

United States Government

Department of Energy

Oak Ridge Operations

memorandum

DATE: January 11, 1989

704796

REPLY TO

ATTN OF: SE-334:Cooper

SUBJECT: HEALTH PHYSICS REVIEW OF UNUSUAL OCCURANCE REPORT 88-10-CT-88-2

TO: J. A. Lenhard, Assistant Manager for Energy Research and Development, ER-10

Attached is a draft inspection report from an inspection conducted by W. T. (Bill) Cooper of my staff on December 27 and 29, 1988, and January 3, 1989. The inspection was conducted to review the circumstances surrounding a contamination incident occurring in ORNL Building 3038.

Please transmit this draft report to ORNL and request they review it for factual accuracy. Also, please request that they respond with the immediate actions they will take to address the concerns related to initiation of radiation work permits and the controls they plan to establish for access to very high radiation areas.

After receipt of ORNL comments, we will issue the report in final form for your transmittal to the contractor. At that time we will request that they respond to each recommendation within 30 days.

Questions or comments concerning this matter should be directed to Bill Cooper on 6-0833.

David B. Howard
David B. Howard, Director
Safety and Health Division

9410.2.3

Attachment:
As stated

cc w/attachment:
L. Derderian, HQ, GTN, EH-342
D. R. Brown, ER-112 (COTR) *ok*

REPOSITORY DOE-FORRESTAL
COLLECTION MARKEY FILES
BOX No. 3 of 6
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SUMMARY

Scope: On December 27 and 29, 1988 and January 3, 1989, an ORO health physics inspection was conducted to review Unusual Occurrence Report (UOR) number 88-10-CT-88-2 and the circumstances surrounding the contamination of personnel and areas in the vicinity of Building 3038 at the Oak Ridge National Laboratory (ORNL). The inspection was also conducted to assess the adequacy of the ORNL actions in addressing the incident. The inspection consisted of interviews with selected personnel, reviews of applicable procedures and records, facility tours, and reviews of ORNL internal documents related to the incident. The contamination incident and subsequent UOR documentation were discussed in detail with contractor representatives.

Results: In the areas inspected, eight concerns and associated recommendations were identified in the areas of (1) health physics review of site procedures; (2) health physics controls established for ORNL operations; (3) UOR program documentation; (4) site-wide compliance with health physics procedural requirements; (5) adequacy of corrective actions established in the UOR; (6) establishment of effective controls to prevent a recurrence; (7) controls established to prohibit access to areas with whole body dose rates in excess of two rem per hour.

REPORT DETAILS

1. PERSONS CONTACTED

Contractor Employees

H.M. Butler, Environmental Compliance and Health Protection Division

M.W. Kohring, Office of Operational Safety

H.B. Piper, Office of Operational Safety

J.R. Slaten, Area Health Physicist

R.A. Underwood, Health Physics Technician

J.S. Wike, Special Projects Supervisor

2. INCIDENT DESCRIPTION

Following is the contractor's account of the contamination incidents occurring at ORNL on November 10, 1988. This information has been excerpted from the investigation report published by the Management Review Committee (MRC) which was established to investigate the contamination incident. The report was forwarded to J.R. Hightower by D.W. Ramey on November 18, 1988.

On Thursday, November 10, 1988, radioactive waste transfer operations were conducted in the Yttrium-90 (Y-90) "hot lab" in Building 3038. Hot cell solid waste [Strontium-90 (Sr-90) and Y-90] was placed in one

gallon metal containers, which were removed from the cell, bagged, and placed in one of three thirty gallon garbage cans. Each garbage can was loaded with two of the one gallon cans. Due to the high radiation levels at the exterior of the garbage cans, they were not smeared for loose contamination. However, the cans were bagged and the bags were subsequently sealed. An additional garbage can was used for waste from the Y-90 glove box/hood operations. However, this fourth can was not bagged.

The liquid low-level waste (LLLW) drains for the Y-90 hot lab cells have been capped off since 1985 due to a breach in the integrity of the underground drain lines. The lack of an operable LLLW drainage system has eliminated the provision to wash down contaminated equipment in the cell and maintain cell contamination levels under proper control. The high cell contamination levels result in a significant contamination risk whenever operations such as waste transfer and product removal are conducted.

