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Preliminary Draft

Proposal for ^{238}Pu Storage

8/21/73

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J. Herceg, H-8

1492
General

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(Herceg)
Preliminary Draft

12078

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3/21/73
J. Herceg

Drum in Cask Concept for ^{238}Pu Storage

I. Engineering

Reinforced concrete cask with asphalt coating as per Fig. 1. To be placed in trench as per Fig. 2. Drums could be slid into cask with cask in horizontal position and cask subsequently stood in trench by lifting with nylon harness just under bell. Alternative would be to stand cask in trench and insert drums by means of some sort of grabber which works similar to ice tongs. In either case, lid could be set in place while cask is in trench.

Problem areas:

a. Bottom of cask is cast after cylinder has set but still green. Differential shrinkage will probably result in small crack around inside of bottom. Proposed to fill with thin grout. Other possibilities are asphalt, epoxy.

b. Some question concerning structural integrity of bottom.

c. What is best material for sealing of top to container? Possibilities are mortar (grout), asphalt, epoxy.

d. Need to define details of handling procedures.

Comments:

Supplier has agreed to build prototype for testing. Propose the following two tests as minimum:

a. Place two water-filled 30-gallon drums in cask and pick up to simulate normal handling. If successful, this

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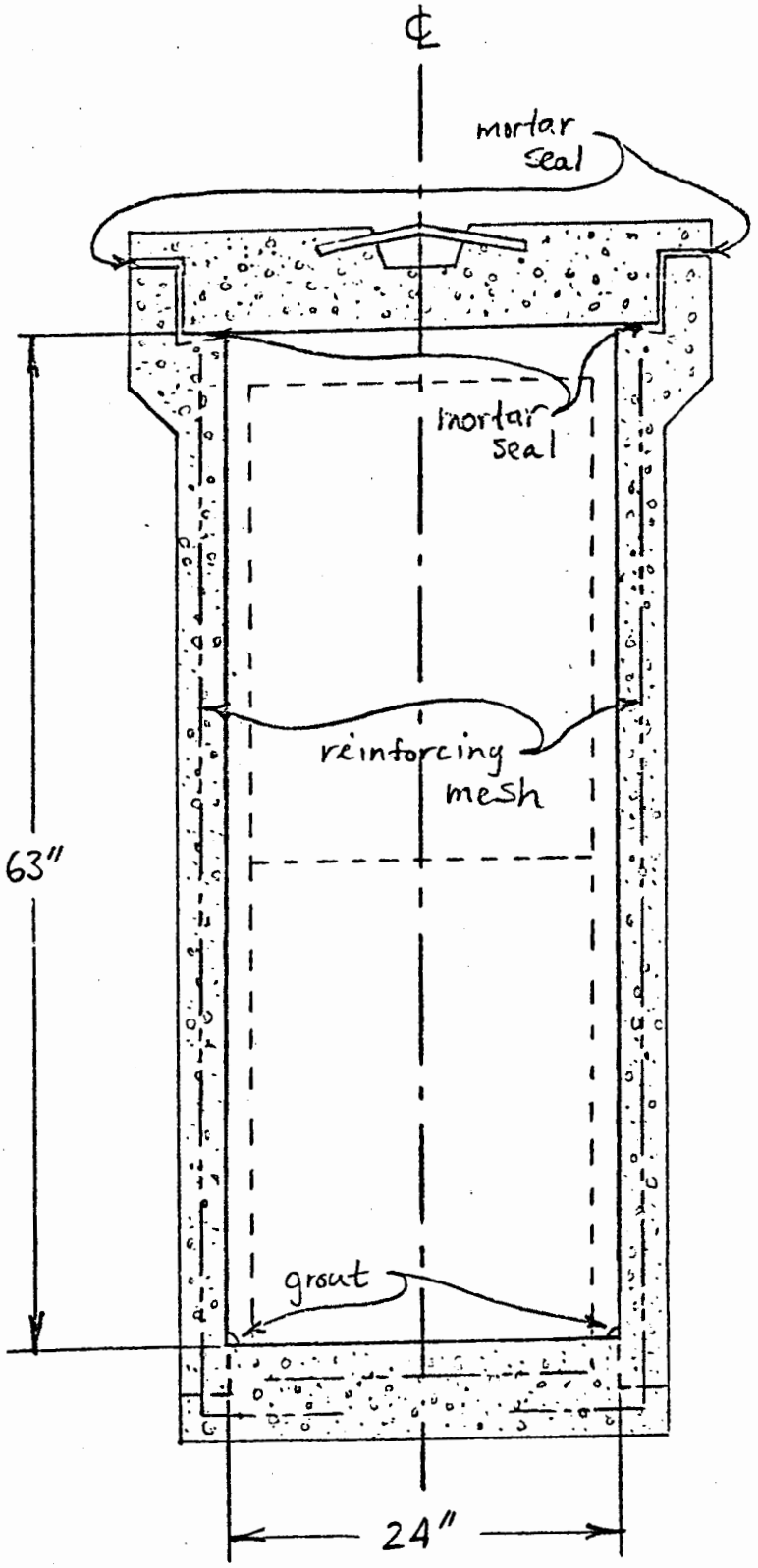
Section at Center of Cask



