

## MEETING THE REGULATORY CHALLENGES OF MIXED WASTE STORAGE AND MONITORING: A NOVEL APPROACH

Dennis Wilkinson  
EG & G Idaho, Inc.

Mark Shaw  
ENPAC Corporation

### ABSTRACT

This paper describes an original approach to providing safe storage of Remote Handled TRU Mixed Waste that is required to meet the EPA double liner and leachate collection system standards. This system, known as the "Environmental Vault Liner", also allows a cost effective means of complying with the EPA's inspection requirements per 40 CFR 265.170, Use and Management of Containers. This approach is modular in nature, allowing additional storage capacity to be added on a demand basis, thereby eliminating significant upfront costs associated with large storage facilities built on estimated needs over many years. It reduces the financial and technical risks associated with large storage construction projects, allows modifications to new Liners put into service based on changing regulations and technologies. The Environmental Vault Liner offers additional benefits including easy waste retrieval, a 300 year design life, continuous below ground liquid detection and monitoring, replaceable instrumentation, inert (Nitrogen) atmosphere for container storage, continuous air monitoring, and remote visual container inspections.

### INTRODUCTION

Proper collection and storage of Remote Handled TRU Mixed Wastes at the Idaho National Engineering Laboratory (INEL) requires compliance with appropriate Department of Energy (DOE) and Environmental Protection Agency (EPA) regulations. The document, "Joint NRC-EPA Guidance on a Conceptual Design Approach for Commercial Mixed Low-Level Radioactive and Hazardous Waste Disposal Facilities" describes an acceptable facility based upon a double liner and leachate collection system with a 30 year design life. It allows licensed generators to develop alternative designs based upon their specific needs. These alternative designs must meet the technical and regulatory criteria as set forth by federal and state agencies.

The challenges at INEL were based on the limited area which would be permitted for retrievable storage of mixed wastes and the need for cost effective solutions. The lack of double leachate collection under the designed geographic area, adequate ground water monitoring wells, ground water sampling, and individual container inspections placed a greater emphasis on efficiency and challenged conventional methods of storage. The need for the mixed waste to be remotely handled and monitored added to the design challenge. EG & G, Inc. developed a design approach based on meeting the site specific challenges.

### DESIGN FEATURES OF THE ENVIRONMENTAL VAULT LINER

A conceptual design is provided in Figs. 1 and 2. Detailed drawings are provided in Figs. 3 and 4.

#### Description

The design is based on primary containment via an inner, cylindrical liner which will accommodate four 55 gallon 17-C open head drums of the Transuranic (TRU) mixed waste. This inner liner is contained by an outer liner providing secondary containment protection. Together this dual liner system provides the primary and secondary containment and leachate collection. These Liners are set into steel vaults which have

been placed into the ground within the RWMC Transuranic Storage Area (TSA) Intermediate Level Transuranic Storage Facility (ILTSF) subterranean vault storage Pad 2. The sixteen vault array on Pad 2 has been added to the RWMC, TSA Part "B" Permit for storage of Remote Handled (RH) TRU mixed waste.

#### Materials of Construction

The primary inner liner is a molded, rigid, linear low density polyethylene resin which is chemically compatible with the chemical composition of the mixed waste. The secondary outer liner is a dual laminate composite constructed of a Fiberglass Reinforced Plastic (FRP) casing bonded to a polyethylene inner wall. This outer liner composite has a design life of 300 years. This claim is supported by extensive testing performed for corrosion, UV, biodegradation, radiation, chemical, creep, and other relevant concerns. This dual wall concept with the FRP/PE composite has also been successfully used in a mixed waste demonstration project at Westinghouse Hanford as described in a paper given by Syed J. Amir entitled, "Alternative Double-Liner Leachate System for the Storage/Disposal of Mixed Low-Level Waste", 1989 (# WHC-SA-0625-FP). The EG & G Idaho Environmental Vault Liner system provides dual containment protection as does the Westinghouse system. The EG & G Liners also meets specific needs by adding an enhanced inspection and container protection system.

#### Handling

The Environmental Vault Liners are designed to allow the containers of mixed wastes to be remotely lowered into the Liners and secured for monitored storage. Should inspections or monitoring show leakage (free liquid or airborne radionuclide release) the design allows access and remote removal.

