PART 30 INSPECTION

UNITED STATES RADIUM CORPORATION
4150 Old Berwick Road
Bloomsburg, Pennsylvania

Date of Inspection: November 13 - 16, 1962 (Announced)

Persons Accompanying Inspector:

Thomas Gerusky, Bureau of Environmental Health, The Commonwealth of Pennsylvania, Department of Health (11/13/62)
Joel P. Lubenau, Bureau of Environmental Health, The Commonwealth of Pennsylvania, Department of Health (11/13 - 16/62)

Persons Contacted:

E. M. Burtsavage, Health Physicist and RSO
Dr. J. G. MacHutchin, Director of Radiochemistry Research and Chairman of the Isotope Committee
W. E. Umstead, Manager, Plant #1
G. E. Widger, Assistant Manager, Radiation Laboratory
I. W. Allam, Chemist
H. P. Copeland, Radiation Physicist
R. Carl, Radiation Technician

DETAILS

Inspection History

9. Initial inspection of United States Radium Corporation (USRC), License No. 37-30-2, was conducted 10/2/57. The licensee was cited for:

   (1) 20.101(a)(2) - Overexposure of personnel in restricted areas

   (2) 20.105 - Employees' exposures were not limited after overexposure

   (3) 20.201 - Airborne surveys were not conducted

   (4) 20.203(f)(1) - A contaminated hood was not labeled

   (5) 30.33 - Expertation of tritium to Canada without authorization

   Because of the overexposures and the lack of airborne surveys, it was felt a hazard existed.

10. Reinspection of License No. 37-30-2 and initial inspection of #37-30-3 and -4 was conducted 4/13 - 16/59. In a letter from DL&R, dated 1/6/60, the licensee was cited for:

   (1) and (2) 20.201(b) - Air surveys were not conducted in unrestricted areas and incomplete evaluations were made of radioisotopes disposed via the sanitary sewer.

ITEM 5 (CONT'D)

License No.	Date of Issue	Exp. Date
GL-112 (Reinspection) amend. 3 (amends license in its entirety)	5/10/61	5/31/63
amend. 4	9/27/61	"
GL-117 (Initial) amend. 1	5/14/62	5/31/64
GL-122 (Initial)		

(For Scope and Conditions See Report Details)

ITEM 6 (CONT'D)

20.105(b)(1) "Radiation levels in unrestricted areas"
- in that radiation levels exceeding 2 mr/hr existed in an unrestricted area (lawn and driveway) outside the east wall of the cesium laboratory and hot cell. (See paragraphs 67 and 68 and Exhibits "C" and "D" of report details).

20.201(b) "Surveys"
- in that the licensee did not make a comprehensive survey of radiation levels existing on the roof above the cesium hot cell. Although "Caution - Airborne Radioactivity Area" signs were present, the area was not posted as a radiation area or high radiation area. (See paragraph 69 and Exhibit "D" of report details).

20.203(c)(1) "High radiation areas"
- in that, although the high radiation area existing on the roof over the Cs-137 hot cell was posted with "Caution - Airborne Radioactivity" signs, it was not posted with "Caution - High Radiation Area" signs. (See paragraph 69 and Exhibit "D" of report details).

20.203(c)(2) "High radiation areas"
- in that the high radiation area on the roof was not equipped with a control device to prevent access to the roof or warn personnel when entry would be made into the high radiation area. (See paragraph 69 of report details).

37-30-2 and GL-112
20.201(b) "Surveys"
- in that the licensee had not performed a comprehensive evaluation of tritium concentrations in the tritium building and had not evaluated the cause of a continuously increasing ingestion of tritium by Allam, an employee in the tritium building. (See paragraphs 43 and 56 of report details).

(3) 20.202(a) - Finger film badges were not issued to individuals using Sr-90

(4) 20.203(c)(2) - High radiation areas were not equipped with interlocks

(5) 20.101(b) - Exposure of an employee to tritium concentrations in excess of prescribed limits

(6) 20.203(f)(1) and (4) - Improper labeling of containers

(7) 20.403(b) - Failure to report an incident

(8) 20.401(c) - Records of sewerage disposals were not kept

It was felt a hazard existed because of failure to evaluate hand exposures and to perform bioassays for individuals working with Sr-90 and Cs-137. DL&R requested a follow-up inspection.

11. During 9/20 - 23/60, initial inspection of License GL-112 and follow-up inspection of License No. 37-30-2 was conducted. The licensee was cited for:

(1) 20.201(b) - Failure to evaluate doses to employees' hands

(2) 20.206 - Improper instruction to an employee working in glove boxes

(3) 20.101(a) - Overexposure to the hands of four employees

(4) 20.201(b) - Inadequate evaluation of hood exhausts

(5) 20.203(c)(2) - Failure to provide the waste storage area with an interlock

The licensee's operations were considered marginal by this office and a follow-up inspection was recommended.

12. During 5/22 - 26/61 reinspection of Licenses 37-30-2, -3, and GL-112 was conducted by J. Roeder and Van Wyck of this office. This inspection was a comprehensive review and an evaluation of the licensee's facilities and radioisotope programs. No items of noncompliance were noted for License 37-30-3. In a letter from E. R. Price, DL&R, dated 1/15/62, the licensee was cited for:

<u>License 37-30-2 and GL-112</u>

(1) 20.201(b) - Inadequate evaluation of airborne concentrations of tritium in the tritium building

<u>License 37-30-2</u>

(2) 20.105(b)(1) - Excessive radiation levels in an unrestricted area outside the radium laboratory

(3) 20.203(b) - The radiation area noted above was not posted

(4) 20.401(b) - Records were not maintained of smear smaples taken in unrestricted areas adjacent to the radioactivity laboratories.

FEB 5 1963

E. R. Price, Assistant Director
Division of Licensing and Regulation, HQ

R. S. Cleveland, Radiation Specialist (Review)
Region I, Division of Compliance

TRANSMITTAL OF LICENSE COMPLIANCE INSPECTION REPORT - 10 CFR 30

CO:I:RGC

Transmitted herewith is the following inspection report involving noncompliance:

UNITED STATES RADIUM CORPORATION
4150 Old Berwick Road
Bloomsburg, Pennsylvania

License Nos. 37-30-2 w/amends. 16 - 22
37-30-6 w/amend. 1
GL-112 w/amends. 3 & 4
GL-117 w/amend. 1
GL-122

The items of noncompliance as noted on the green sheet were discussed with W. E. Umstead, Manager, Plant #1, Dr. J. G. MacHutchin, Director of Radiochemistry Research, and E. M. Burtsavage, Radiation Safety Officer. All three gentlemen expressed concern over the noncompliance and assured the inspector corrective action would be taken.

