

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 70-687/87-01

Docket No. 70-687

License No. SNM-639

Priority 1

Category UHBR

Licensee: Cintichem, Inc.
P. O. Box 324
Tuxedo, New York 10987

Facility Name: Cintichem, Inc.

Inspection At: Tuxedo, New York

Inspection Conducted: January 14-15, 1987

Inspectors: John A. Croffey for 2/4/87
A. A. Weadock, Radiation Specialist date

Approved by: M. M. Shanbaky 2/4/87
M. M. Shanbaky, Chief, Facilities Radiation date
Protection Section

Inspection Summary: Inspection on January 14-15, 1987 (Report No. 70-687/87-01).

Areas Inspected: Special, unannounced followup inspection to review events and radiological controls associated with an apparent extremity overexposure to one worker during the third quarter, 1985.

Results: Ten apparent violations were identified: failure to limit and failure to report a worker extremity exposure in excess of NRC limits (section 4.1), failure to provide appropriate personnel monitoring (Section 5.0), failure to perform and failure to document radiological surveys (Section 6.0), failure to adequately instruct radiation workers (Section 7.0), failure to inform management of high personnel exposure in accordance with SNM license (Section 8.0), failure to post and failure to lock and control High Radiation Areas (Section 9.0), failure to meet ventilation requirement for laboratory hood (Section 10.0).

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DETAILS

1.0 Persons Contacted

- *J. J. McGovern, Plant Manager
- *C. J. Konnerth, Manager, Site Operations
- *L. C. Thelin, Radiation Safety Officer
 - J. Ditton, Health Physics Associate
 - J. Lesandro, Maintenance Technician
 - W. Rose, Maintenance Technician
- *A. Chibbaro, Sr. Radiophysicist, State of New York
- *L. Cabasino, Sr. Radiophysicist, State of New York

*Attended the exit meeting on January 15, 1987.

The exit meeting was also attended by M. Shanbaky, Chief, Facilities Radiation Protection Section, NRC-Region I.

2.0 Purpose

During NRC Inspection No. 687/86-06, conducted at the subject facility on December 15-19, 1986, the inspector identified that a maintenance worker (Worker A) received an occupational radiation exposure to the left hand during the third quarter of 1985 in excess of the NRC regulatory limit of 18.75 rem/calendar quarter. Licensee dosimetry records indicated a cumulative exposure to Worker A's left hand of 21.453 rem during the July - September, 1985 calendar quarter.

The purpose of the current inspection was to review the overexposure incident and to assess licensee control over radiological work activities relative to the overexposure.

Subsequent to the inspection, a Confirmatory Action Letter was issued to the licensee on January 20, 1987. This letter detailed specific actions committed to by the licensee to improve radiological controls associated with the manipulator hand repair operation and to perform accurate dose assessments for the involved workers.

3.0 Extremity Exposure Incident

Licensee extremity dosimetry records indicated that the extremity overexposure of Worker A during the third calendar quarter of 1985 occurred during the performance of repair work on mechanical manipulator hands that had been removed from the hot cells. Extremity monitoring was performed using TLD rings on the worker's hands. Radioactive contamination inside the hot cells and on the manipulator hands consists of a mixture of uranium and fission products. This contamination is generated inside the hot cells during the separation of medical isotopes from cylinders containing irradiated uranium.

Two plant workers, Worker A and Worker B, are responsible for the routine maintenance and repair of all plant remote manipulators. This includes the fairly routine repair of damaged manipulator hands. During an interview of the two workers, they indicated that the manipulator hand repair operation is essentially a three step process described as follows:

a. Description of Manipulator Hand Repair

(1) Step 1 - Hand Removal and Transport

Damaged manipulator hands are removed from the manipulator arms while inside the hot cell and are held for an unspecified period of time to allow for decay of fission products. Manipulator hands are brought out of the hot cells through a door located at the conveyor station. Damaged hands are transported through the hot cells to the door on a transfer cart located in the hot cells where they are surveyed by a Health Physics (HP) technician. Hands below a certain dose rate criteria are bagged out of the hot cell conveyor station and transported by the worker approximately 30 feet to a hood in the Radiopharmacy Laboratory. The bagged hands are placed inside a shielded "cave" inside the hood for further decay.