#### Dual Leak Detection

Each containment liner has its own leak detection operating independently of the other. The leak detection system is based upon a leak detecting wire which runs the length of the vertical liners in a protective tube which terminates at the base

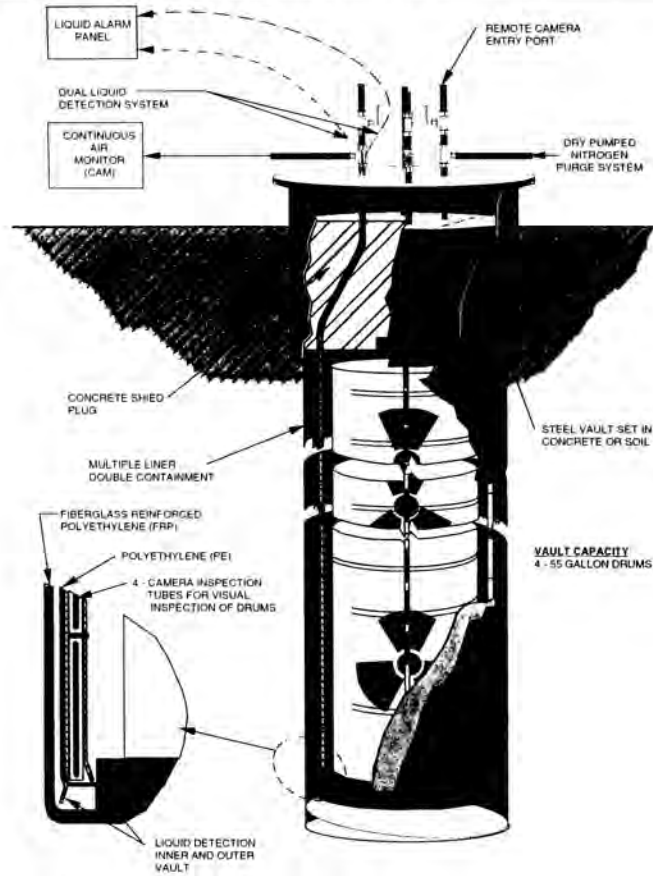


Fig. 1. ILTSF environmental vault monitoring system.

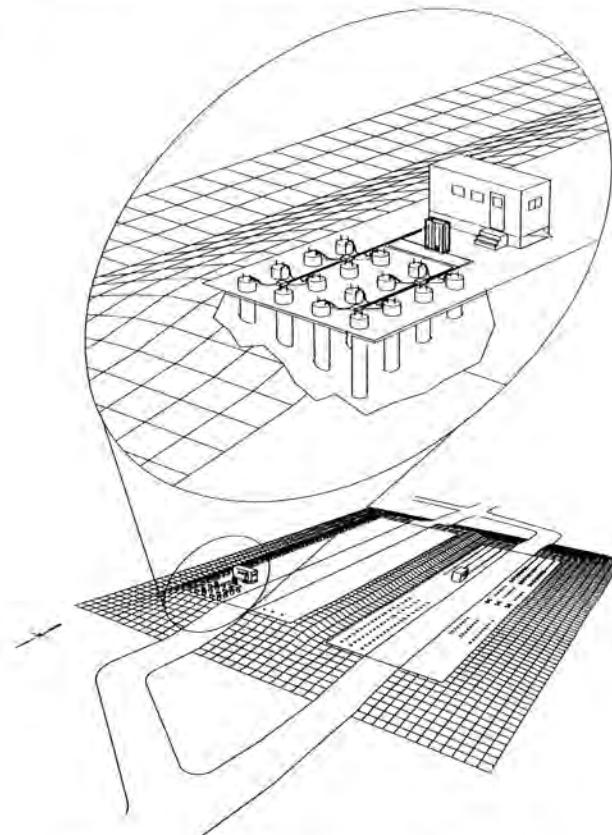


Fig. 2. Conceptual view ILTSF storage area.

