air pump is turned off and valves in the auxiliary system are realigned to allow the gas volume in the cask to return to atmospheric pressure. If the elevation of the liquid in the facility tank is above the elevation of the top of the LR56 fill line, the facility must have a valve to break the siphon and stop the loading process. Following the completion of the transfer, the hose may be flushed to reduce the residual internal contamination in the hose. The isolation valve to the fill line is then closed, and the self-sealing connector is removed from its receiver. A sample of the liquid in the cask can then be drawn through a sample tube connected through an additional fitting in the rear well to confirm the contents of the tank and to prepare the appropriate shipping documentation. The venting isolation valve is then closed, and the jumper connection to the auxiliary system piping removed.

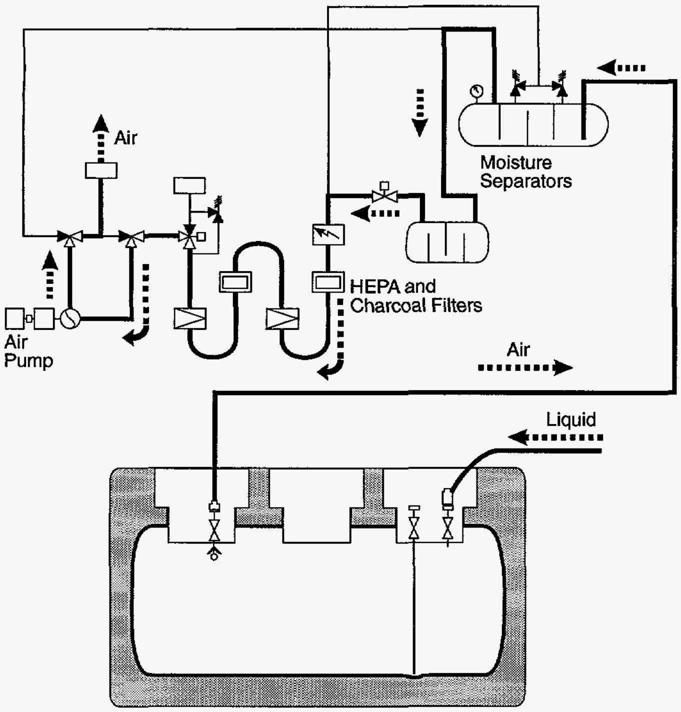


Figure 3 - Vacuum Loading Mode

During the vacuum loading mode, a permissive signal can be received by the LR56M from the loading station. If the loading station determines that the transfer must be terminated, the permissive signal can be removed and the LR56M will terminate the transfer independent of any direct communications between the loading station operator and the LR56M operator. The LR56M provides an analog cask level signal to the loading station so that the volume transferred can be monitored at the loading station. The LR56M can also operate in the vacuum fill mode independent of any signals from a loading station.

Pumped Loading

In many facilities, the liquid to be transported is at an elevation below the lift capability of the LR56M vacuum loading mode; therefore it must be pumped up to the top of the LR56M. During pumped loading operations (Fig. 4), the pumping system capacity is limited to 3 bar (the design pressure of the cask) and to 7m^3/h (30 gal/min) to ensure that the cask's venting system can adequately maintain cask pressure below the setpoint (800 mbar) of the relief valves which are located on the moisture separator of the auxiliary system. A pump permissive signal is sent to the loading station to ensure that the cask is not overfilled. During loading operations, the LR56M can provide a level signal to the loading station so that the volume transferred can be monitored both at the LR56M control panel and at the loading station.

During the pumped loading mode, the loading hose and jumper hose are connected to the cask at the same locations as in the vacuum loading mode, and the isolation valves at the connectors are opened. The auxiliary system is then aligned to vent the tank through the filters to the atmosphere. When the components on the trailer have been properly aligned, a pump permissive signal is sent to the loading station. Once the level in the LR56M has reached a value set on the control console for the transfer (the quantity of the transfer may be limited to less than a full load due to the radioactive content of the liquid) or the level has reached the high-level set point for the cask, the LR56M control console removes the pump permissive signal and loading operations are stopped.