(2) Step 2 - Hand Decontamination

After an unspecified "cooling-off" period, the worker places the damaged manipulator hands into an ultrasonic cleaner containing decontamination solution. Both workers indicated this step was performed without actually touching the manipulator hands; manipulator hands are generally removed from the bag into the tub by upending the opened bag or picked up by using tongs. Manipulator hands usually receive two cycles of ultrasonic cleaning. No direct Health Physics coverage is provided during this step; however, a survey meter is available and is used by both workers. The licensee did not provide data to indicate the survey meter sensitivity and accuracy in measuring beta radiation emanating from the manipulator hands.

(3) Step 3 - Hand Repair

During this step the manipulator hands are removed from the decontamination solution, dried, and removed from the shielded "cave" to an open area in the hood for repair. Both workers indicated that the hands are removed from the decontamination solution and dried off using tongs. Repair work to the manipulator hands can be exacting, requiring the replacement of springs and small screws, and may take as long as 45 minutes per hand, depending on the scope of repair. During repair, the manipulator hand must be physically grasped, held, and worked on with the worker's gloved hands. The inspector determined that the ring TLD, when used, was worn under the glove. No direct HP coverage is provided during this phase; however, a survey meter and ring badges are available. Both workers indicated that

radiation surveys of the manipulator hands were performed prior to repair. The inspector determined, through discussion with the workers and other licensee personnel, that no training was given to the workers to perform radiological surveys including beta dose rate at the manipulator hands.

b. Scope of NRC Review

NRC review of the events causing and contributing to the apparent extremity overexposure included the following activities:

- interview of involved personnel,
- discussion with cognizant HP supervisory and technical personnel,
- direct inspection of the hot lab and radiopharmacy lab, including the manipulator repair area,
- performance of independent radiation surveys in the above areas,
- analysis of a sample of smearable contamination obtained by the licensee, on a manipulator hand removed from the hot laboratory hot cells,
- review of the following documentation:
 - training records for involved personnel
 - dosimetry/exposure records for involved personnel.

4.0 NRC Findings

a. Exposure Summary

During interviews of Workers A and B the inspector determined that both workers were experienced at manipulator maintenance and repair work and had been performing these activities for several years. Review of previous exposure for Worker A during manipulator hand repair indicated typical extremity exposure for this job averaged approximately 1.5-2.0 rem. However, as initially identified during NRC inspection No. 687/86-06, licensee records show that on July 2, 1985, Worker A received 13.946 rem exposure to his left hand while performing "work on manip. hands." From July 8 to August 23, 1985, Worker A received an additional 1.683 rem to the left hand performing various tasks, bringing his quarterly cumulative extremity exposure to 15.629 rem. On September 10, 1985, Worker A received an additional 5.824 rem to his left hand while performing "manip. hand repair," bringing his third quarter cumulative left hand exposure to 21.453 rem.

During the following quarter, on November 15, 1985, Worker A received a 15.641 rem exposure to the right hand while performing activities denoted as "take manip. hands out of conveyor station" on licensee exposure records. Subsequent work activity performed during the

fourth quarter and notated as "wash manip. hands" and "repair manip." resulted in a fourth quarter extremity exposure to the right hand of 17.126 rem.

10 CFR 20.101 restricts occupational exposure to the hands and forearms to 18.75 rem per calendar quarter. 10 CFR 20.405(a)(1)(i) requires that each exposure to an individual above the limits given in 10 CFR 20.101 be reported to the NRC within 30 days. Failure of the licensee to:

- 1) restrict Worker A's left hand quarterly exposure to less than 18.75 rem during the third calendar quarter of 1985, and
 - 2) report Worker A's overexposure to the NRC within 30 days,
- constitute apparent violations of 10 CFR 20.101 and 10 CFR 20.405, respectively (687/87-01-01, 687/87-01-02).