Scale: 1" = 1'

Concrete Cask
(1 req'd per 2 drums)

Dimensions nominal:
24" diam x 64" long
clear volume
3" wall thickness
Cast reinforced concrete
~ 5000 psi compression
Reinforcing mesh:
Longitudinal:
#6 6" o.c.
Circumferential:
#6 2" o.c.
Bottom cast integrally with longitudinal reinforcing folded into bottom. Grouted around edge. ~ 6" thk.
Top cast separately with flush lifting hook. Mortared in place. ~6" thk.
Asphalt coating on cask exterior but not on lid.
Weight ~2500 lb empty
Price ~$100 ea.

Fig. 1.

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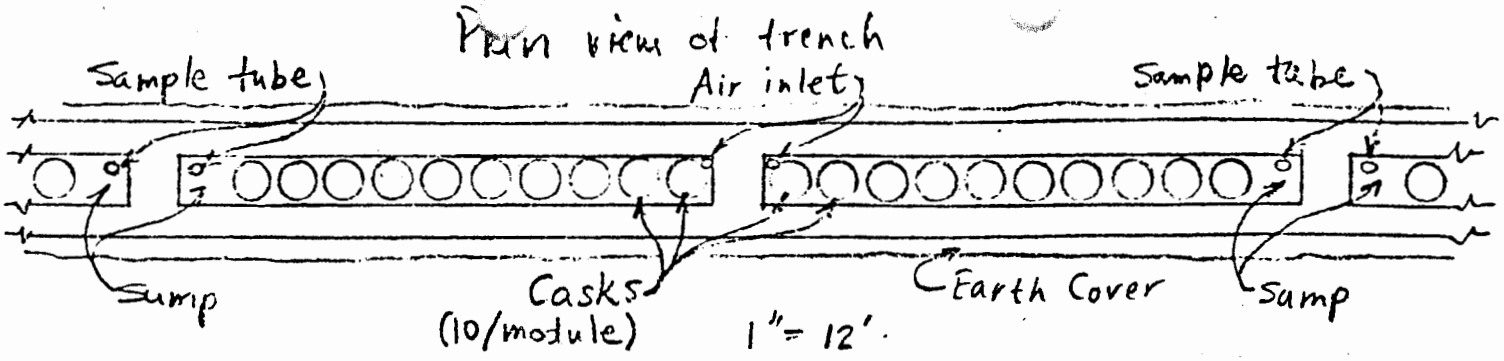