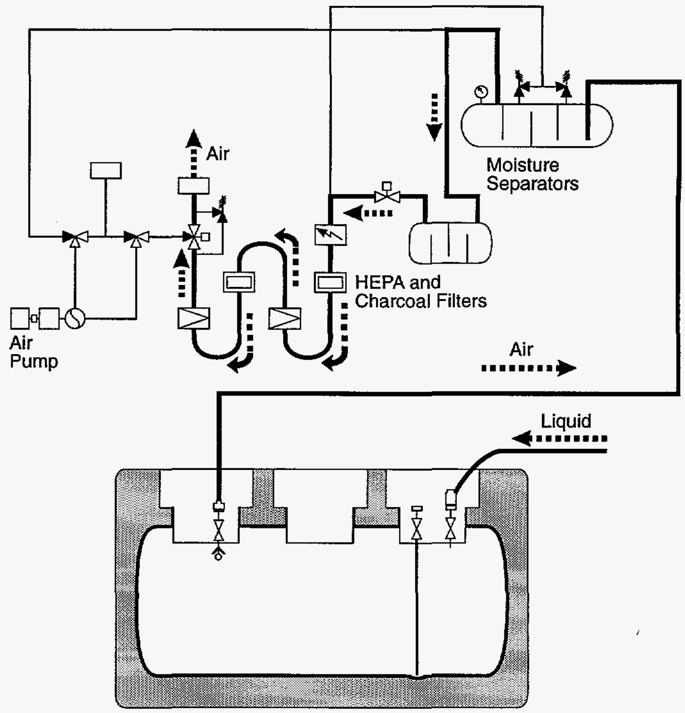


Figure 4 - Pressure Loading Mode

Vacuum/Siphon Unloading

The vacuum/siphon unloading mode (Fig. 5) is the preferred mode for unloading because the liquid in the hose and connectors is subatmospheric. In this mode, a hose with a self-sealing connector is mated with the unloading receiver, and the jumper hose is installed between the venting connector and piping to the auxiliary equipment cabin. The auxiliary system is then aligned to permit air flow into the cask as liquid is removed. Once this alignment has been completed, a permissive signal is sent to the unloading station.

An initial vacuum is then established by the unloading station to lift the liquid up through the unloading nozzle to a point higher than the truck. Once the liquid has been lifted to this point, a siphon is established which will continue the remainder of the unloading operation, so the source of the vacuum can be stopped. For example, a steam jet may be used to initially lift the liquid in the piping. Once the siphon has been established, the steam supply to the steam jet may be turned off by the unloading station. The siphon transfer will continue until air is ingested into the unloading piping. The siphon will then be broken, and a small quantity of liquid between the bottom of the unloading piping and the high point of the external piping will return to the bottom of the cask.