The licensee indicated during NRC inspection No. 687/86-06 and again during the current inspection that Worker A's third quarter, 1985 left hand exposure was not considered an overexposure by the licensee, as the dose resulted primarily from exposure to byproduct material, which is licensed by the State of New York. The inspector stated that the overexposure resulted from a mixture of isotopes from the hot cells and was, in part, due to the worker's entry into radiologically controlled areas in the reactor building. The inspector also stated that the source of activity leading to the overexposure was radioactive contamination existing on the manipulator hands and existing in the hot cells. The licensee indicated during the current inspection that uranium constitutes a fraction of the contamination existing in the hot cells. An effort was made during the current inspection to quantify this fraction by analyzing a sample of contamination obtained from a manipulator hand in the hot cells. However, both licensee and NRC analyses were not capable of determining the uranium content of the sample because of the low expected concentration present on the sample. The low uranium content was expected because of the atypical and potentially unrepresentative sampling techniques used to obtain a very small sample to allow for safe handling and transport to the Region I offices.

The May 13, 1982 letter from the NRC to Mr. Marcus Voth, Manager Nuclear Operations, Union Carbide Corporation, stated, in part, that where byproduct material is essentially completely separated from special nuclear material, processing will be under the regulatory control of the Agreement State. However, in the case of other byproduct material, not as well separated, which continues in process or in storage and is co-mingled with NRC licensed special nuclear material will be considered to be subject to NRC regulatory authority on the grounds that safety of handling of the special nuclear material requires NRC control of the co-mingled byproduct material at these phases of the process.

5.0 Personnel Monitoring

Worker A stated that he wore a whole body film badge, a wrist film badge, and a TLD ring on each hand during all steps of the manipulator repair operation. The inspector verified by discussion that TLD rings were properly oriented during repair work, i.e., TLD chip towards the palm of the hand. Worker B indicated that he also wore a whole body badge, wrist badge, and TLD rings during Steps 1 and 2 of the manipulator repair operation. However, he indicated that he had discontinued the use of TLD rings on his hands during Step 3 of the repair operation as they interfered with the repair work. 10 CFR 20.202 requires the licensee to supply and require the use of appropriate personnel monitoring equipment for each individual who is likely to receive a dose in any calendar quarter in excess of 25 percent of the regulatory limits. Review of the hand exposures received by Worker A during performance of the manipulator repair operation indicates that an individual performing this operation can be anticipated to exceed 25 percent of the quarterly limit. Failure of the licensee to require the use of TLD rings by Worker B during all steps of the manipulator hand repair operation constitutes an apparent violation of 10 CFR 20.202 (687/87-01-03).

6.0 Surveys

10 CFR 20.201(a) defines "survey" as an evaluation of the radiation hazards incident to the production, use, release, disposal or presence of radioactive materials. 10 CFR 20.201(b) requires licensees to make such surveys as necessary to comply with the regulations and are reasonable to evaluate the extent of radiation hazards that may be present. 10 CFR 20.401 requires the licensee to document and retain records of such surveys as required above.

Licensee personnel indicated that radiological surveys were routinely performed at several points during the manipulator hand repair process. These included:

1. Survey by a HP technician of the manipulator hands prior to being brought out of the hot cell,
2. Survey of the manipulator hands by Workers A and B during the decontamination and repair phases of the operation.

The inspector interviewed the involved workers, an HP technician who had provided coverage for Step 1 of the repair operation, and HP supervisory personnel. The following deficiencies were noted:

- (a) Although evidence suggests that the surveys discussed above are routinely performed, no documentation of such surveys were available for review. The licensee indicated surveys for the manipulator hand repair operation are typically not documented.