All four cans were removed from the hot lab to the north end of Building 3038 through a door which is normally used only for material transfer. The three bagged garbage cans were individually placed on a dolly and moved across the street to a lead-lined dumpster located in Building 3118. The fourth can, which was not bagged, was hand carried by an employee wearing a standard lab coat and company shoes. The transfer operation was complete by mid-afternoon (1400 - 1500 hours).

Contamination levels were first noticed by an employee working in the Building 3038 shipping area which is adjacent to, but not accessible from, the Y-90 hot lab. Prior to leaving the shipping area, the operator had frisked his shoes and found them to be clean. He then drove a company truck from the area north of Building 3038 to Building 3026C and later returned with the same truck to Building 3038. Following several activities within the shipping area, he checked his shoes and discovered that the right shoe was contaminated. He immediately informed the building health physicist (HP) whose shoes were also found to be contaminated.

The HP had been involved with the waste transfer operations inside the hot lab where shoe covers had been worn. He had frisked his shoes prior to exiting Building 3038 through the east door (the normal exit path) and found them to be clean. Following a brief period of time in Building 3037, he walked down the road along the north end of Building 3038 to the HP office adjacent to the shipping area at some time apparently after the waste had been transferred to the dumpster.

At this point (approximately 1500 hours), all personnel who had been in the area were checked for shoe contamination and extra HPs were contacted to assist in determining the extent of the area contamination. In all, the shoes of six persons were found contaminated to varying levels. They included two operators and the supervisor of the shipping area, two P&E personnel, and the Building 3038 HP. None of the personnel involved in the transfer of material

(with the exception of the HP) were found to have contamination on their shoes. A search for the source of the contamination revealed the following:

- Floor surfaces within the shipping area were found contaminated up to 27,000 disintegrations per minute (dpm) beta-gamma transferable;
- An area of the floor inside the Building 3038 shipping area airlock was found contaminated to 160,000 dpm beta-gamma transferable;
- Areas of the street outside the shipping area were found contaminated up to 60 millirads per hour (mrad/hr) as measured by a portable Geiger-Muller survey meter;
- The floorboard and pedals inside a company truck (E-9142) were found contaminated to low radiation levels; and
- Within areas visited by two employees who used the truck (Buildings 3026C and 2000), a few areas were found to be contaminated to low radiation levels.

All contaminated surfaces (including the street and shoes) were decontaminated to levels that required no further action.

Later in the afternoon (about 1600 hours), the employee who carried the unbagged garbage can to the dumpster detected beta contamination on one side of his lab coat (the same one worn during the waste transfer operation). A sample of the contamination from the smears taken was analyzed and judged to be from a high-energy beta emitter like Y-90 or Sr-90. In addition, subsequent counting operations performed on the shipping area airlock smear read 190,000 dpm on November 11 and 244,000 dpm on November 15. These readings are indicative of the exponential activity increases expected following a Y-90/Sr-90 separation.

Management Review Committee Conclusions

The method of deposition of the contaminant on the street north of Building 3038 has not been determined. However, based on the fact that the contaminants are Y-90/Sr-90 isotopes and the order of activities in that area, it is likely that the contamination was tracked into the 3038 shipping area from the street. In addition, the process used for the waste transfer operation and the employee's contaminated lab coat strongly suggest that the waste from the Y-90 hot lab was the source of the street and shoe contamination discovered in the Building 3038 vicinity.

Management Review Committee Recommendations

The following recommendations were made by the MRC as a result of their investigation into the incident.

1. The Building 3038 Y-90 Laboratory is desperately in need of a LLW drainage capability. Continued use of the hot cells in the present configuration offers a high potential for the spread of contamination every time transfer operations are carried out. A high priority should be placed on modifying the lab to accommodate the rinsing of hot cell equipment prior to transfer operations.
2. Transfer operations should not be conducted until appropriate procedures are developed and approved to adequately contain the spread of contamination. In addition, a Radiation Work Permit (RWP) should be in place prior to future hot cell waste transfer operations.
3. Facility management should consider methods to reduce the background radiation levels in the Y-90 laboratory to enhance the effectiveness of personal radiation monitoring activities.
4. To prevent contamination of personal clothing, a determination should be made concerning the type of clothing that may be worn in the laboratory, especially during waste handling operations.