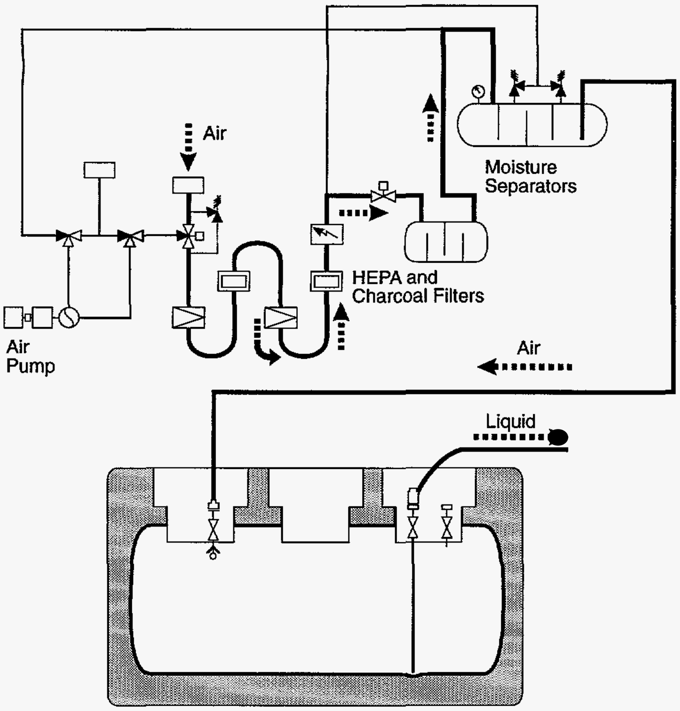


Figure 5 - Vacuum Unloading Mode

In order to stop an unloading operation, a siphon-break valve is required at the high point of the piping in the unloading station. The loss of the permissive signal from the LR56M during a transfer causes the unloading station to open the siphon-break valve and terminate the transfer.

Normal vacuum/siphon unloading operations for the LR56M include a rinse cycle in each unloading operation to rinse out the transfer hose and fixed piping at the unloading station and to minimize the radioactive contents of the liquid retained in the cask at the end of the operation. For this rinsing operation, a separate line is connected to the quick disconnect in the middle well of the cask. Each of the wells has a rinse line connector which can be used consecutively if a full rinsing operation of the cask is required. A full rinsing operation is a separate mode selected from the control panel. In addition to providing rinsing water to dilute the remaining contents of the LR56M and to rinse out the unloading piping, rinsing through the connector at the middle well also removes any residue from the floating level sensors. Once a programmed level is reached during the unloading operation, an additional permissive signal is sent to the unloading station to start a rinse cycle. The end of the unloading process is a type of feed-and-bleed process in which clean water is being added to the cask while the cask is being emptied.

Pressurized Unloading

The pressurized unloading mode (Fig. 6) uses the onboard air pump to create an overpressure (less than 800 mbar) in the cask and force the cask contents up the unloading pipe. Since this mode is not anticipated for routine operations of the LR56M, this mode of operation is administratively restricted by a key-locked switch at the control console. If the unloading system contains a tank at an elevation lower than the LR56M cask, a siphon will be generated once the piping system is filled to the high point. For this operating mode, a siphon break on the facility piping system is required to terminate the transfer. If the unloading system tank is not below that of the LR56M cask, then the transfer will be terminated when the LR56M auxiliary system is aligned to vent off the overpressure.