- (b) Surveys of the manipulator hands may be inadequate in that the licensee has not developed specific beta correction factors for the survey instruments commonly used during these surveys. Evidence suggests meter response may vary greatly due to beta endpoint energy and source-to-detector distance (NUREG/CP-0050, Proceedings of the International Dosimetry Symposium).
- (c) Surveys performed by the involved maintenance workers appear to be inconsistently performed since the training provided in this area appears inadequate. Worker B indicated he performs surveys by holding the survey instrument as close to the manipulator hand as possible without contaminating the instrument (i.e., touching the survey instrument to the mechanical hand). Worker A indicated he routinely surveyed the manipulator hands by holding the survey instrument approximately one foot from the hand.
- (d) No survey (evaluation) of the actual dose to Worker A's left hand was made by the licensee subsequent to the exposures received during the third quarter of 1985. The licensee indicated that the readout dose from the TLD ring was relied upon and viewed as the dose of record. The inspector observed Worker A perform simulated repair work on a mock-up of a manipulator hand while wearing TLD rings according to his normal practice. This preliminary review indicated dose to the tips of the fingers may not be accurately assessed by the TLD rings, which are worn 1-2" away at the base of the fingers. The inspector noted that as the worker holds the manipulator hand, the TLD ring may actually be shielded by the "yoke" or bottom portion of the manipulator hand assembly. The worker's fingertips, however, reach up and around the yoke and extend towards the highly contaminated "fingers" of the manipulator hand.
- (e) No in-depth, documented survey (evaluation) of work practices associated with the manipulator hand repair operation was conducted in a timely fashion after the July 2, 1985 hand exposure of 13.946 rem. This exposure represented an approximate ten-fold increase in the exposure typically received for this task (1.0-2.0 rem). Licensee personnel indicated a limited investigation, consisting of asking Worker A if he had done anything different, was conducted; however, this investigation was not documented and it is unclear whether it was conducted after the July 2, 1985 or the November 15, 1985 event. Apparently, at no time in 1985 was a review conducted to identify causes of the increase in exposure, identify whether such causes might be affecting the performance of Worker B, and prevent any subsequent high exposures. Consequently, ongoing repair work performed on September 10, 1985 resulted in 5.824 rem exposure to Worker A's hands and a quarterly cumulative overexposure.

Licensee HP supervision did indicate that a review of the manipulator hand repair operation was conducted in 1986 to identify the causes of the high exposures and whether they could be reduced. Although the scope and find-

ings of this review were not documented, the licensee indicated it was concluded that the process itself was not unsafe and that individual work practices led to the high exposure. Upon review of the work area, the inspector noted several poor radiological work practices. The inspector discussed potential improvements in this area with the licensee which may include procedurally limiting the number of damaged hands in the hood, the use of a deeper ultrasonic cleaner tub to take advantage of water shielding, use of proper survey meters, performance of adequate surveys, providing ALARA training to workers, the use of a remote tool or vise to hold the mechanical hand during repair, or the use of thicker gloves while holding the manipulator hand.

Due to the significant variability in the dose rates delivered to different locations on the individual's hands, the 21.453 rad indicated by the TLD ring badge may not be representative of the actual dose received by the highest exposed location on the individual's hands. The inspector discussed with the licensee representative the nature of localized exposure from beta activity. The licensee stated that no further dose assessment was performed. The inspector stated that based on observation of the worker's handling objects similar to the manipulator hands, it appears that the highest dose may have been received by the tips of the fingers.

The inspector also discussed with the licensee the adequacy of relying solely on the TLD ring to determine the dose to the individual hands. The licensee did not provide any Quality Control data to support the adequacy of the TLD response to mixed fission products.

Failure of the licensee to perform an adequate survey (evaluation) of the exposure received by the individual during the third and fourth quarters, 1985, and to perform a thorough and timely evaluation of radiation hazards associated with the manipulator hand repair operation constitutes an apparent violation of 10 CFR 20.201(b) (687/87-01-04). Failure of the licensee to document or maintain surveys routinely performed in support of the manipulator hand repair operation constitutes an apparent violation of 10 CFR 20.401 (687/87-01-05).

