TO: Jane H. Hall, Assistant Director

DATE: September 22, 1961
Revised - November 3, 1961

FROM: Jerome E. Dummer, Health Physicist, H-1

SUBJECT: DISPOSAL OF LIQUID WASTE FROM J-11 ROVER OPERATIONS

SYMBOL: H-1-D-18

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Introduction:

During the next few years, J-11 expects to create approximately 400 liters of liquid radioactive waste as a result of radio-chemistry on Rover fuel elements. The waste will be produced at the rate of about 50 liters per reactor, and will contain about 60 curies of mixed fission products per liter when it is disposed of one month after each reactor test. Each liter will contain from 40 to 100 grams of U-235. The solutions are corrosive, containing 1 N HF, 2 N $HClO_4$, and 3 N HNO_3. The long term storage characteristics of such solutions are unknown, but they are potentially hazardous. For this reason it seems advisable to make the final disposal of the material as soon as possible after each reactor experiment.

We will consider here the possible methods of disposal both at LASL and at NTS. For most disposal methods the problems are generally similar for either site. Difficulties arising from transporting the material to Nevada, and the lack of certain specialized equipment at NTS make disposal at LASL more attractive.

Disposal Methods:

1. Deposit the waste in a hole, using the shielded truck method described in LAMS-2566, "Low Exposure Method for Disposing of High Activity Wastes", by Schulte, et al. Migration of the material can be slowed by lowering an unbreakable bottle containing vermiculite into wet concrete.

2. Disperse the solution in a drum of concrete and bury the drum.

3. Package the bottled solution in the center of a drum; shield and contain the bottle with concrete and lead.

4. Store the material for future recovery.

The pros and cons of these methods are discussed below.

Discussion:

Method 1. Due to the corrosive nature of the solutions, serious objections can be raised about the migration of the radioactive material held in a single primary container. If suitable absorbing material can be used, or if a permanent container can be designed within a $10\frac{1}{2}$ inches diameter cylinder, the method would be applicable without extensive modification of the existing truck and shielding. A hot cell would be required for packaging and loading the cask. As many as five one-liter bottles can be disposed of in one hole (assuming 100 gm/liter U-235) with no criticality problems. Even more bottles can be placed in one hole if

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cadmium poison can be added and kept in solution in the waste.

A procedure has been outlined by H-7 (verbal communication) which will eliminate objections due to the potential migration of material when using Method 1 and Method 3. This is done by converting the solution to a sludge or a dry cake, using the facilities of Wing 9, CM Building, which are available between Rover operations. The details of this procedure are unknown to me, but if feasible, the whole disposal problem will be greatly simplified.

Note: Wing 9 is not available for this operation - see meeting notes dated November 2, 1961.

Method 2. Calculations using the QAD 704 code (N-2) show that a homogeneous mixture of 60 curies of one-month-old fission products and concrete in a 55 gallon drum gives maximum gamma dose rates of between 40 and 92 r/hr at the top surface of the drum. Not only do these levels require elaborate and large handling and transporting equipment, but some chemistry (dilution or neutralization) is required before stable concrete can be made. A large chemical hot cell would be needed. At these levels of activity this method has very little merit.

Method 3. A one-liter bottle surrounded by one inch of lead and centered in a 55 gallon drum of ordinary concrete should measure approximately 95 mr/hr-curie at the surface of the drum; two inches of lead should give 20 mr/hr-curie; and iron-loaded concrete around two inches of lead should give 3 mr/hr-curie. The above methods would provide suitable radiation protection for shipping for 2, 10, and 65 curies respectively. More than one inch of lead does not seem practical to me, and iron-loaded concrete is troublesome; therefore, the method is limited to about 2 curies/drum. Packaging could probably be done by semi-remote techniques, although a hot cell would be preferable. Objections due to the corrosive nature of the solutions would still stand and perhaps be even more pronounced.

Method 4. Tank farming or lengthy storage of waste material is not advisable, and this method will not be considered further.

Disposal Site:

Without duplicating expensive equipment or providing heavy portable shields, Method 3 appears to be the only method for disposal at NTS; however, the number of drums at 2 curies/package is very large for disposal at NTS. In addition, one is rather nervous about shipping liquids of this activity and corrosiveness. If the corrosive problem can be solved, as in the H-7 proposal, Method 3 would be quite acceptable for disposal at NTS if the cost of transporting many durms is not prohibitive.

For disposal at LASL, Method 1 is certainly the most expedient, if people concerned with the eventual leakage of the disposal package can be satisfied. Solidification of the waste should make this method acceptable to all.

Summary:

1. Disposal at LASL vs. NTS hinges primarily upon the dangers involved in transporting for long distances solutions of radioactive materials which are highly corrosive and possibly explosive. This hazard disappears if the material can be solidified or neutralized. Method 3 is then the method of choice for NTS, provided a large number of drums can be handled.

2. If solidification or neutralization cannot be accomplished, the method of choice (at least for the next few reactor experiments) is Method 1, using the best available container and some absorbent packing.

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