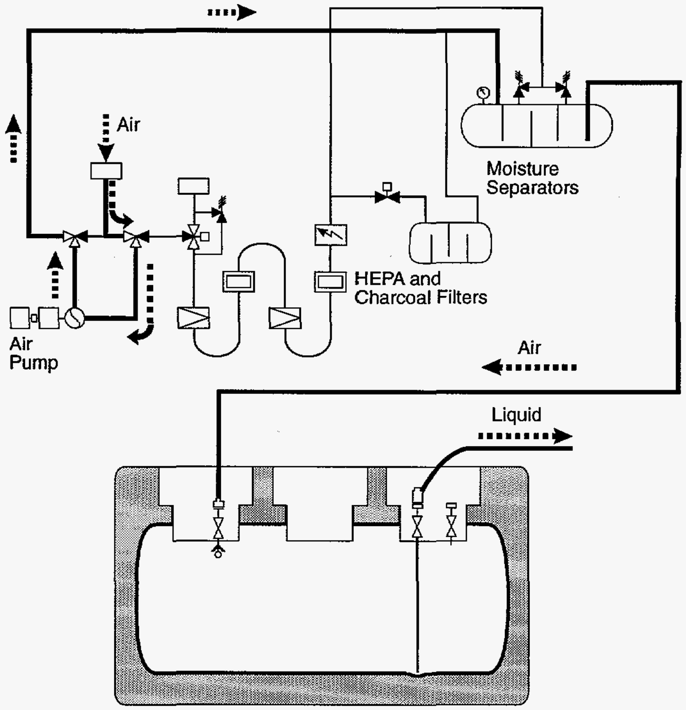


Figure 6 - Pressure Unloading Mode

In this unloading mode, a hose with a self-sealing connector is mated with the unloading receiver in the rear well, and the jumper hose is installed between the venting connector in the forward well and the installed piping to the auxiliary equipment. When the unloading station is ready to receive the radioactive liquid, the manual isolation valves on the cask vent line and unloading line are opened. The LR56M control station then aligns the auxiliary system to permit the air pump to pressurize the cask. Once the transfer has been completed, the auxiliary system is aligned to vent the cask overpressure through the HEPA and activated charcoal filters. The pressurized unloading mode may be followed by a rinse cycle to reduce the residual contamination in the cask and connected hose. Following the rinse cycle, the pressurized unloading cycle would be repeated to transfer the rinse liquid.

Completion of Transfer

Once the transfer of liquids has been completed, the isolation valve to the self-sealing connector is closed and the self-sealing connector is removed from the receiver in the real well. The control console aligns the auxiliary system to restore the interior of the cask to atmospheric pressure. For loading operations, a sample can then be drawn through the sample fitting in the rear well to confirm the chemical and radiological contents of the cask. The venting isolation valve is then closed and the jumper connection to the auxiliary system piping is removed. The surfaces within each well and the surrounding areas will then be monitored for contamination.

The lid for each of the wells is then torqued closed, compressing the two elastomeric o-ring seals on each well flange. The performance of the seals is then measured by monitoring the interseal pressure (as indicated on the control console) for thirty minutes. After the leak tightness of the primary containment vessel is verified, each plug is then lifted from its stored position using the onboard crane or overhead crane, aligned and lowered into the cask, and locked in place.

Before moving the trailer, the demisters are drained of any liquids accumulated during the transfer and the liquid contents can be sampled. If excessive contamination on the interior of the demisters is detected in the sample, water or other decontamination fluids can be used to flush the demister. Following the completion of the transfer and the draining of the demister, the auxiliary system can be dried by drawing air through the demister and venting it to the atmosphere through the filter system.

The electrical connections for the power supply and the instrumentation and control signals are then disconnected, with electrical cables placed in storage locations on the trailer. LR56M hoses used during the transfer can be stored in the cask cabin. The roll-back cover for the cask cabin is then slid to the rear of the trailer and latched. The stairs are then loaded on the trailer, and the trailer doors are closed and locked.

Hanford Operations

Due to the elevation of the underground tanks, it is not possible to load the LR56H using the onboard vacuum pumping capability. Instead, the LR56H will be loaded in the external fill mode, with the radioactive waste pumped from the storage tanks to the LR56H. One concept for the LR56H loading operations is to provide a trailer-mounted piping support and valving assembly which would accompany the LR56H to the facility where it will be loaded. Loading operations would use double-contained piping or a hose within a hose for all aboveground operations. The piping support structure would rigidly elevate the transfer piping above the height of the LR56H trailer walls.

Current plans are to unload the LR56H at the double-shell tank farm, with the LR56H moved to within 50 feet of the receiving tank. Unloading equipment will have a valve system to assist in flushing and venting the transfer system after the transfer of radioactive liquids. The piping system will include the valves necessary to prevent liquid waste from leaking to the environment when equipment is disconnected. No additional isolation valve is required at the end of the hose with the special self-sealing connector.

ORNL Operations

To meet FFA requirements, permanently installed portions of ORNL's LLLW system have been upgraded with new tank systems, new double-contained piping, and leak monitoring systems. These upgrades include the construction of an LLLW unloading station (a new facility designated the Transported Waste Receiving Facility [TWRF]) to add a truck loading station to the Process Waste Treatment Facility (PWTF).

TWRF Unloading Station. The TWRF can receive bulk quantities of LLLW from top loading/unloading transporters (including unshielded containers other than the LR56M), as well as bottled LLLW. The TWRF has two barriers of containment for radioactive waste at all times. The floor of the unloading bay is covered with welded stainless steel plate and is sloped to a sump at the rear of the unloading bay. Any liquids collected within the unloading bay will be collected within a sump for analysis before being directed to the proper processing system. Two stages of HEPA filtration are provided for all areas that may contain radioactive materials.