The items of noncompliance involve radioisotope authorized for use under the provisions of License 37-30-2 and GL-112. Although no discrepancies with regulations or license conditions were observed for programs conducted pursuant to 37-30-6 and GL-117 and 122, AEC Form 591's were not issued inasmuch as all aspects of these licenses were not thoroughly reviewed.

With reference to the high radiation areas existing above the roof and on the outside wall of the cesium

hot cell, information given the inspector indicated that corrective action would be taken in two steps. A short range program would be instituted to (1) post the roof area as a high radiation area and control access to the roof, and (2) some means would be taken to reduce radiation levels in the unrestricted areas outside the building, i.e., the yard and driveway. MacHutchin and Umstead indicated a long range corrective program would probably include steps to phase out the cesium source fabrication at this plant.

Both gentlemen stated that the facilities available were probably inadequate to handle the present scope of the company's activities. A new program would probably be instituted and would most likely involve the purchase of encapsulated cesium from an outside concern. The inspector pointed out to the company representatives that the high radiation levels on the roof above the hot cell had apparently been in existence for several years and no apparent attempt had been made to perform a complete radiation survey of this area. Burtsavage acknowledged this fact and stated that he had been aware that inadequate shielding was present above the hot cell and that radiation levels of at least 40 mr/hr would exist above the roof when large quantities of radioactive materials (5 to 10 c cesium) were present at the cell. He stated that a comprehensive survey had not been performed to establish exactly what levels existed on the roof, and continued that he regarded this situation as "a skeleton in the closet." Noncompliance with Section 20.105(b)(1) for high radiation levels on the roof was not discussed because, as noted in paragraph 69 of the report details, Burtsavage considered the roof area restricted. He stated that all employees of USRC had been warned not to go to the roof of the main building without first checking with him. However, Burtsavage did indicate that he could not guarantee that he exercised positive control over access to the roof.

The licensee should have made a precise evaluation of the radiation levels on the roof because of the presence of filter box housings and the small shed to which the electrical supply lines were connected. Both of these structures require periodic maintenance and both are in the radiation field (shed > 5 mr/hr and housing >200 mr/hr when 10 c of cesium would be present in the cell). According to Burtsavage, except for the occasional wash downs following the use of 10 c of cesium, from 1 to 10 c of Cs-137 would be present in the hot cell. A wash down was made about ten times since the last inspection.

With reference to the failure to evaluate airborne concentrations in the tritium building, Burtsavage stated that within thirty days he would perform such an evaluation. He was not, however, certain of the approach to be taken. The evaluation would include steps to calibrate the tritium monitor in absolute units rather than in arbitrary units as was previously done. Burtsavage pointed out that modifications were being made to increase the air flow in the exhaust system from the hood above the work area in which most of the tritiating was being performed. The modification was expected to be completed within two weeks. As noted in paragraph 56 of the report details, Burtsavage stated that an evaluation had not been made to determine why Allam had been receiving continuously increasing body doses from ingestion of tritium. He stated some evaluation would be performed in the future. An evaluation should be made, as Allam's whole body dose from tritium has been increasing over the past three quarters.

As described in paragraph 78 of the report details, employees in the etching building had been using an area located adjacent to the waste storage area as a temporary lunch room. The inspector expressed some concern about allowing employees to eat in an area located in close proximity to rooms in which handling and storage of radioactive materials were being made. Umstead indicated this lunch room would be abandoned and employees urged not to eat in any rooms in this building.

Upon summing the items of noncompliance with the three gentlemen, the inspector noted that his evaluation of the radiation safety program indicated that the Health Physics Division was apparently understaffed and overworked. It was pointed out that the Health Physics staff was performing a good job under the existing conditions; however, they had to continuously exert themselves to keep abreast of the mandatory details, i.e., those functions absolutely necessary from a health physics standpoint, and often left undone, or not satisfactorily completed, those details which, from a health physics standpoint, should be done. Examples of the latter category would be comprehensive roof surveys, environmental sampling, and an evaluation of Allam's tritium ingestion, which, if not done, would not result in serious health consequences. Burtsavage agreed that this was the case and often resulted in inadequate surveys and evaluations. He pointed out that details that had to be done, such as the counting and analyses of smears, took much valuable time away from his staff. Smears had to be taken to USRC's other plant in Bloomsburg, which contained

facilities required for low-level counting. It was pointed out to management that in each year since 1957 the company has had some noncompliance item associated with the tritium building and with tritium hazards. Burtsavage stated he was aware of the dilemma and was trying to devise a method to alleviate or eliminate the problem.

The following items were also pointed out as representing weaknesses in the health physics program and ones which would be desirable to correct: (1) a review of the working conditions in all laboratories was needed to insure that signs and labels were removed from areas, hoods, and containers no longer used in the handling or storage of radioisotopes; (2) a study was needed to determine the air flow patterns from areas in which large quantities of radioisotopes were handled; and (3) the performance of environmental surveys was needed throughout the company premises, specifically along the banks of the brook leading from the liquid waste discharge pipe to the Susquehanna River. With reference to the above items, Burtsavage noted that: (1) he attempted to cultivate good working habits in the employees, such that they would concern themselves with posting and labeling problems; (2) continuous construction within buildings made the performance of air flow patterns impractical; and (3) environmental surveys such as air samples and ground samples, especially around the brook, were desirable, but sufficient time was not available to accomplish this.

The inspector noted that this inspection did not include all aspects of the licensee's operations and did not include a determination of compliance with all the applicable license conditions. It was also pointed out that the Health Physics staff appeared capable of furnishing adequate protection for the employees of the company. Employees observed in the performance of various tasks with radioisotopes appeared qualified and capable of handling radioactive material and were apparently observing company rules in the performance of their work.

The inspector took numerous smear samples during the inspection, most of which are summarized in the attached Exhibit "I". Analysis of the smear samples indicated the Health Physics Division is apparently controlling contaminants both within and without their restricted areas. Unrestricted areas not normally attended to during cleaning operations showed removable contamination higher than that detected in areas cleaned daily.

Upon completion of the inspection, a review was made of the incident of 10/27/61 involving the loss of 75 c of H-3. This review was made pursuant to a request by CO:HQ noted in the 12/14/61 memo from L. Dubinski, CO:HQ, to E. R. Price, DL&R. As noted in paragraph 83 of the report details, Burtsavage stated he could not furnish any additional information from that stated in his letter dated 11/14/61 to DL&R.