REVISION			
REV	DESCRIPTION	DATE	APP'D
A	SEE "A" DCN	12/18/91	A.R.R.
B	SEE "B" DCN		

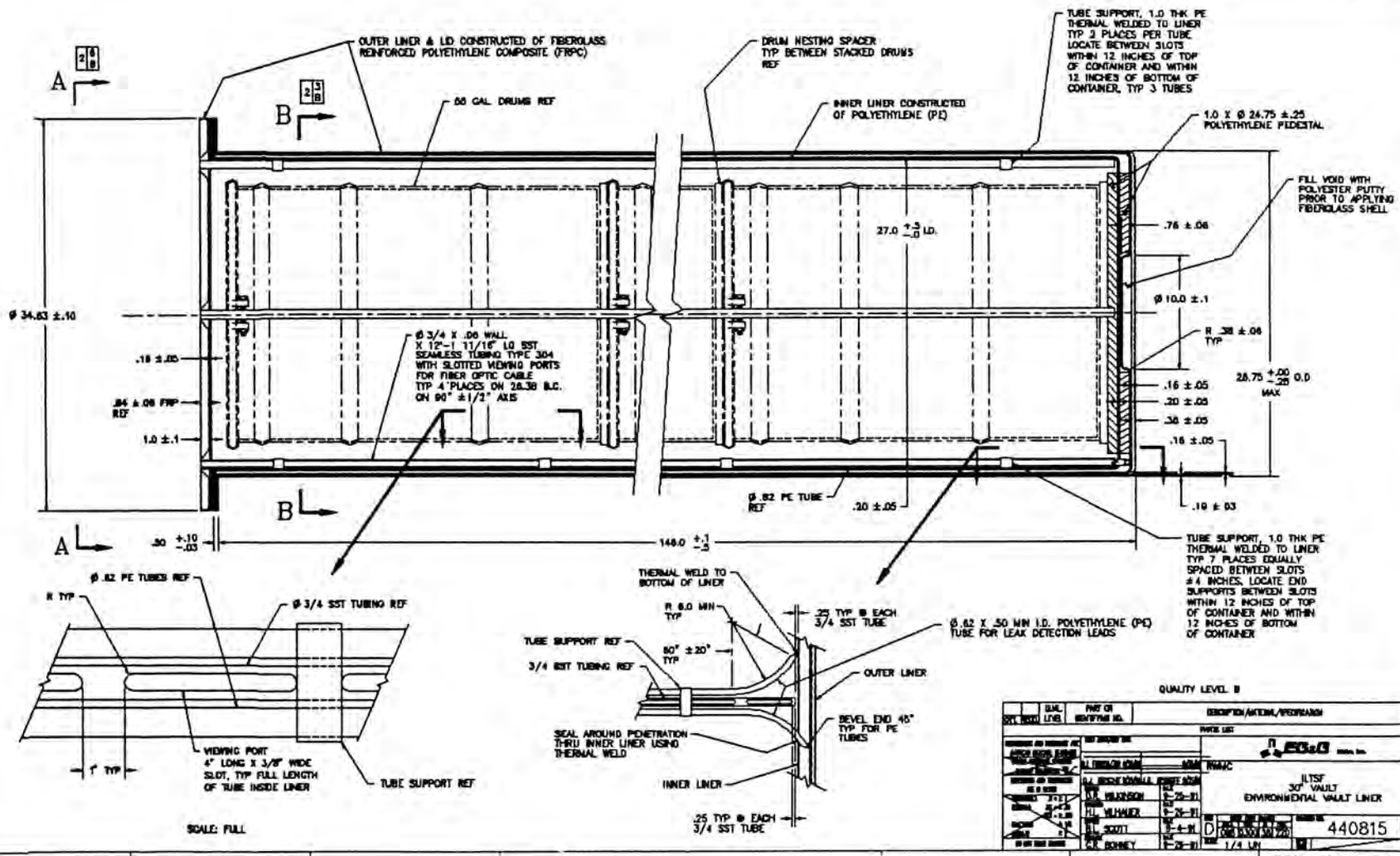


Fig. 3. Construction drawing vault liner.