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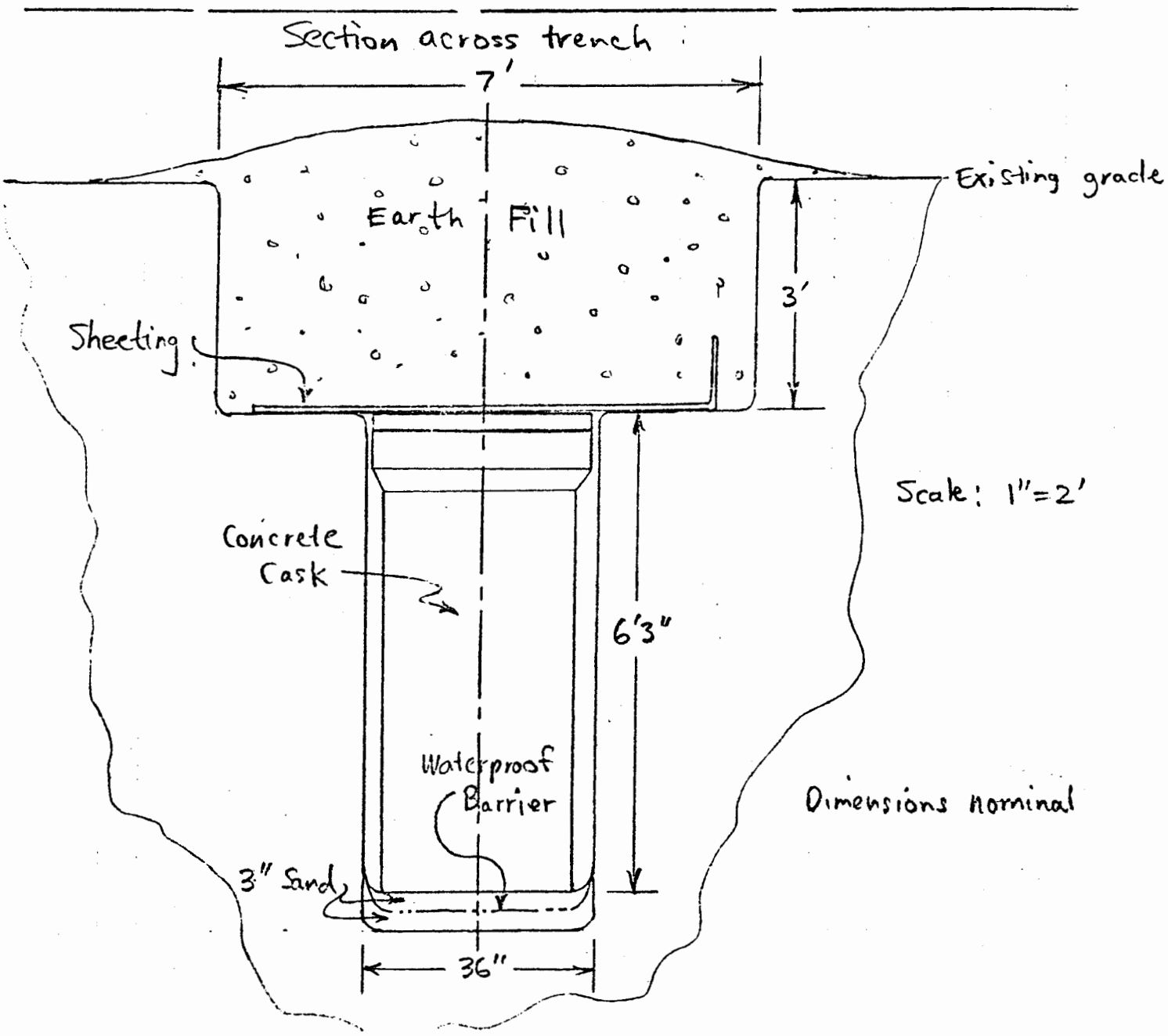

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Fig 2.

will verify structural integrity of bottom and proposed handling procedure.

b. Fill cask with water. This will provide ≈6½' of head to test tightness of bottom joint.

Need to ascertain what Quality Assurance steps need to be taken by ENG Dept. to make sure that all casks will pass these tests.

II. Costs

(H-8 estimate. Cost of casks per phone quotation from Hydro Conduit Corp. of Albuquerque.)

Preparation of trenches	$ 4,000
(Excavation, covering bottom surface, separation of modules by either block barricades or discontinuities in trench.)	
Casks (250 req'd. for 500 drums)	25,000
(Reinforced concrete, with lid, asphalt coated.)	
Emplacement of wastes	3,750
(1.5 man-hr/cask at $10/man-hr.)	
Covering of trench	3,000
(Waterproof sheets over casks, backfill.)	
Monitoring	7,500
(Sample tubes, collection equipment, sample collection and analysis time for 2-yr operations - present accumulation of 300 drums of wastes plus 2 yr at rate of 100 drums/yr.)	
Total cost	$43,250

Comments:

Subject to verification of Estimating Section of ENG Dept.