3. ORO REVIEW OF THE BUILDING 3038 CONTAMINATION INCIDENT

On December 28 and 30, 1988 and January 3, 1989, the inspector interviewed contractor personnel and conducted tours of the facilities involved in the contamination incident. On January 5, 1989, the inspector requested a survey of the areas on top of the cell in Building 3038, the results of which were provided by the contractor on January 6, 1989.

ORNL Health Physics Procedure (HPP) 1.1A, "Responsibilities for Radiation Safety," paragraph 5(b), required work to be stopped if it appeared likely to result in unnecessary contamination of the facility or equipment. Statements made in the UOR and by cognizant contractor personnel indicated that the potential for significant contamination risk related to the handling of solid waste and product removal from the Building 3038 hot cell had been recognized soon after the cell drain lines were capped due to a breach in system integrity in 1985. Since the drainage system for the cell was capped off, liquid decontamination of the cell and items removed from the cell has not been accomplished. Repair/replacement of the drainage system is currently identified as a FY 1991 budget line item. The inspector identified the failure to stop work when the potential for unnecessary contamination of the facility was recognized as an apparent nonconformance with HPP 1.1A.

HPP 1.1A, paragraph 9, required the development of written procedures

for the safe execution of operations, which were approved by the Division Director. HPP 4.1, Handling and Transfer of Radioactive Materials Within the Laboratory, required that handling of significant quantities of radioactive materials prior to transfer be done in accordance with approved operating procedures. Recommendations made by the MRC and interviews with contractor personnel substantiated the fact that no procedures were in place for the safe conduct of this operation. Further, contractor management stated that nothing special was done during this operation and that the operation was considered routine. The inspector stated that HPP 4.1, did not differentiate between routine and non-routine tasks, but appeared to require the level of control to be commensurate with the hazard involved in the transfer of material. The inspector identified the failure to develop and implement written procedures as an apparent nonconformance with HPP 1.1A. Interviews with contractor personnel on January 3, 1989, indicated that operations procedures addressing this process were under development. However, no implementation date for the procedures was provided to the inspector by the contractor.

HPP 1.1A, paragraph 10, required that hazard evaluations be prepared for all operations involving significant quantities of radioactive materials or other sources of ionizing radiation. Interviews with cognizant contractor personnel indicated that no health physics hazard evaluation had been performed for the conduct of waste transfers and product removal from the Building 3038 hot cell since the drains were capped in 1985, even though this constituted a significant change in

the facility's ability to control the potential spread of contamination. However, an annual review of the facility safety parameters was conducted by the Office of Operational Safety through the Safety Analysis Report process where the operations in the SR-90/Y-90 hot cell were discussed. The Radioactive Operations Committee (ROC) reviewed the situation in the Building 3038 hot cell area in their 1986 report and noted that the loss of LLLW drainage capability impacted ORNL efforts to maintain exposures as low as reasonably achievable (ALARA). In 1987, the ROC recommended the installation of LLLW drainage capability to serve Building 3038. This recommendation was made again in the 1988 report when no action was taken in response to the 1987 recommendation. The inspector identified the failure to conduct a health physics review of the hazards associated with continued operations in the Building 3038 hot cell as an apparent nonconformance with HPP 1.1A.

HPP 1.1A, paragraph 11, required the initiation of RWPs as required for operations involving radioactive materials or other sources of ionizing radiation. HPP 3.6, Radiation Work Permits, Regulations, paragraph 1(b) required an RWP in advance of work involving the exposure of an individual to a dose rate greater than 1 rem per hour (R/hr) to the total body or greater than 10 R/hr to the unprotected extremities. Paragraph 1(d) required an RWP when specified in posted regulations governing a Radiation or Contamination Area, when specified in local operating rules and procedures, or when the radiation and/or contamination situation was not well understood.