The information contained in paragraphs 38 through 42 of the report details is considered by USRC personnel as proprietary information. Some of the subject matter included in this section, which summarizes operations conducted in the Tritium Building, covers certain production and research concerning the application of tritium to plated foils. Both the green sheet and the report details note these paragraphs to be company confidential.

The noted deficiencies were not felt to constitute a serious hazard and no follow-up inspection will be scheduled. However, it is felt there are substantial deficiencies in the licensee's program and a reinspection is planned after completion of the enforcement action. The reinspection will be particularly concerned with the corrective action of the deficiencies and those areas not covered during this inspection.

This report is forwarded for appropriate enforcement action.

Enclosure:
1 cy of Rpt.

cc: CO:HQ
w/orig of Rpt.

Form AEC-417
(4-58)

UNITED STATES ATOMIC ENERGY COMMISSION

COMPLIANCE INSPECTION REPORT

1. Name and address of licensee	2. Date of inspection
UNITED STATES RADIUM CORPORATION 4150 Old Berwick Road Bloomsburg, Pennsylvania	November 13 - 16, 1962
	3. Type of inspection Initial & Reinspectio
	4. 10 CFR Part(s) applicable 20 - 30

5. License number(s), issue and expiration dates, scope and conditions (including amendments)

License No.	Date of Issue	Exp. Date
37-30-2 (Reinspection)		
amend. 16 (amends license in its entirety)	5/17/61	5/31/63
amend. 17	7/18/61	"
amend. 18	10/9/61	"
amend. 19	12/29/61	"
amend. 20	3/19/62	"
amend. 21	4/3/62	"
amend. 22	9/21/62	"
37-30-6 (Initial)		
amend. 1	9/27/61	3/31/63

(CONT'D)

6. Inspection findings (and items of noncompliance)

U.S.R.C., Bloomsburg, Pennsylvania, a producer of various gauges, devices, and instrument panels using radioisotopes, presently employs 225 persons, about 60 of whom work with radioactive material. Activities of the Health Physics Division, supervised by E. M. Burtsavage, RSO, are guided by the general safety committee and the isotope committee. Burtsavage is a member of both committees. Surveys taken included area, surface contamination, air sampling and stack monitoring. Personnel exposure is determined through film badges (whole body and finger), pocket chambers, radon breath analysis, and urinalysis. Records are kept of area and personnel monitoring results. Waste disposal is accomplished by shipment of solid wastes to Oak Ridge National Laboratory and Nuclear Engineering Company and by the discharge of low level liquid waste to the Susquehanna River. Disposal records are kept. During a general review of company operations and observation of working habits of personnel and a review of the adequacy of area surveys and personnel monitoring, the following items of noncompliance were noted:

37-30-2
License Condition 8A
- in that the licensee exceeded by 41 mc the 200 mc possession limits for Ni-63. (See paragraph 14 and Exhibit "A" of report details).

(CONT'D)

7. Date of last previous inspection	8. Is "Company Confidential" information contained in this report? Yes ☒ No ☐ (Specify page(s) and paragraph(s))
37-30-2 - 5/22-26/61 GL-112 - "	Pages 9 & 10 Paragraphs 38 - 42

DISTRIBUTION:
- Orig. - CO:HQ
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2 cys. - CO:I

Richard G. Gilbert
(Inspector)

Approved by: R. S. Cleveland, Radiation Specialist (Review), Region I
Division of (Operations office) Compliance

(Date report prepared)

If additional space is required for any numbered item above, the continuation may be extended to the reverse of this form using foot to head format, leaving sufficient margin at top for binding, identifying each item by number and noting "Continued" on the face of form under appropriate item.

16—73314-2 U. S. GOVERNMENT PRINTING OFFICE

RECOMMENDATIONS SHOULD BE SET FORTH IN A SEPARATE COVERING MEMORANDUM

The letter from DL&R noted that items 2 and 3 above were corrected at the time of the inspection. The letter also noted that, on numerous occasions during 1960, concentrations of Kr-85 released to unrestricted areas exceeded the maximum permissible levels specified in Part 20 prior to its revision of 1/1/61 and that the licensee failed to notify the Commission, pursuant to 20.403(b), of the releases to unrestricted areas. In a letter dated 2/9/62, USRC notified DL&R of corrective action taken on items 1 and 4 above. This was acknowledged by DL&R on 3/5/62.

13. As noted in the above summaries of previous inspections, the USRC radiological safety program has been weak in areas relating to performance and evaluation of airborne contamination surveys, protection of employees from radiation exposure, and prevention of high radiation levels in unrestricted areas. In each instance the licensee was cited for noncompliance with section 20.201(b). In each of the previous inspections, this office expressed in the transmittal memorandum some concern over the licensee's ability to evaluate airborne concentrations in the tritium, cesium and strontium laboratories.

Synopsis of Current Inspection

14. Outlined below are the licenses inspected, the type of inspection, and the license conditions for which no inquiry was made regarding compliance. It is to be noted, however, that most of the conditions mentioned for licenses 37-30-2 and GL-112 have been thoroughly reviewed during previous inspections, and statements regarding compliance are contained in the previously submitted reports.

License No.	Type of Inspection	Conditions Not Reviewed
37-30-2	Reinspection	11-field use, 14-op. procedures, 15-GL sales, 14(A-E)-leak tests, 17-field tests
37-30-6	Initial	13-op. procedures, 14(A-H)-qual. control, 15-sales rpts., 16-sales rpts., 17-30.24(i) tests
GL-112	Reinspection	13-export prohib., 15-mfg. specs.
GL-117	Initial	11-Kr-85/ss, 12-sales rpts., 18-profile survey & rpt., 19-mfg. & sales specs.
GL-122	Initial	12-export prohib., 15-sales rpts.

Where records were required to be kept to ensure compliance with the above conditions, such records were available for inspection, but they were not reviewed. A summary of the byproduct material on hand, as of 10/31/62, is shown in Exhibit "A". The material noted here does not represent all radioisotopes authorized for use and possession, but only those very recently used. As noted in Exhibit "A", the licensee had on hand 241 mc Ni-63, 41 mc in excess of license limits (License 37-30-2). This resulted when the company ordered 200 mc of Ni-63 (for a special order of Ni-63 coated electrodes) while having 41 mc on hand. The Ni-63 electrodes (containing a total of 176 mc Ni-63) were sent out the latter part of November, 1962.

