DISTRIBUTION

1. T. W. Ambrose
2. G. E. Backman
3. J. P. Duckworth
4. O. H. Greager
5. W. A. Haney
6. P. C. Jerman
7. F. E. Owen
8. O. C. Schroeder
9. 300 Files
10. Record Center

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, makes 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.

This document consists of
3 pages. No. 9 of
10 copies. Series A.

This document classified by:

P. Jerman

December 11, 1963

DECLASSIFIED

Classification Cancelled and Changed To

DS A-1 1-03-94
By Authority of DS A-1 1-03-94
PR 24
By MS A-1 1-06-94
Verified by DS A-1 1-7-94

RADIOLOGICAL ASPECTS OF
DISSOLVING IRRADIATED Li-Al

INTRODUCTION

If a metal shipment from the reactors to a chemical processing plant contained irradiated Li-Al pieces, there would be a release of tritium during processing.

Two situations were analyzed -- one where a single piece is inadvertently mixed in a bucket of irradiated uranium metal pieces, and the extreme case where three buckets of Li-Al instead of uranium are sent in a regular well car shipment. One piece contains about 600 curies of H^3 and three buckets of 585 pieces each would contain a total of about 10^6 curies.

SUMMARY

Release of tritium from Li-Al pieces in the CPD irradiated uranium metal dissolvers would occur during the caustic coating removal step. About 10^6 curies are available in three buckets of metal, which could potentially cause (1) exposure of plant personnel up to 1 rem during sample handling or from inhalation of stack gases, (2) exposure

MASTER

DECLASSIFIED

DISTRIBUTION RESTRICTED TO U.S. ONLY

RECEIVED
MAR 08 1994

DECLASSIFIED

HW-79944
Page 2

of off-site personnel up to 50 mrem, (3) a five per cent increase in ground water tritium, and (4) some restriction on possible future handling of the contents of an underground coating waste storage tank. It is not believed any occupational or general public exposure limits would be exceeded. It would probably exceed an operational atmosphere release limit recommended by RPO, HL, of an average of 2000 curies per week per plant, which is 10^5 curies in a year. Investigation and evaluation of the situation would no doubt cause a great deal of concern. The involvement of one Li-Al piece would create no problem of radiological concern.

DISCUSSION

The extreme situation, dissolution of three buckets of Li-Al, will be discussed here. From discussions with J. P. Duckworth, Purex Process Engineering, CPD, W. A. Harey, Chemical Effluents Technology, HL, and G. E. Backman, Radiation Protection Operation, HL, the following conclusions were reached.

All of the Li-Al would be dissolved during the five-hour caustic coating removal step in the chemical processing plant dissolver releasing the tritium. Release would not start for about a half hour until the jacket had been penetrated. It would peak within the first hour when the maximum Li-Al surface area is exposed. At Purex, a dissolver is charged with 12-15 buckets and at Redox nine buckets, assuming that three of these are Li-Al, Redox will have the more concentrated solution. Possibly at Purex and almost certainly at Redox, the coating waste would end up a gelatinous mass because there will not be enough excess caustic to hold the Al in solution. This would probably be the first clue to such a situation.

Chemical Effluents Technology has found about 60 per cent of the tritium from irradiated uranium metal processing ends up in the ground water. Their analysis of the stack gases shows that about three per cent of this tritium goes out the ventilation stack. This leaves about 37 per cent of the H^3 unaccounted for. Laboratory experiments at Oak Ridge indicated that about 75 per cent stays in the liquids and 25 per cent goes with the off-gas. There is some doubt as to its form, gas (H_2^3) or oxide (HTO). The gas will rise and disperse in the upper atmosphere, while the oxide becomes a homogeneous part of the water and water vapors with which it makes contact. The oxide case would cause the most hazardous consequences, so it is assumed that all the tritium is in the oxide form.

In considering how the tritium oxide will manifest itself from the coating wastes, it is assumed that 75 per cent, about 8×10^5 curies, of the activity remains in solution and 25 per cent leaves as an HTO vapor. This would mean a maximum concentration of 0.11 curies/cc in Redox coating waste.

The volume of coating waste samples taken for laboratory analysis varies from 1 to 5 cc. This amounts to 100-500 millicuries of tritium as compared to a 1 millicurie maximum permissible body burden (MPBB). A single ingestion of 1 mc of H^3 would cause a whole body exposure of about 90 mrem. The process operator and laboratorien who take and analyze the sample could ingest some tritium oxide through inhalation or contact with the liquid or vapor. Because semiremote

handling methods and waterproof gloves are used, it is hard to imagine any contact exposure except through an accidental spill. Ingestion could occur through inhalation of vapors from an open sample container, however there would be considerable dilution before inhalation because of the well-ventilated facilities. Under the worst conditions, it is hard to imagine a person being able to ingest as much tritium as there is in 0.1 cc of a sample. This would amount to about 10 mc H^3 , which on a single ingestion would cause about 0.9 mrem whole body exposure.

Coating waste is stored in an underground nonboiling tank so it would end up containing the 8×10^5 curies of tritium. This would have to be considered in any future handling of the contents of this tank, such as volume reduction by evaporation or cribbing supernate. Environmental Studies, RPO, HL, recommends restricting release of tritium oxide to the atmosphere from one plant to less than 10^5 curies per year (2000 curies/week). Cribbing the supernate would add the tritium activity to the ground water, which would more than double the present ground water level. The ground water limit has not been defined yet; but, serious consideration would have to be taken if such a case should present itself.

Some of the liquid would remain behind when the coating waste is jettied from the dissolver. This is estimated at two per cent, representing 1.6×10^4 curies of tritium. If the situation is not discovered until after the metal dissolving cycle is complete, then the tritium will be dispersed through the process solution and will end up in the ground water via the other waste streams. This would increase in ground water tritium activity less than five per cent.

Assuming as much as 25 per cent of the available tritium escaped via the ventilation stack as HTO , this would mean 2×10^5 curies to the atmosphere. Under the worst meteorological conditions, it could mean an exposure to an individual at the plant up to 1 rem. This would then approach our operational whole body limit of 1 rem per badge period. Offsite this might create an exposure of up to 50 mrem, which is below one-tenth the standard occupational limit of 3000 mrem.

Detection and evaluation of tritium is not a normal routine function performed for the chemical processing plants. Specialized procedures would have to be adopted to be able to perform the necessary evaluations. Investigation of the amount and extent of exposure created by the foregoing condition would be difficult and create much concern.

CONCLUSIONS

One incident during a year involving the dissolving of three buckets of irradiated Li-Al would probably not exceed any radiation protection standard limits, either for those occupationally exposed or the general public. The situation would not be desirable and operational control limits would be taxed and possibly exceeded. Dissolving of one Li-Al piece would not create any radiological problems.

J.E. Owen

Radiological Engineering Unit
Research and Engineering Section
IRRADIATION PROCESSING DEPARTMENT

DECLASSIFIED

DATE

FILMED

14 / 14 / 94

END