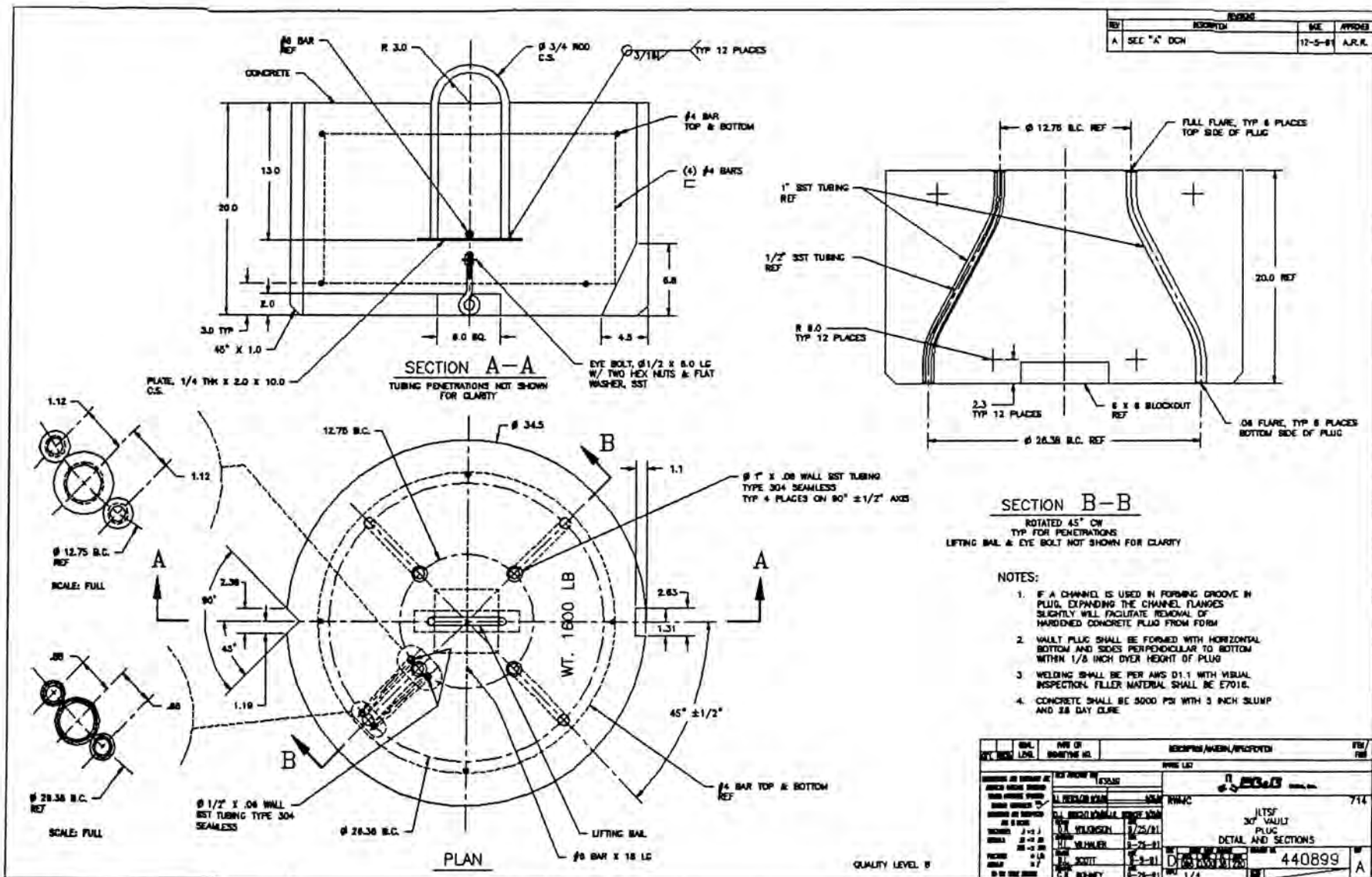


Fig. 4. Construction drawing vault shield plug.

of the liner. This allows the sensor wire to signal the presence of a leak at contact along its entire horizontal and vertical length. The detection sensor wires are attached to a remote instrumentation panel that provides for continuous monitoring at the storage location and at the RWMC supervisory alarm system through a secondary signal. The leak detection system design permits removal, repair, and re-installation of instruments without requiring the removal of waste or the vault liner system. EG & G Idaho, in designing and specifying the leak detection system, decided on a TraceTek signal system. Due to multiple hazards that may be encountered in future mixed wastes, a system capable of sensing a wide variety of materials, (ie. hydrocarbon based solvents, organics, etc) would be needed. In addition the TraceTek system will perform the self diagnostic tests to verify operation and will alarm if specific conditions are not met. It is EG & G Idaho's position that a sophisticated system such as the TraceTek would provide a more balanced approach to existing and future requirements.