15. The inspection was not devoted to any specific license, but rather a broad review was made of the company radioisotope program, concentrating on the operating conditions in the various laboratories, observing working habits of employees engaged in the handling of radioisotopes, and an evaluation of the health physics (radiation safety) program. Most of the above centered around compliance with 10 CFR 20. The buildings visited are noted in Exhibit "B". Considerable attention was devoted to those areas in which the licensee has been consistently weak (see paragraph 13), and to the survey program, the personnel monitoring program and to the low-level-liquid-waste-disposal system.

16. Records pertinent to the above programs were reviewed. Independent surveys were made by the inspector. Summaries extracted from the licensee's records and the results of the inspector's surveys are noted in Exhibits "C" to "X".

Radioisotope Program

17. USRC uses various radioisotopes (see Exhibit "A") in the research and development of new products and the manufacture of products for distribution to AEC authorized recipients. (Exhibit "A" lists only the isotopes of recent use, no inquiry was made as to all material used since the last inspection). Many of the products are in the form of sealed sources containing encapsulated material or coated foils. Burtsavage stated that USRC hopes in the near future to begin mass production of tritiated time pieces for sale or distribution as an exempt item. The distribution of tritiated time pieces is authorized by License 37-30-6 and is subject to the provisions of 10 CFR 30.10(a). Both MacHutchin and Umstead indicated that the company anticipates tritium and americium will supplant radium as a luminescent material used on time pieces.

18. Burtsavage stated that, as in the past, the General Plant Safety Committee is charged with the responsibility of overall plant safety (including radiation) and that the Isotope Committee reviews and supervises use of radioisotopes and designates persons eligible to work with radioactive materials. With the exception of authorized field uses, stipulated in Condition 11 of 37-30-2, byproduct material was reportedly used only at the Bloomsburg facilities. In addition to Burtsavage, two other persons are employed as technicians in the Health Physics Section.

Facilities and Uses of Radioisotopes

19. During the period of the inspection a visit was made to most of the radium and to all of the byproduct material facilities involved in the use of and fabrication of products containing radioisotopes. Personnel engaged in normal working routines were observed to determine their competency in handling radioactive substances, awareness of hazards, observance of company safety rules and the kind of protective clothing and monitoring devices worn. Posting and labeling were reviewed in each of the shops. The below paragraphs contain a summary of the facilities, type of work in progress and comments on personnel and posting and labeling as noted during the visit. Comments relating to personnel monitoring and surveys are noted in the sections entitled "Personnel Monitoring" and "Surveys", respectively.

ETCHING PLANT

20. The Old Etching Plant, designated building No. 2 in Exhibit "B", currently houses radium operations, a tritium research and development laboratory, and the waste storage area. According to Burtsavage, USRC anticipates eliminating radium from their operations and products and eventually converting the entire building to the production of tritiated products, such as "Exit" signs.

21. Radium operations currently conducted in the building include the dial processing department where radium paint is prepared, the screening operations where radium paint is applied to watch dials, and a production area where the dial face plates are manufactured. On 11/14/62 the inspector observed a female employee engaged in a screening operation. This process involved inserting a sheet containing 100 watch dials into a machine which rolled radium paint through a screen such that numerals and dots on the watch dials were coated with a thin film of paint. The sheets measured about 14" X 14". Coated sheets were stored in a rack prior to being placed in an oven for baking and proper setting of the paint. The employee was very proficient in her work and was aware of the radiation hazards of radium. According to Burtsavage, this operation was performed for approximately 20 hours every other week. The employee was noted to be wearing a film badge. Protective clothing consisted of a white lab coat.

22. The second area visited in this building was the tritium R & D laboratory. Burtsavage stated the work conducted in this laboratory was currently limited to research and development of tritium filled "Exit" signs, which would eventually be distributed under license GL-122. One male employee, Cowan, a chemist, and one female technician were working with H-3 signs at the time of the inspection. Cowan stated that, at present, his work involves the testing of the "Exit" signs for leakage prior to the introduction of tritium gas. The H-3 is introduced by another employee in the tritium lab. located in the General Laboratory of the main building. After being filled with tritium gas the signs are returned to this laboratory for further research and development test. All testing work is performed in a hood located in this laboratory. After the integrity of the seal has been determined, it is not necessary to restrict further work to the hood. Burtsavage noted that the completed "Exit" signs are considered sealed sources. Cowan stated that two different size "Exit" signs (sources) were made, the smaller sign containing 2.2 c tritium, and the larger 3.3 c of tritium. He noted that 2 of the larger size signs could be combined to form a single unit with a total of 6.6 c tritium. In addition to a laboratory coat, Cowan was wearing a film badge and two pocket chambers.

23. Burtsavage showed the inspector sample labels that would be affixed to the "Exit" signs. The laboratory and the hood were posted with "Caution - Radiation Area" and "Caution - Radioactive Material" signs. Form AEC-3 was posted outside the laboratory.

24. The third area visited in this building was the waste storage room. Prepared and packaged wastes are stored here prior to shipment to a waste disposal agency. According to Burtsavage, as a matter of economy, the company accumulated radium wastes (or barrels containing byproduct material in addition to radium wastes and handled as though all radium) until they had slightly less than 40 units. At this time the wastes would be shipped via common carrier to Nuclear Engineering Company, Kearny, New Jersey. Burtsavage stated that in no instance would more than 40 units be shipped. He noted that on occasion the 40 units might include some liquid and/or gaseous byproduct material stored in another area of the plant.

25. The byproduct material wastes are accumulated until USRC has approximately 15,000 to 20,000 pounds of prepared wastes, which might run up to 200 radiation units, and at this time the wastes would be shipped via common carrier (Mason-Dixon Line) to Oak Ridge National Laboratory. Burtsavage noted that USRC was authorized an exemption from ICC regulations allowing shipments of this quantity of radioactive material. The exemption was allowed on condition that Mason-Dixon handle this material only for the shipment, i.e. no mixed shipments. Burtsavage stated that, on several occasions, containers with surface readings of 100 mr/hr had been shipped. USRC performed all monitoring, smearing, and loading of containers aboard the van. The determination of radiation levels existing outside the trailor and in the cab would be made by USRC personnel and in no instances would these radiation levels exceed 2 mr/hr. Burtsavage continued that inside and outside shipping containers were properly labeled with "Caution - Radioactive Material" signs, and marked as to type of material, amount and surface levels. During the course of the inspection the inspector observed and checked the labels affixed to inside and outside containers and noted the labeling to be in accordance with the requirements of 10 CFR 20. Labels on outside containers indicated they contained smaller packages of solid radioactive wastes.