During LR56M unloading operations at the TWRF, the LR56M will be backed into the unloading station and disconnected from the tractor. The tractor will leave the unloading bay, and the building door will be closed. An inflatable seal on the door will be pressurized to provide the necessary building confinement. The TWRF unloading bay's overhead crane will then be used to remove the impact limiting plugs from the wells of the cask. The LR56M will be connected with the building's AC power distribution system to energize the LR56M control and monitoring station. Instrumentation will be connected to the TWRF for the passage of interlock, permissive, and analog signals. An additional connection will be mated with the TWRF to send digital signals from the onboard PLC to corresponding equipment in the TWRF control station.

An elevatable, rotatable boom has been located on the side wall of the TWRF to position the self-sealing connector near the rear well of the cask. The operator will unlock the boom from its storage location on the side wall and rotate it approximately 90 degrees. Approximately 12 feet of flexible hose will be attached to the end of the boom to provide the necessary tolerances in the positioning of the trailer and to permit the use of additional on-site transporters which have connections at lower elevations. An electrically operated siphon break valve is installed at the high point in the unloading station piping, several inches above the elevation of the unloading boom.

The LR56M will be unloaded at the TWRF using the vacuum/siphon mode. The initial vacuum will be developed by a steam jet which is slightly below the elevation of the unloading station floor. LLLW will gravity drain from the steam jet to an LLLW collection tank. When the unloading piping has been filled to the siphon break valve and a flow commences into the collection tank, the steam supply to the jet will be isolated and the unloading operation will continue in a siphon mode.

A demineralized water system will be used for the addition of rinsing water to the cask. A demineralized water hose with a quick disconnect is attached to the unloading boom for operator access. The hose is long enough to reach the rinsing quick disconnect fitting at any of the three cask well locations.

PWTF Loading Station. The PWTF has been modified to add a truck loading station to replace the single-wall piping to the central waste collection header. The new loading station will include a boom design similar to that in the TWRF (no siphon break valve required) for locating the self-sealing connector above the cask. LLLW will be pumped from a tank in the PWTF, and the LR56M will operate in this facility in the pumped fill mode.

Other LR56M Operations. Due to changes in the generation of LLLW at ORNL, DOE has determined that the LR56M should be made available for transport of LLLW at other DOE sites. Operating contractors at several other DOE sites have requested information regarding the use of the LR56M as a Type A packaging for transportation of radioactive liquids from their facilities. Based upon these unsolicited inquiries, LMES initiated a functional analysis to determine the steps necessary to expand the mission of the LR56M to other users. An initial survey of other DOE facilities was conducted to identify additional potential users for the LR56M. Subject to authorization from DOE, the LR56M will be made available for transportation between DOE sites and within the boundary of another DOE site under an agreement signed between the radioactive waste generating site and LMES. It is planned that trained and certified operators and drivers would be provided with the LR56M equipment.

SRS Operations

Details of the planned operations and facility interfaces for the LR56S are still in the conceptual phases.

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REFERENCES

"Authorized Type A Packages," Title 49 Code of Federal Regulations 173.415, as amended at 60 FR 50312, September 28, 1995.

Clément, G. and David, G., 1995, "Evolution of the LR56 Type B(U) Cask System for the Transportation of Radioactive Liquid Waste," ICEM '95, The Fifth International Conference on Radioactive Waste Management and Environmental Remediation, Berlin, Germany, September 3-8, 1995.

"Packaging and Transportation Safety," DOE Order 460.1, change1, September 27, 1995.

"Regulations for the Safe Transport of Radioactive Material," IAEA Safety Standards, Safety Series No. 6, 1985 edition (as amended 1990).

Smith, R. J., 1995, "Packaging and Transportation of Radioactive Liquid at the U.S. Department of Energy Hanford Site," ICONE-3, The Third International Conference on Nuclear Engineering, Kyoto, Japan, April 23-27, 1995.