Interviews with HP personnel involved with the waste transfer indicated that the dose rate at two inches from the one-gallon cans ranged from 40 R/hr to 100 R/hr. Contractor statements further indicated that it was generally building management's responsibility to request initiation of RWPs for work to be performed in their area. The inspector identified the failure to initiate and implement RWP requirements for the work in Building 3038 as an apparent nonconformance with HPP 1.1A and HPP 3.6. This apparent nonconformance was identified in the MRC review of the incident and one recommendation resulting from the incident required RWPs to be initiated prior to future hot cell waste transfer operations. However, product transfers were not addressed by this recommendation.

HPP 2.7 required the contractor to take certain precautions when general area dose rates exceeded 1 R/hr. These controls included erection of barriers to preclude area access and exercise of positive access control over the area in question. During tours of the Building 3038 hot cell area, the inspector noted that dose rates on top of the cell were, as a minimum, to a level of 4 R/hr from a survey conducted over a year ago. On January 5, 1989, the inspector requested that the contractor perform a survey of the areas on top of the Building 3038 cell to determine the dose rate profile. The survey, performed by a contractor HP technician, found the general area dose rates to range from 1 R/hr to 2 R/hr. Radiation streaming around the manipulator arm penetrations on top of the cell was found to be on the order of 10 R/hr to 40 R/hr dependent upon the materials

in the cell. Contact dose rates at a plexiglass shield installed to shield the operator during manipulator work were 1.5 mr/hr while dose rates at two feet were found to be 0.3 mr/hr. Posted zoning for the area included: "High Radiation Area," "Contamination Zone," "Full Protective Clothing Required," and "Respiratory Protection Required." Accepted industry practice has been to lock or otherwise control access to areas where dose rates exceed 1 R/hr, although controls at this radiation level were not established in ORNL procedures. Additional controls had not been established to preclude personnel access to this area even though the dose rates present in the area warranted such controls. In addition, the cell doors were not secured to preclude access to interior portions of the cell. It was not known to what level an individual would be exposed when accessing the hot cell doors as no surveys inside the cell had been conducted. However, it was conservatively estimated an individual would encounter dose rates well in excess of 10 R/hr, based upon the streaming observed around the manipulator arms. It was observed that the contractor had begun establishing measures to provide a locking mechanism for one of the hot cell doors. However, this modification had not been completed at the time of the inspection. The inspector identified the failure to properly control access to very high radiation areas as an apparent nonconformance with HPP 2.7.

HPP 1.1A, Environmental Control and Health Protection (ECHP), paragraph 2, required the Radiation Protection Department's Area Complex Leaders to maintain intimate knowledge of the radiation-safety

aspects of work being carried out in their area of responsibility and to currently assess the hazards of each operation. Through discussions with cognizant contractor personnel, it did not appear that this operation had been reviewed by the Area Complex Leader, nor had there been an assessment of the hazard associated with the waste transfer/product removal operations. The inspector identified the failure to conduct an assessment of the hazards associated with the Building 3038 waste transfer operations as an apparent nonconformance with HPP 1.1A.

HP management stated that they did not routinely review and concur with the health physics content of site level procedures published by other groups. This activity would appear necessary to ensure health physics controls in ORNL operations were adequately addressed and is required by HPP 1.4, Operating Procedures, paragraph 3(a). It was also noted that the health physics group acted in mainly a support capacity and did not enforce strict compliance with applicable HP procedures. Site management appeared to give the operating divisions and supervisory personnel much latitude in the implementation of health physics controls relating to their area of responsibility. Contractor personnel stated that, in some cases, they believed compliance with site HP procedures to be optional. It is DOE's position that if the operating divisions establish adequate health physics controls through their procedural framework, then elevated HP oversight for procedural compliance is not necessary. However, if health physics guidance is not provided in operations procedures,

the procedures must be revised, and the HP group must assume a proactive role to ensure compliance until such time as operations procedures are adequately established.