26. At the time of the inspection four 55 gallon drums containing smaller packaged containers of wastes and 10 wooden crates were located in the waste storage room. The entrance to the waste storage area was observed to be locked and the keys were kept in the Health Physics office. The area was appropriately posted with "Caution - Radiation Area" signs. The entrance to the waste area was not equipped with an interlock or alarm system which would activate an audible or visible alarm should unauthorized entry be made to the area. Burtsavage stated that should levels of radiation greater than 100 mr/hr exist for more than 30 days he would install an alarm and interlock system in the room.

27. The inspector noted that an area outside the west end of the tritium laboratory was being used by company employees as a lunch room. This area was in close proximity to the waste storage room and some of the radium operations. As noted in paragraph 78 this area was apparently free from contamination at the time of the inspection. (Refer to Exhibit "H" for the location of this area.)

MAIN BUILDING - FIRST FLOOR

28. The first floor of the main building (No. 1 in Exhibit "B") houses the general laboratory, the krypton, cesium and strontium laboratories and the laboratory annex, in addition to most of the administrative offices for USRC plant No. 1. All areas were visited during the inspection; however, work was in progress in only the krypton and general laboratories.

29. At the time of the inspection operations being performed in the krypton laboratory were restricted to the coating of copper filaments with Ni-63. The copper filaments were being inserted by hand into holders positioned along a continuous belt. The belt carried the copper filaments through a Ni-63 bath (nickel suspended in solution) such that approximately $\frac{1}{4}$" at one end of the filament was coated with nickel. The equipment used in the coating operations was noted to be equipped with an exhaust system. Two male employees were operating the Ni-63 coating equipment. Both employees were wearing the film badges and pocket dosimeters and showed considerable care while working with the radioactive material. Burtsavage stated that tritium and krypton activation operations had been performed in a large

vented hood located in this laboratory. Several dozen sources, each activated with approximately 200 mc of tritium, were stored in the hood at this time. Burtsavage stated that the small sources were used by the USAF in buttons placed around the tip of refueling drogues. A Nuclear-Chicago Model #1620 A krypton monitor was installed in the exhaust system above the hood in which the sources were stored. According to Burtsavage this instrument was used as a tritium or krypton stack monitor.

30. The only operation being conducted in the general laboratory was the activation of each of six "Exit" signs with approximately 250 mc Kr-85 gas. This work was performed on a special rig constructed inside a large 3' X 15' vented hood. The rig was designed to activate the "Exit" signs with either 250 mc of krypton or 3½ c of tritium. Burtsavage noted that this work was being done under License 37-30-2. Both sides of the hood had been fitted with large sliding lucite panels. Several of the panels had been moved to leave a considerable area of the hood open. Burtsavage pointed out that each of the six signs being activated were connected to the tank of Kr-gas by feed lines of small copper tubing. When the proper luminosity of each of the signs was reached, the small copper feed tube to the sign would be crimped and solder sealed. All the connections of the copper tubings were noted to be solder sealed. Burtsavage stated that a Baird-Atomic Model 440 Kr monitor (with an alarm) was used as a stack monitor for this hood. The probe was positioned in the center of the exhaust line. Burtsavage stated that when either krypton or tritium was used in the hood, the operator did not rely on the tritium monitor for determining releases of gas, but instead used the manometer and pressure gauge for determining the amount of gas used and for computing losses of gases via the exhaust stack. According to Burtsavage this method was considerably more accurate than the stack monitor and enabled the operator to determine immediately when a loss occurred and exactly how much gas was lost. Burtsavage stated the stack monitor would prove valuable for detecting losses of gas which might occur during the absence of operating personnel. All work in this laboratory is performed under the supervision of Mr. G. E. Widger.

31. A quantity of Kr-85 sealed sources were in temporary storage in the laboratory at the time of the inspection. These sources were reportedly manufactured and distributed pursuant to the conditions of License GL-117. Samples of the labels and markings required by Conditions 13 through 16 of the license were showed the inspector. All working areas in the laboratory were posted with "Caution - Radiation Area" signs and all completed sources were properly labeled and tagged as radioactive material.

32. Burtsavage stated that most of the work performed in the three small laboratories, designated lab annex rooms # 2, 3, and 4, would be research and development with Kr-85 and tritium. All storage containers in these rooms were noted to be labeled with "Caution - Radioactive Materials" signs, including contents and date of assay. Hoods in which work was performed were posted with "Caution - Radiation Area" and "Caution - High Radiation Area" signs. It was noted that many containers now empty were still labeled with the radiation signs and several hoods, not vacant (formerly used for experiments), were still posted with radiation warning signs. Burtsavage stated that there was no strict discipline for removing old labels and signs; however, he insured the inspector that employees were not indifferent to the warning signs. He stated that he would encourage the employees to remove signs and labels no longer needed.

33. Burtsavage stated that both Sr-90 strips and capsules used in the fabrication of sealed sources were made in the Strontium Laboratory. A detailed description of the laboratory and operating procedures is contained in pages 11 and 12 of the previous inspection report.

34. The hot cell located in the Cesium Laboratory has been used for the fabrication of 5 mc to 10 c cesium sealed sources. All steps required for the fabrication of sealed sources have been performed in this laboratory. A description of the operations is contained in page 13 of the previous inspection report. Burtsavage noted that several changes in the production method will result in the second seal of the sources being performed in a new cell box being installed in the Radium Laboratory. (Refer to Exhibit "C" or "E"). The various hoods, storage areas, glove boxes and the hot cell noted in the rooms described in paragraphs 33 and 34 were noted to be posted with "Caution - Radiation Area" and "Caution - Radioactive Material" signs. Storage containers were labeled "Caution - Radioactive Material" and the labels were marked as to type and activity of material contained within. Form AEC-3 was posted in the change room leading to the Sr-90 laboratory.

MAIN BUILDING - SECOND FLOOR

35. Operations currently conducted on the second floor of the main building are the radium hand painting operations, where women employees apply Ra-226 phosphors to watch dials and hands, and the room in which the tritium plates, previously activated in the Tritium Building, (refer to paragraph 42) are assembled into completed dials. In addition to these operations, an area formerly used for radium dial work is being refurbished and equipped for future tritium production. (See Exhibit "F").

36. The inspector, on 11/14/62, reviewed the operations conducted in the above mentioned rooms, took smear samples from these areas, and performed a radiation instrument survey. Smear results are noted in Exhibit "F" & "I" and instrument surveys in Exhibit "F". At the time of the inspection six female employees were working in the radium hand painting room. Their work was being supervised by a male supervisor. Working habits and operations performed by these employees were observed by the inspector. All persons exhibited an awareness of the radiological hazards of radium, demonstrated proficiency in handling the radium phosphor, and were apparently abiding by company regulations governing the use of such materials.