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III. Risk

1. Handling: Seven drums with highest ^{238}Pu loading (18.4 - 38.7 g) of previously packed drums were measured for total (n +γ) dose rates at surface. Average for random placement of detectors was 12.2 mRem/hr with a range of 7.3 to 23. This is subject to some fluctuation, however, as one particular location adjacent to one drum gave a measured neutron dose rate of 100 mRem/hr. Radiological hazards during handling seem to be rather nominal, even for this extraordinary case.

2. Accident during storage: Analysis of one incident in which pressurization of a friction lid-type can resulted in loss of containment and subsequent spread of contamination indicates that perhaps 10^{-4} of the hazardous material becomes airborne and escapes the container. The uncertainty in this estimate is probably an order of magnitude in either direction. Taking the conservative estimate of 10^{-3} and applying it to each of 3 containment levels (drum, cask, burial; we take no credit for containers inside the drum) we estimate a release fraction of 10^{-9}. Note that for this fraction to escape, all 3 levels of containment must fail. Assuming worst case weather conditions (stable - $\sigma_\theta \approx 2.5^\circ$, speed 2m/s) and standard radiological health constants, the 50-yr dose commitment to a resident of White Rock, some 2500 m distant, would be ~0.9 mRem to the lung (insoluble ^{238}Pu) or ~30 mRem to the bone (soluble ^{238}Pu) from the release of 40 g of ^{238}Pu through the three levels of containment.

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3. Environmental: Literature on transport of Pu through unsaturated soil is scarce (it is very unlikely that soil below or beside casks will ever become saturated, and sheeting above casks gives added protection in that direction.) Available information (mostly from Hanford) indicates that:

a. Pu diffuses about 8.5 cm in 2.5×10^4 yr. How does Soil compare

b. Less than 0.1% is leachable by groundwater once sorbed on soil particles. Provided no polymerization or complexing.

c. When carrier is a fluid, rate of Pu migration is 10^{-4} times the fluid velocity.

It seems unlikely that ^{238}Pu will get into the environment in any appreciable quantities.

Problem areas:

1. Handling: need to define details of handling and assess results of damage to cask incurred during handling.

2. Accident: Release mechanisms not clearly understood:

a. Radiolytic gas evolution rate - sufficient to pressurize cask and cause damage to it? Need to vent cask?

b. Production of HCl from radiolytic or thermal decomposition of PVC - sufficient to breach containment of cask? Should we consider some method of neutralization?

c. Heat problem - use something other than vermiculite as packing material?

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d. Mositure from within and without - put dessicant inside cask? What is best sealant or coating, asphalt, epoxy, mortar? Apply to inside as well as outside? We should check asphalt.

e. Packaging - do containers, e.g., 30-gallon drums, paint cans, etc., inside cask perform any valuable function? YES, i.e., do we need them? YES

3. Environment: Need more data on transport mechanisms.

Comments:

A-412 and F-651 Programs may be able to provide some information pertaining to questions raised in 2. and 3. above. Examination of containers removed from drum containing 38.7 g ^{238}Pu by CMB-11 (4 cans, ~10 g/can) revealed the cans to be in very good condition after 1 yr of storage. Temperature of can (at surface, in vermiculite) was ~50°C. Further investigation by CMB-11 should provide more information.

IV. Monitoring

Monitoring program would consist of 4 phases:

a. Grab sample of air from each 10-cask module on a quarterly basis. Suggested scheme is similar to that used in H-8 environmental air sampling network: pump air from sampling tube with vent open (note: pipes closed at all other times) at ~200 l/min for a period of 1 day to 1 wk. Particulate filter to be measured for gross-α activity with

check for NCl, N_2? increased CO_2?

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more detailed analysis (α-spectroscopy) if necessary.

b. Collect whatever water may have accumulated in sump at same time air grab sample is collected. Measure for gross - α with more detailed analysis if warranted.

c. Soil sample from vicinity of each module annually. Analyze for gross - α with more detailed analysis if necessary.

d. Continuous weekly air sample collected in area. Same as H-8 weekly air sample with same analyses. See LA-5184 for details.

V. Schedule

a. Fabrication of prototype cask within 2 wk. ?

b. Initial procurement actions concurrent with fabrication of prototype.

c. Production of 150 casks within 45 days of placement of order.

d. Preparation of trenches and completion of analysis concurrent with production of casks.

e. Possibility of temporary placement of drums in trenches pending arrival of casks needs more study.

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