7.0 Training

10 CFR 19.12 "Instructions to Workers" requires that occupational radiation workers be instructed in, amongst other things, precautions or procedures to minimize exposure, purposes and functions of protective devices, and the applicable provisions of NRC regulations. Section 2.6, Training, of the NRC-approved license application indicates that the Health Physics Department shall determine the need for followup radiation safety training for plant personnel from followup observations and the results of personnel monitoring.

The inspector interviewed Workers A and B and determined both individuals had a basic understanding of radiation safety principles, including the use of time, distance, and shielding to minimize exposure. The inspector

determined, however, that although both workers were performing radiological surveys to support manipulator hand repair, neither worker had received adequate, formal instruction from the HP staff to ensure the consistent use of proper survey meters or evaluation of the results.

Consequently, Worker A performed surveys while holding the meter at one foot from the source; Worker B held the meter as close as possible to the source. Worker B would perform repairs (Step 3) on manipulator hands reading 100-800 millirad/hr. as they came out of the decontamination wash. He indicated higher dose rate hands would be returned to the wash. Worker A indicated that although he anticipated a dose rate of approximately 400 millirad/hr. on hands after decontamination, he would work on any manipulator hand as long as the area monitor located directly over the hood did not alarm. The inspector noted the overhead area monitor (a Victoreen Vamp) responds to gamma radiation only and will not measure beta radiation which was the predominant activity present on the hands.

The inspector determined that no procedure was in place to control the manipulator hand repair operation and establish predetermined, radiological hold points for the workers performing these surveys. Additionally, neither Worker A nor B were familiar with NRC extremity dose limits.

Failure of the licensee to adequately instruct workers in the use and interpretation of survey meters, the beta radiation hazard, and the applicable exposure limits constitutes an apparent violation of 10 CFR 19.12 (687/87-01-06). In addition, the inspector noted the licensee apparently failed to comply with Section 2.6 of the NRC-approved license application in that additional formal radiation safety training was not provided to Worker A upon review of the results of personnel monitoring records for the third and fourth quarter, 1985. The inspector noted that TLD rings are read immediately after the rings are turned in by the worker and consequently the HP department was aware of the significant exposures on the day they occurred. Licensee HP supervision indicated to the inspector that Worker A was briefed concerning the use of "time, distance and shielding" after the July 2, 1985 exposure; however, this briefing was not documented by the licensee.

8.0 Licensee Followup

The licensee's SNM license condition 3.1.2, "ALARA Policy," requires in 3.1.2.5 that all radiation exposures in excess of 50 percent of the limit shall be reported to management at least quarterly. The inspector noted that the 13.946 rem exposure to the hand of Worker A on July 2, 1985 constitutes an exposure in excess of 50 percent of NRC exposure limits. The inspector reviewed licensee followup actions to assess adequacy in preventing a recurrence and for compliance with their SNM license conditions.

The licensee indicated senior management, including the Plant Manager, were made aware of the July 2, 1985 exposure and subsequent high exposures in a timely fashion. In addition, licensee management and HP supervision indicated the following actions were performed in response to the July 2, 1985 exposure.

1. The manipulator hand repair work process was modified to allow a preliminary decontamination of the manipulator hands while still inside the hot cell;
2. Worker A's supervisor was informed as to Worker's A's sudden increase in exposure;
3. Licensee HP supervision questioned Worker A concerning his work practices (see paragraph 6(e)) and provided informal "time, distance, and shielding" instruction (see Section 7.0).

Subsequent to the November 15, 1985 incident, the licensee indicated the following additional actions were taken:

- a) Worker A received additional briefings and was removed from all high exposure work as of November 15, 1985;
- b) A review by HP supervision was performed, apparently in 1986, to evaluate the manipulator hand repair process (see paragraph 6(e)).