37. The operations performed in the tritium room involved the fabrication of dials, previously mentioned in paragraph 35 as having been fabricated in the tritium building. This work is performed under License 37-30-6. The plates are pressed to a scribed front piece of plastic and passed through a small furnace which heats the plastic, sealing it to the plate. The finished product emerging from this room is a completely sealed dial piece, marked to read in mr/hr. According to Burtsavage the completed pieces are used as instrument dials on radiation detectors. All operations involving the fabrication of these dials have been performed in vented and evacuated glove boxes. The interior of the glove boxes were lined with a plastic vinyl ("Contac"). Burtsavage stated that all glove boxes and hoods in this area are maintained at a negative pressure equivalent to about 3/4" of water. The floor in this area was completely covered with heavy kraft paper. Burtsavage noted that here, as in other restricted areas, he was attempting to limit removable contamination to 4000 cpm. This included interiors of glove boxes. Unrestricted areas, including the change room, he was trying to hold removable contamination to 20 cpm. Burtsavage admitted that he might have to increase the allowable contamination levels in unrestricted areas to possibly 100 or 1000 cpm for tritium.

TRITIUM BUILDING

(NOTE: Paragraphs 38 - 42 are Company Confidential)

38. Mr. I. Allam, Chemist, stated that most of the time he was the sole occupant of this building. Allam stated that he prepared the tritiated foil used in the various USRC LAB sources authorized for distribution to general licensees pursuant to GL-112. Allam stated the tritium was normally applied to a 9" x 11" sheet of foil from which various sizes and shapes could be cut as required by the specific USRC sources. Allam stated the procedures used resulted in a fairly uniform application of tritium to the foil. The activity would be approximately 1 c/sq. in. Allam stated there had been little production of foils for distribution under GL-112 since late spring of 1961; however, he added that the company recently received an order for a number of units. Allam commented that he had been experimenting with methods for tritiating foils and phosphors of products authorized for distribution pursuant to Licenses 37-30-6 and GL-122. He added that several sources had been fabricated as test units; however, tritium application had not produced sufficient luminosity for these sources. Allam stated that he also supervised several experiments in the application of imported tritiated luminous compounds to various metal and plastic surfaces. USRC ships H-3 gas to the Radium Chemie (R-C) Company in Switzerland, which in turn tritiates compounds both as a dry powder and in an applied form and returns the tritiated material to USRC. Amendment No. 2 to License 37-30-6 authorizes the use of R-C tritiated paint on time pieces and dials. Exportation of the gas and importation of phosphors and foils is outlined in a letter dated 11/19/62 from USRC to DL&R.

39. At the request of the inspector Allam demonstrated and explained the nature of his work and the various operations he performed. The entire process of tritiating the foil is performed in a semi-enclosed box located in the center of the building. (Refer to Exhibit "G"). An exhaust hood covers the entire work area. Both Allam and Burtsavage referred to the working area as a vented hood.

40. Allam stated that he placed a piece (9" x 11") of stainless steel foil which was plated with zicronium and/or titanium in a steel cylinder. The cylinder was partially evacuated and the plated foil exposed to tritium gas. Heat would then be applied to the foil and tritium would be adsorbed on the Zr and/or Ti plating. Allam stated the tritium is very carefully controlled by manometer readings and that he can estimate to within .001 mc the quantity of tritium adsorbed by the foil. Allam stated his losses have been kept to a minimum known amount and a record of these losses maintained in his laboratory book. He added that several ml of H-3 gas are lost occasionally when the line is purged. The inspector noted a sign posted on the hood above the tritium container stated that a maximum of 750 mc of tritium could be exhausted through the hood in a 24 hour period without exceeding the limits of Part 20. Allam's records indicated his losses to be considerably less than this figure.

41. Allam explained that the method he used to deliver H-3 gas to the cylinder containing the foil gave him excellent control over use of the gas. Allam stated that the tritium gas was slowly released from its storage container and was absorbed by uranium metal contained in a small cylindrical pot measuring approximately 1½" in diameter and 1" in height. (The resulting compound, UH_3 is stable at room temperature). Allam continued that when application of tritium was to be made, copper feed lines leading from the UH_3 pot to the steel cylinder holding the foil would be evacuated.

The pot would then be heated to 400° C, at which temperature 90% of the tritium would be driven off. (At 600° C, 100% of the tritium would be driven off.) The tritium gas migrates along the copper line leading to the cylinder containing the zirconium and/or tritium coated foil. Allam stated that, using manometers to record the pressure in the line, he knew exactly how much tritium would pass through the copper line and be adsorbed by the foil. Most of the work would be performed at one atmosphere and involve from 150 to 175 c of tritium. Allam stated that the tritium came from Oak Ridge National Laboratory in either 500 or 1000 liter (500 - 1000 c) containers at one-half atmosphere of pressure. He added that usually all 500 or 1000 c of the gas would be absorbed by uranium located in the small pots. One or two spare pots were always kept in reserve.

42. As noted in Exhibit "G", on the left hand side of the tritium building there is a series of interconnected glove boxes and hoods which pass through a dark room. This area is used for the application of the imported tritiated phosphors to a plate which forms the back part of the radiation detector dial. Burtsavage stated about 5 c of tritiated phosphor would be applied to a small cup on each plate. All work with tritiated phosphors would be performed in glove boxes, each operated at approximately 3/4" negative pressure. Burtsavage noted that 1½"negative pressure would be maintained with new absolute filters and when the pressure dropped to 3/4" the filters would be changed. The tritiated phosphor has been applied to the plate with a spatula by woman employees. After application of the H-3, the dial plates would pass through a small opening into an oven where they would be baked to dryness. In subsequent operations the plates could be lacquer coated. The f inal product would be a sealed tritiated light source. Finished products from this area are then delivered to the tritium processing laboratory located on the second floor of the main building. (See paragraph 37.) Burtsavage noted that the company is conducting experiments in an attempt to duplicate the imported phosphor. He added that the experimentation involves determining various methods of tritiating the phosphor oil such that it would adhere to any of the metals and other materials used by USRC for fabricating various dials and face plates. As noted in paragraph 38 this work is supervised by Allam.

