Cover Sheet for a Hanford Historical Document
Released for Public Availability

Released 1995

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute

Battelle

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED
## File Designation

**300 N**

## Title

**TASK I NUCLEAR SAFETY STUDY**

## Author

**W. N. Mobley**

---

### Route To

<table>
<thead>
<tr>
<th>Payroll No.</th>
<th>Location</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>4086</td>
<td>226</td>
<td>JD</td>
<td>8/24/51</td>
</tr>
<tr>
<td>13059</td>
<td>326</td>
<td>W. Kepluch</td>
<td>8/26/51</td>
</tr>
<tr>
<td>525</td>
<td>326</td>
<td>C. L. Brown</td>
<td>JUL 2 1959</td>
</tr>
</tbody>
</table>
DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, make any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.
This document consists of restricted data as defined by the Atomic Energy Act of 1954. The transmittal of this disclosure of any manner to an unauthorized person is prohibited.

J. H. Warren
Manager
Separations Section

TASK I NUCLEAR SAFETY STUDY

SUMMARY

A study of the Nuclear Safety aspects of Task I has revealed that at the production rate of 600 grams of plutonium per batch, the degree of certainty that criticality will not be reached in the Hood 5 supernatant hold tank (SNHT) is below the HAP0 "criterion". This "criterion" is best explained by describing how, under past operating conditions, the SNHT limited the average size of the runs routinely processed through the Task.

The Engineering Department calculated for each vessel in Task I the minimum amount of product required under ideal conditions for the tank to reach criticality. Considered in these calculations are tank size, geometry, shielding, MWD/T, plutonium concentration, etc. The SNHT has the smallest criticality of all Task I vessels, a value of 630 grams of plutonium. From these calculated criticality values, each vessel was assigned an operating batch limit, usually about 50% of the criticality value, under which the tank must be operated at all times during routine production. The criticality values and batch limits for each vessel in the Task are then considered together with the tank functions and the general operating system to determine the size of batch that can be processed safely with a degree of certainty. The certainty "criterion", established by the HAP0 policy, states that criticality must not be reached in any vessel after two (but not three) simultaneous operating mistakes and/or equipment failures occur. Task I was initially designed to operate at a batch size of 600 grams of plutonium, the limiting factor being the SNHT.
Even though Task I was designed to operate at a 600 gram batch size, it was found that the supernatant transfer system would not meet the "two-mistake" criterion. It was possible, through two operating errors and/or equipment failures, for enough plutonium to be introduced into SNHT to exceed the 630 gram criticality. When this situation was recognized, production through Task I was discontinued pending corrective action. Changes were made which permitted production to be resumed at a 400 gram batch size. Additional safe-guards were later inaugurated whereupon the batch limit was returned to 600 grams.

FALLACIES IN THE SUPERNATANT TRANSFER SYSTEM

The schematic diagram in Figure 1 shows the general arrangement of the plutonium processing hoods in Task I. The supernatant hold tank (SNHT) in Hood 5 is the only tank where the criticality limit could conceivably be exceeded at the present production rate. This tank functions as a waste receiver for solutions to be transferred to RC Cans for loadout or to Recuplex (G-36 Tank) for recovery. All four SNCT's connect directly to SNHT through a common header.

The criticality value for SNHT is 630 grams of plutonium and the operating limit is 250 grams. Since the batch sizes received from Redox range between 550 grams and 650 grams of plutonium, it is conceivable that as much as 650 grams of plutonium could be introduced into SNHT singly or additively. Examples of errors that might be involved are given below:

1. An entire 700 gram run could be introduced into SNCT through an operating error and/or valve failure and a second mistake could introduce the run into SNHT.

2. An incorrect supernatant analysis could cause more than 250 grams of plutonium to be introduced into SNHT unknowingly. The present supernatant kill procedure is not 100% reliable and occasionally, plutonium oxalate solids in the supernatant do not dissolve. The sample taken of this solution for plutonium assay will thus give an erroneous result. It is also possible for the supernatant when transferred to the SNHT to pick up a small plutonium heel left from a previous run.

3. Leaking valves between SNHT and the four SNCT's could cause more than one supernatant solution to be drawn into SNHT.

IMMEDIATE ACTION TAKEN TO INSURE NUCLEAR SAFETY IN SNHT

Action taken to date and planned for the immediate future to make certain that criticality limits are not exceeded in SNHT include the following:

1. To Neutralize Valve Failure

   Vents have been installed above each SNCT such that if any or all valves between SNCT and SNHT leak or fail, either during a regular transfer or while all SNCT's are charged, it is not possible for the supernate to be drawn unknowingly into the SNHT.
2. To Increase The Reliability of the Plutonium Assay

Two independent samples instead of one are being taken on each supernatant solution prior to transfer to SNHT. No transfer to SNHT is made until both analysis are received and approved by the operating supervisor.

3. To Lessen The Possibility of an Operating Error

Locks have been placed on the switches that operate the valves between each SNCT and SNHT such that a supervisor is required to insert a key before a transfer to SNHT can be made.

4. To Minimize Product Pick-Up

Heels remaining in the reactor systems (Hoods 1, 2, 3, & 4) will be kept below 250 grams of plutonium. Also, the volume reading in SNCT will be taken prior to sampling and immediately prior to transfer to SNHT to insure that solution from an external source has not been introduced in SNCT while the supernatant was being held for laboratory results.

5. To Avoid The Possibility of Feed Entering SNCT

A run will not be brought into any THT until the supernatant of the run immediately proceeding it is "killed" and sampled. (After sampling, vacuum application to SNCT terminates.)

6. To Monitor Solutions of Unknown Concentration Destined For Recovery

Solutions brought into Task I for recycle or loadout will enter an SNCT instead of the SNHT. This line change is now in progress. While in the SNCT the waste solution will be sampled and held until the analysis is returned and approved by the operating supervisor.

7. To Increase The Criticality Value For The SNHT

The lead glass shielding around the SNHT is to be removed. It is estimated that this change will increase the criticality of the SNHT from 630 grams to about 750 grams and thus increase the margin of nuclear safety.

FUTURE ACTION TO BE TAKEN

The study of the nuclear safety aspects of Task I is to be continued. Additional nuclear safeguards are planned for the future to increase the margin of safety and to permit the operating batch size to be increased. These changes if required, should be in effect prior to January 1956.
They include:

1. To determine and initiate a more reliable supernatant kill procedure for Task I. This change will increase the degree of reliability that can be placed on the supernatant assay.

2. To determine the feasibility of installing a subcritical tank in place of SNHT. This change cannot be economically justified at this time and at the 600 grams batch production rate it is not needed. If the batch size is increased to between 800 and 1000 grams of plutonium next year, however, the installation may be justified.

W. N. Mobley
Superintendent
Z Plant

WNM/CL Brown/Jab
Schematic Diagram of Task I showing basic equipment arrangement, piping, valves, and the nuclear safety limits for each vessel.

**DECLASSIFIED**

Hoods 2, 3 & 4 have the same equipment and piping arrangement as Hood 1; furthermore, all four SNCT's connect to the SNHT through a common header.

**LEGEND:**
- **C** - Calculated critical mass in grams of plutonium.
- **EBL** - Batch limit set by the Engineering Department.
- **MBL** - Batch limit observed by the Manufacturing Department.