#### Remote Inspection Apparatus

The EPA requires weekly inspection of containers of hazardous wastes under 40 CFR 265.170. The high radiation levels (up to 30 R/hr) of the waste in conjunction with the Vault and Liner construction prevents standard means of inspection for compliance purposes. This Environmental Vault Liner is designed to meet the inspection requirement by allowing a small remote video camera to be inserted through an above ground valve system which connects to the stainless steel inspection tubes. The tubes are accessible through the 2 foot thick concrete shielding plug and carbon steel blind vault flange. Four inspection tubes spaced 90 degrees apart are slotted to allow maximum viewing area for the video camera. The equally spaced tubes run the vertical length of the four 55 gallon drums and will allow accurate, weekly inspections of the drums in storage. The camera system is equipped with elimination, replaceable lens, articulating control of the camera lens and a video cassette recorder (VCR) with voice and data overlay. The Olympus camera system used for this application was tested in high radiation and the camera lens will withstand 100 R/hr of continuous use without clouding of the lens. When clouding does occur, replacement of the lens is a simple and inexpensive procedure.

#### Shielding

To prevent the radioactive "shine" from being directed through the top of a waste filled vault system, a two foot thick concrete plug is placed on top of the Environmental Vault Liner. Stainless steel tubes for the leak detection and video inspection instrumentation have been cast into the shield plug in an offset serpentine design. The shield plug is keyed to the vault so positive alignment is maintained in component assembly.

#### Nitrogen Purge System with Continuous Air Monitoring (CAM)

The Environmental Vault Liner is also equipped with a dry-pumped nitrogen purge system. The purpose of this system is to provide a dry, oxygen free environment for the storage containers. This will prevent degradation due to moisture and oxidation of the steel containers. After leaving the vault, the discharged nitrogen is connected to a continuous air

monitor (CAM) and HEPA filter to provide early detection of airborne radionuclides. The CAM system is equipped with a chart recorder and alarm which is also connected to the RWMC supervisory alarm system. CAM recorders are inspected on a daily basis at RWMC by certified Health Physics Technicians. An added dimension to the above design would involve a closed loop nitrogen-oxygen mix. After achieving an inert atmosphere in the vaults containing waste, the system would be secured (valved out) from the down stream empty vaults, thus creating a closed loop. Nitrogen from the vaults containing waste could be prepared or purged from the system and sampled in the laboratory for hazardous or radioactive constituents.

### **BENEFIT ANALYSIS**

#### 300 Year Design Life

The FRP/PE composite provides long term protection for safe and retrievable storage. (Ten time safety factor based on required 30 year design life).

#### Modular Design

Eliminates the need for large dollar capital expenditures to build projected capacity facilities. The modular design allows additional Environmental Vault Liners to be purchased on a "Just-In-Time" basis as drummed wastes are accumulated. Risks associated with large scale projects are reduced as the dollar exposure is limited initially and added in increments over time as waste accumulates. The flexibility of FRP/PE composites allow construction of systems tailored to container type as well as storage need.

#### EPA Requirements Compliance

The double liner and leachate collection design provides adherence to, and compliance with, mixed waste regulations. The system allows INEL to adapt a storage plan to meet site specific needs while remaining in regulatory compliance.

#### Remote Inspection System

The most costly part of mixed radwaste below ground storage is the EPA requirement for weekly inspections of all containers of hazardous wastes. This ongoing cost is further complicated in INEL's case since the drums are virtually inaccessible due to the storage method. The highly radioactive nature of the waste, and the adverse weather conditions add to the challenge of carrying out inspections on time. It must be noted that high radiation, rain, snow, wind, and high humidity are not exclusive to southeast Idaho or the INEL. These conditions exist nationwide to a varying degree. All national laboratories with a mixed waste storage issue have similar problems to overcome to remain in compliance. The remote inspection system addresses all of these concerns. Weekly drum inspections via the remote video camera inspect and record the condition of each drum. Container degradation or leaks will be quickly identified, allowing appropriate actions in a timely manner.

#### Leak Detection

The Dual Leak Detection System will provide continuous monitoring of each liner, indicating internal leaks (from inside out), or leaks from an external source (from outside in). In either case, they will serve as a early warning prior to the

weekly visual inspection. The system will indicate which Vault is experiencing a leak. Verification of a false alarm or real condition is achievable by replacement of the liquid sensor or sampling of sensor cable and tube prior to removing the waste. The sensor tube also acts as a sample probe simply connecting to a specially designed Randolph pump.