(NOTE: The above paragraphs 38 - 42 contain priviledged information)

43. An Atomic Accessories TSM-91 tritium monitor was noted to be in operation within the tritium building. Burtsavage stated the monitor was currently operated on the x10 scale. He added that he was not certain of the concentration of tritium in the air required to trip the tritium monitor. However, he stated that the monitor had tripped on several occasions in the past. Burtsavage stated that he relied on the urinalysis results for determining the concentrations of tritium in the air. As noted in paragraph 56, the tritium urinalysis has showed Allam's body burden to be increasing over the past nine months.

44. A log book kept by Allam contained the results of smear samples taken within the building. The log, according to Burtsavage, was reviewed on a weekly basis by the Health Physics staff. This log was not reviewed at the time of the inspection.

Instruments

45. As noted from an inventory of detection equipment possessed by USRC, the following equipment was on hand at the time of the inspection:

18 count rate meters
17 survey instruments
1 tritium monitor
8 proportional counters PCC's
1 Keleket alpha detector

Burtsavage stated that calibration and maintenance of the instruments were performed by USRC personnel. Instruments are calibrated approximately once a month.

Treatment of Radioactive Liquid Wastes

46. Pages 16, 17, and 18 of the previous inspection report contains discussion of the system employed by USRC for the disposition of low-level liquid wastes. As noted in the previous report the disposal facility was inoperative for a short time in the spring of 1961 due to the collapse of a wall as a result of a heavy rain storm. Burtsavage stated repairs were completed several weeks after this incident and waste disposal operations were resumed during late spring of 1961. A summary of the treatment and disposition of liquid wastes has been made in the following paragraphs.

47. As also noted in paragraph 64, the high level radioactive liquid wastes from the Cs hot cell are first sent to a hold-up tank located under the floor of the shed attached to the outside east wall of the hot cell. Periodically these wastes are passed through a series of three ion exchange columns located in this shed. Burtsavage stated that the process of running the liquid through the column, which extract most of the Cs, would take about two days. The low level effluent (10^{-4} to 10^{-5} uc/ml Cs) would then flow to the low level liquid waste system. The high level waste (ion exchange resin) would be considered as a solid waste and packaged and disposed of as such.

48. A summary of the steps taken in the processing of liquid wastes has been made in the attached Exhibit "J". After liquid wastes have passed through the ion exchange column and evaporator, the liquid would be stored in one of two hold-up tanks (C or D). When a hold-up tank was almost full, a 5 to 7 liter sample would be extracted, the liquid evaporated, and the residue counted to determine the various isotopes and quantity of each appearing in the sample. Using these results a computation would be made to determine the activity (in uc/ml) for each identifiable isotope contained in the tank. Burtsavage stated that, using this data, and knowing the total liquid content of the tank he could obtain the total activity of each isotope contained in the tank, and similarly, the sum activity of all isotopes in the tank. Burtsavage stated that when the contents of a tank would be discharged to the Susquehanna River, the effluent from the hold-up tank would be combined with the continuous flow of liquid coming from the condenser (coolant water). The discharge from the hold-up tank would be metered such that it would be diluted by a factor of ten by the condenser water. In any event the dilution would be such to insure the activities (uc/ml) would be less than that stipulated in 10 CFR 20. Burtsavage stated that it normally took 24 hours to empty a hold-up tank. He added that no analyses of the soil along the ground leading to the river had been performed. The discharge pipe from the facility appears above ground approximately 50' from the building and the effluent flows above ground as an open brook for the remaining distance of about 40' to the river.

49. Waste disposal records kept by Burtsavage since the last inspection were reviewed during the inspection. Burtsavage stated that he used the concentration for insoluble materials appearing in Appendix B, Table 2, Column 2, Part 20, as the maximum limits for activities in the waste effluent. He used the equation appearing in note 1 to this appendix as the limiting factor for a mixture of radionuclides. The review of records indicated that the equation appearing in note 1 was employed in every instance to compute the sum of the ratios of activities of the

radioisotopes, and in no instance did the sum of the ratios exceed unity. Extractions from the 1962 disposal records were made and they are noted in Exhibit "K". The following computation was taken from the records of the discharge appearing in entry (1) Exhibit "K":

Activity per radioisotope as determined by counting the evaporated residue on the planchet:

H-3 = 4.6×10^{-3} uc/ml
Ra-226 = 9.02×10^{-5} uc/ml
Cs-137 = 2.16×10^{-6} uc/ml

Volume of liquid in tank "A" = 9.01×10^{-6} ml

Activity of radioisotopes in tank "A" - H-3 = 41,536 uc
Ra-226 = 812.7 uc
Cs-137 = 19.5 uc

Coolant water discharged during 24 hr. period = 88.49×10^{6} ml

Total waste + dilution for 24 hr. discharge = 97.5×10^{6} ml

Computation of new activity (uc/ml) based on 97.5×10^{6} ml liquid:

H-3 = 4.27×10^{-4}
Ra-226 = 8.35×10^{-6}
Cs-137 = 2.01×10^{-7}

Using the activities noted in Appendix B, Table 2, Column 2, for insoluble isotopes, Burtsavage computed the following number for the sum of the ratios of the radionuclides in tank A:

$$\frac{4.27 \times 10^{-4}}{3.0 \times 10^{-3}} \text{ (H-3)} + \frac{2.01 \times 10^{-7}}{4.0 \times 10^{-5}} \text{ (Cs)} + \frac{8.35 \times 10^{-6}}{3.0 \times 10^{-5}} \text{ (Ra)} = .923(1$$

Personnel Monitoring Program

Body Film Badge

50. USRC utilizes Radiation Detection Company film badge service, provided on a weekly basis. Only the film badge records maintained on AEC Form 5 were reviewed during the inspection. AEC Form 4 and the processor's records were not reviewed. A review of the 1961 and 1962 whole body film badge records indicated that 55 persons of the licensee were subscribed to this service. Burtsavage stated that the company was abiding by the regulations outlined in paragraph 20.101(b)(1) and (2), permitting individuals in restricted areas to receive whold body doses not exceeding 3 rems/quarter and accumulative yearly operational doses not exceeding 5 (N-18) rems (where N equals an individual's age in years). The records reviewed indicated that in no instances were these limits exceeded. The review of the 1961 records showed the average quarterly dose received by employees was .335, .8, 1.2, and 1.5 rem respectively, for each of the four quarters. Examples noted were:

a. [redacted] - .8 rem for the entire year, and a weekly average of 30 mrem gamma.

b. [redacted] - 1.7 rem for the year, average weekly doses of 25 mrem, and an average quarterly dose of 0.640 rem. The doses noted resulted mostly from beta radiation.

c. [redacted] - Quarterly doses of 1.2, 16, 1.9 and .98 rem with a yearly total of 4.7 rem. The high weekly dose noted was .3 rem, with the average about .1 rem.

d. [redacted] - Quarterly doses of 1.47, 1.8, 2.6, and 2.3 rem with a total for the year of 8.1 rem. The highest weekly reading noted was .305 rem. All exposures were noted to be from the gamma radiation.