HPP 2.5, Radioactive Contamination Control, Responsibilities, paragraph 2(a), required all areas to be surveyed and inspected. Contrary to this requirement, smear surveys of the cans removed from the hot cell were not conducted due to health physics technician extremity dose considerations. However, the use of long-handled tools or other means to conduct the surveys was not considered. It appeared that the failure to conduct adequate surveys of the cans removed from the hot cell directly contributed to the contamination incident. The inspector identified the failure to conduct adequate surveys as an apparent nonconformance with HPP 2.5.

During ORO review of the UOR, it was noted that not all information related to the contamination incident was presented in the UOR. It was necessary for the inspector to review three documents in order to obtain the complete narrative summary of the event. Further, corrective actions established as a result of the contamination incident were not clearly described as to scope and recurrence control, nor were action items assigned to specific individuals for completion of corrective actions. Also, no proposed dates when corrective actions were expected to be completed were presented in the documents reviewed by the inspector.

4. RECOMMENDATIONS

Although the following recommendations specifically address the contamination incident at Building 3038, it is suggested that each recommendation be reviewed generically to other health physics related activities conducted at the site.

88-HP-02-01 - ORNL management should take the actions necessary to ensure site personnel are aware of the health physics requirements for work stoppage if it appears the conduct of an activity presents a significant risk for contamination of buildings or equipment.

Basis: When the drain system for the Building 3038 hot cell was capped in 1985, the operating parameters for the cell changed, i.e., it was not possible to decontaminate the cell or its contents. The inability to decontaminate this area presented a significant potential for the spread of contamination outside the hot cell containment when waste transfer and product removal type operations were conducted.

88-HP-02-02 - Other methods for decontaminating the Building 3038 hot cell and equipment removed from that cell should be evaluated and implemented prior to continuing operations in the cell.

- The proposed move of the Y-90 separation operation from its current location in Building 3038 to the hot cell in Building 3047 should be expedited.

Basis:

- The Management Review Committee stated in Recommendation 1 of their report of November 18, 1988, "The Building 3038 Y-90 Laboratory is desperately in need of a LLLW drainage capability. Continued use of the hot cells in the present configuration offers a high potential for the spread of contamination every time transfer operations are carried out. A high priority should be placed on modifying the lab to accommodate the rinsing of hot cell equipment prior to transfer operations." It was learned, during interviews conducted on January 3, 1989, that plans are under way to move the Y-90 operation to building 3047, which has LLLW capability. Expected date for the completion of this move was not noted by the contractor, but was expected to occur sometime within the next quarter. However, if it is anticipated that the Building 3038 cell will continue to be used, this recommendation should be reviewed, evaluated, and implemented.

88-HP-02-03

- ORNL management should take actions necessary to ensure that operations conducted at the site are

adequately addressed in operating procedures, reviewed and approved by the appropriate level of site management, and adequately implemented.

- Operating procedures should receive and multidisciplinary review on a routine frequency established by management. This will ensure that procedural content continues to adequately address HP requirements.
- This procedural review should be established site-wide.
- Procedures for operations having radiological impacts should receive review and concurrence from the health physics organization prior to implementation.
- Followup reviews of HP procedural compliance, conducted by HP and Operations management, should be routinely conducted and documented.
- Procedures should be of such depth so as to provide assurance that operations will be conducted safely, in compliance with all applicable DOE and ORNL requirements, and pose no undue risk to the health and safety of the workers or the general public.

Basis:

- At the time of the contamination incident in Building 3038, no operating procedures were in place which described the activities to be conducted or health

physics precautions to be utilized during waste transfers or product removal from the hot cells. ORNL Health Physics procedures clearly required this guidance be in place prior to the conduct of these operations.

- It is the operating division's responsibility to ensure that adequate procedures are developed, implemented and maintained which ensure operations are conducted in compliance with all applicable DOE Orders, Standards, and accepted industry practices.
- Health physics review of, and concurrence with, operating procedures will ensure that radiological controls are procedurally established for site work having radiological impact.
- Followup reviews by HP and Operations management will ensure that problems and weaknesses are identified and adequately addressed.
- 88-HP-02-04 - ORNL management should ensure that hazard evaluations for those activities conducted at the site, which involve significant quantities of radioactive materials or other sources of ionizing radiation, are conducted, documented, and maintained in a readily

auditable form.