#### **Versatile Design**

The Environmental Vault Liners accommodate standard 55 or 30 gallon drums, allowing contact or remote handled waste to be accepted, or future waste to be packaged into the standard drum size. The system's design has the versatility to be dimensioned for a variety of situations, needs, or sizes.

#### **Cost Analysis**

In determining the most cost effective alternatives, a comparison study was conducted between the following:

1. No action.
2. Upgrading the existing facility.
3. Installing the Environmental Vault Liner system.

**Study on 1:** No action. This would allow the facility to remain "as is" with no monitoring and no upgrades.

**Conclusion:** DOE and EG&G Idaho found the no action alternative to be inconsistent with the policy and commitment on Environmental Health and Safety. Container degradation, leaks, and spread of radioactive and hazardous material contamination would not be known until the individual vaults were opened. The cost of non-conformance, due to individual or multiple per-violation fines from state and federal regulators would far exceed the cost of alternatives 2 or 3.

**Advantages:** None.

**Disadvantages:** Many.

**Cost of Non-conformance:** Unknown at this time.

**Study on 2:** Upgrading the existing facility. This would require installation of a monitoring well system down gradient from the proposed storage location. Development of a ground water sampling and analysis plan with clean-up contingency plans, installation of a double lined leachate collection system and constructing a tension structure for weekly vault disassembly and container inspections. The tension structure design would be closed with overhead crane or mobil crane access, light, ventilation, and remote power.

**Conclusion:** EG&G Idaho would have to relocate the existing facility to a new location due to the subterranean nature of the storage system. Determining "need" for a new facility would require detailed waste projections and long term planning. Additional costs include preparing an environmental assessment (EA), and an environmental impact statement (EIS). Costs to construct a new facility, less the EA and EIS, for sixteen vaults, and drilling monitor wells would be approximately \$2.4 million.

**Note:** Above costs do not address weekly visual inspections or the appropriate National Environmental Policy Act (NEPA) documentation required for a new facility. These costs would be highly speculative and would far exceed the cost of construction.

**Advantages:** A new facility would meet current Environmental Protection Agency (EPA) and State regulations for storage of mixed waste and the facility storage could be expanded if adequate leachate collection was provided.

**Disadvantages:** Unknown costs of permitting, future regulations, and "need" present an unacceptable risk to the INEL.

**Total Cost:** Specifically unknown, estimated in excess of \$4.8 million.

**Study on 3:** Installing the Environmental Vault Liner System would require minor modification to the existing facility, the addition of underground power lines, remanufacture of shield plugs, and the purchase of slip-in liners and remote monitoring instrumentation.

**Conclusion:** We found this alternative to provide the most benefits of all the alternatives examined. Minor modification to an existing facility precludes the NEPA requirements for additional documentation. Associated modifications are as follows:

1. Manufacture environmental vault liners.
2. Remanufacture vault shield plugs, remove internal channel from vault.
3. Purchase monitoring instrumentation, equipment, storage, and monitoring trailer.

**Advantages:** Meets all existing storage and inspection regulations without building a new facility. It provides container corrosion protection, remote inspection, modular design, multiple alarms, and meets the DOE/EG&G Idaho ALARA (as-low-as-reasonably achievable) goal of no exposure to personnel. Additional vaults may be added to the system as the need arises.

**Disadvantages:** Only sixteen vaults are being considered for the RWMC Part "B" permit. This will only provide storage for sixty-four 55 gallon containers of mixed waste. Additional vaults could be added, but would require a change to the Part "B" permit.

**Total System Cost:** Approximately \$426,000.

#### **FINAL CONCLUSION**

INEL and RWMC were presented with a series of challenges in handling and storing mixed wastes. Geographic formations limited storage space, while cost constraints required efficiency and low up front investment. Weekly inspection and monitoring costs had to be minimized without a loss of quality. The long term objective was to identify all State and Federal regulatory requirements that impact storage at the RWMC. It is the expressed desire of DOE and EG&G Idaho to meet and, where possible, exceed the existing requirements for mixed waste storage. A *commitment* to verbatim environmental compliance, doing it right the first time, and high quality is the end result. The Environmental Vault Liners present a very real alternative for mixed waste storage and a novel, innovative approach to the mixed waste storage issue. The prototype design, modular construction, and multiple inspection capabilities put this system on the cutting edge of existing mixed waste storage methodology. With modifications specific to the needs of each generator site, this system has the potential to be a practical, low cost, and environmentally safe solution for today's mixed waste problems.