The inspector evaluated the licensee's followup actions by discussion with licensee personnel and review of records. The inspector noted the following:

- i) No documentation existed to indicate the above followup actions were taken or completed.
- ii) The inspector noted some confusion among various members of the HP staff as to whether action number 3 above was taken after the July 2, 1985 or the November 15, 1985 exposure incident. Worker A indicated that this discussion took place after the second high exposure.
- iii) Licensee dosimetry records indicated that Worker A performed work notated as "wash manip. hands" and "repair manip" from November 18, 1985 to December 23, 1985. Dose received during this period totaled 0.9 rem to the right hand and 3.464 rem to the left hand. The majority of this exposure was accumulated during the "repair manip" work. Records also indicate Worker A continued work in radiological areas until April 1, 1986.

The inspector noted the licensee had no documented evidence to indicate that licensee management was appropriately informed as to Worker A's July 2, 1985 extremity exposure. This constitutes an apparent violation of Section 3.1.2.5 of the NRC-approved licensee application (687/87-01-07).

The inspector also noted that licensee follow-up and corrective actions, even if assumed to be taken after the July 2, 1985 exposure, were ineffective in preventing a subsequent cumulative overexposure to the worker's left hand on September 10, 1985.

9.0 High Radiation Area Control

10 CFR 20.202(b)(3) defines a "High Radiation Area" as any area where a major portion of the body could receive in any one hour a dose in excess of 100 millirem. 10 CFR 20.203(c)(i) requires that each high radiation area be posted with a sign bearing the radiation caution symbol and the words "Caution" or "Danger," "High Radiation Area." 10 CFR 20.203(c)(2)(iii) requires that High Radiation Areas be maintained locked or guarded.

During a tour of the conveyor station area in building 2 on January 15, 1987, the inspector noted that neither access door to the inside of the conveyor station was locked or posted as a High Radiation Area. The conveyor station features an upper "hatch" (approximately 16" x 16") and a lower door (approximately 3' x 2.5') which allow material to be brought out of the hot cells. The inspector requested the licensee to open both the hatch and door and made survey measurements using an Eberline RO-2 (S/N 3248, calibrated November 24, 1986). Survey results indicated whole body gamma exposure dose rates of 150 mR/hr measured at the plane of the upper hatch opening, and 900 mR/hr approximately 12 inches inside the lower door opening.

During a tour of the Waste Storage Building, performed during the 687/86-06 inspection, on December 16, 1986, the inspector observed that there was a B-25 shipping container, filled with waste, but not prepared for shipment, located inside the Waste Storage building yard. The yard area was surrounded by a fence with a locked gate. The gate was posted with a "Caution-Radioactive Material" sign and a "Caution-Radiation Area" sign. The B-25 shipping container was surrounded by a rope upon which was hung a "Caution-High Radiation Area" sign. In addition, the radiation dose rate at the rope was identified on the sign as being 150 mrem/hr. At the request of the inspector, the licensee performed a radiation survey on this container. The radiation dose rate at the surface of the box was found to be 250 mrem/hr; and, at the rope, the radiation dose rate was 200 mrem/hr.

Failure of the licensee to either post or lock and control access to the doors at the conveyor station and to adequately post access to the B-25 shipping container constitutes apparent violations of 10 CFR 20.203(c)(i) and 10 CFR 20.203(c)(2)(iii)(687/87-01-08, 687/87-01-09).

10. Plating Laboratory Hood Velocity

During examination of the uranium target Plating Laboratory, the inspector noted that the hood flow velocity appeared to be low. At the request of the inspector, licensee representatives measured the air flow velocity

into this hood with a velometer and determined it to be between 50 and 90 linear feet per minute. This was identified as a violation of Section 3.2.2.3 "Ventilation Requirements" of the NRC-approved license application that states, in part, that the minimum hood velocity is 100 feet per minute (687/87-01-10).

11. Exit Meeting

An exit meeting was conducted with licensee representatives denoted in Section 1.0 at the conclusion of the inspection on January 15. The purpose, scope, and findings of the inspection were summarized by the inspector at this meeting.