- Health Physics Complex Leader evaluation of operations within their areas of responsibility, and potential HP related issues identified during those evaluations, should be documented and maintained in a readily auditable form.
- HP operational evaluations should be conducted on a proceduralized frequency established by ORNL HP management.

Basis:

- Personnel cognizant of the ORNL Health Physics hazard evaluation program stated that no analysis was performed by the Health Physics Area Complex Leader for the waste transfer and product removal operations, even though significant quantities of radioactive materials were routinely handled in this area. This conduct of this evaluation was required ORNL Health Physics procedures.
- Self identification and correction of weaknesses relating to the implementation of the site HP program forms part of the basic framework for the effective conduct and control of operations at a facility. Implementation of this recommendation would serve to further formalize the hazard evaluation program already required by site HP procedures.

- 88-HP-02-05
- ORNL management should take the actions necessary to establish a program to ensure that RWPs are prepared for control of radiological work as required by site procedures.
 - The use of RWPs for the removal of product from the hot cells should be reviewed and implemented if necessary.

Basis: During waste transfer operations in Building 3038, general area and extremity dose rates in the area exceeded the recommended levels at which an RWP would normally be required, respiratory protection was in use during the waste transfer operations, and the contamination levels present on the containers removed from the hot cell were not known to personnel working in the area. In accordance with Health Physics site procedures, conduct of operations meeting any of these conditions required the issuance of an RWP to control work activities.

- 88-HP-02-06
- ORNL Health Physics controls to restrict personnel access to very high radiation areas should be reviewed.
 - Adequate access controls which meet the intent of site HP procedures should be established.

- ORNL postings used to inform personnel of radiation hazards should be routinely reviewed to ensure they adequately reflect the hazard present in the restricted area.

Basis:

- HP postings in Building 3038, for areas on top of the cell, indicated that dose rates were measured at a level of at least 4 R/hr. Surveys conducted on January 5, 1989, indicated the presence of general area dose rates of 1 to 2 R/hr on top of the cell and streaming around the manipulators in excess of 10 R/hr. During this review, it did not appear that the controls established to restrict access to this area were commensurate with the hazard.
- Accepted industry practice dictates that areas having whole body dose rates greater than 1 R/hr (measured 18 inches from the source) should be locked, guarded, or be otherwise controlled, restricting personnel access to those areas.

88-HP-02-07

- ORNL management should ensure that all site groups are aware that the conduct of operations in accordance with all applicable DOE and ORNL HP requirements is their responsibility.
- A Policy Statement addressing health physics program

ownership should be developed and issued to all ORNL Divisions.

Basis: During the ORO review of the Building 3038 contamination incident, it was perceived that the ownership of the HP program did not lie with the operating divisions. As discussed in Recommendation 88-HP-02-10, it is DOE's position that the operating divisions have the ultimate responsibility for ensuring that all operations are conducted safely and in accordance with all applicable requirements. If the operating divisions assume the responsibility for conducting their operations in a radiologically safe manner, the HP group may assume the advisory and consulting role currently established. Until ownership of the HP program is established for operating divisions by ORNL management, the HP group must assume an aggressive enforcement role to ensure the radiologically safe conduct of operations.

88-HP-02-08 - Health physics management should take the actions necessary to ensure adequate surveys are conducted to determine the extent of the radiation hazard present in contractor operations.

Basis: ORNL HP procedures required the area supervisor to

ensure surveys were conducted. However, due to the high contact dose rates on the cans removed from the cell and corresponding extremity dose considerations, the HP technician did not smear the cans. It appears that the failure to conduct an adequate survey contributed to the contamination incident.

88-HP-02-09

UOR documentation should be reviewed, upgraded and expanded to ensure that information sufficient to allow DOE to assess an incident is provided via the UOR document.

Basis:

- During review of the incident in Building 3038, it was necessary to obtain three separate documents to allow an adequate review of the incident's narrative description.
- Substantive information relevant to the incident should be provided in the UOR document such that an adequate review may be conducted by DOE personnel.