51. A review of the 1962 records indicated that for woman employees quarterly doses did not exceed 1 rem and that the average quarterly dose was 0.6 rem. Male employees had slightly higher average quarterly doses. The quarterly doses for two male employees were as follows: [redacted] - 1.85, .9 and .95 and [redacted] - 2.4, 1.9 and 1.7 rem. [redacted] doses represented the highest of any male employee during the first three quarters of this year.

Hand Badges

52. Nineteen employees of USRC subscribed to the weekly hand badge service provided by Radiation Detection Company. A review of the records maintained on AEC Form 5 indicated in no instances was the 18-3/4 rem limit specified in Part 20 exceeded. Examples were extracted from the 1961 and 1962 records and the yearly and quarterly doses, in rems, are as follows:

1961

[redacted] - year - 13.8; quarterly - 2.5, 3, 6.7, and 1.5

[redacted] - year - 27.9; quarterly - 5.9, 11.6, 2.0, and 8.3

[redacted] - year - 13.4; quarterly - 5.3, 2.06, 4.9, and 1.14

1962 (Quarterly Only)

[redacted] - 8.5, 4.3, 8.7

[redacted] - 10.8, 6.8, 17.3*

[redacted] - 9.2, 6.8, 5.3

[redacted] - 3.9, 3.8, 2.9

[redacted] - 15.8, 13, 9

[redacted] - 6.6, 4.9, 6.8 (3.8 to the right hand and 3 to the left hand)

*USRC investigated cause of high reading and determined that 14. rem gamma was received during the week of 7/23/62 while handling radium.

Pocket Chambers

53. Seventeen employees of the licensee utilize Victoreen pocket dosimeters. Two chambers are worn by each person engaged in operations involving the use of any radioisotope. The chambers are turned into the Health Physics Office at the conclusion of each work day. The Health Physics staff reads

each of the chambers daily, recording the readings in a logbook. Burtsavage stated that the company was currently working with the option of 300 mr per week based on past experience, but he was endeavoring to reduce the upper limit to 100 mr per week. A review of 1961 and 1962 records indicated that in no instance was the limit 300 mr per week exceeded. The 1961 records indicated most weekly readings were between 70 and 150 mr. The highest weekly reading was approximately 200 mr, and the highest daily reading was approximately 150 mr. An example was extracted from the October-November 1962 results. The following figures represent an average weekly reading, the highest weekly reading, and the highest daily reading in mrem:

[redacted] - 20, 40, and 15

[redacted] - 130, 270, and 130

[redacted] - 50, 300, and 270

Urinalysis

54. Burtsavage stated that a semi-annual urinalysis was made of individuals working with Strontrium-90, and Cs-137, and that a weekly urinalysis was made of individuals working with tritium. Burtsavage noted that he was working towards a limit of 30.7×10^{2} dpm/1500 ml for Sr-90, and 30.2×10^{4} dpm/1500 ml for Cs-137. The urinalyses for Sr and Cs were performed by Isotopes, Inc., Westwood, New Jersey. Results of urinalyses performed subsequent to the last inspection follow (figures represent dpm/liter):

Sample of 8/1/61

[redacted] - Cs-137 - 27,700

Sample of 9/12 to 9/13/61

[redacted] - Sr-90 - 285

[redacted] - Sr-90 - 15.7

[redacted] - Cs-137 - 17,400

[redacted] - Cs-137 - 3.13

[redacted] - Cs-137 - 3,270

Sample of 3/27/62

[redacted] - Cs-137 - 7,300

[redacted] - Cs-137 - 5,710

[redacted] - Sr-90 - 24.8

[redacted] - Sr-90 - 15.4

Sample of 9/21/62

[redacted] - Sr-90 - 62.6

[redacted] - Sr-90 - 14.5

[redacted] - Cs-137 - 1,450

[redacted] - Cs-137 - 4,330

55. Burtsavage stated that the guidelines used for tritium urinalysis were the same as noted during the last inspection, i.e., use of LA-2163 as a reference. Analysis is made by USRC personnel. A total of 12 persons have been involved in the tritium up-take program. Burtsavage noted that in the future he hoped to limit tritium uptake such that persons would not receive a whole body dose exceeding 100 mrem per week. The inspector noted that for the period subsequent to the last inspection, the tritium up-take dose was on several occasions in excess of 100 mrem/week for one individual as noted in the following paragraph. Extracts taken from the records for individuals working with tritium in areas other than the tritium building are as follows (figures represent total quarterly dose):

[redacted] - First quarter 1962 - 0.034 rem

[redacted] - For each of the first three quarters of 1962 -
- 0.112, 0.122 and 0.190 rem, respectively

[redacted] - First three quarters of 1962 -
- 0.27, 0.15 and 0.183 rem, respectively

[redacted] - For first three quarters of 1962 -
- 0.026, 0.026, and 0.054 rem, respectively

The 1961 results were similar to the 1962 results in almost all instances.

56. A review of the 1962 records for [redacted], who was involved in most tritium operations conducted in the tritium building, showed the following (in rem):

First Quarter - .742; highest weekly dose .184

Second Quarter - 1.195; highest weekly dose .524

Third Quarter - 1.935; highest weekly dose .336

For the seven days preceeding 11/12/62, [redacted] had urinalysis results which indicated 91.47 uc/l (about 365 mrem whole body dose for the period). The 1961 urinalysis results for [redacted] indicated his tritium uptake was averaging less than the first quarter 1962, with the tritium uptake remaining almost constant throughout the year. As noted by the above tabulated results, the dose received by [redacted] apparently has been increasing during each consecutive quarter of the present year. Burtsavage stated that no evaluation had been made to determine the concentration of tritium in the air around the area in which [redacted] would be working. Burtsavage stated that a study to determine the air flow pattern or characteristics had not been made because employees were constantly changing hood damper positions or leaving open the doors to the tritium building. Burtsavage stated that he had not made an attempt to evaluate the cause of [redacted] continuously increasing uptake of tritium. He noted, however, changes were being made to increase the air flow through the hood above the operator's position and that this change should reduce [redacted] uptake. Burtsavage stated the modifications would double the air flow away from the face of the hood.

Radon Breath Analysis

57. Burtsavage stated that radon breath analysis, similar to that reported in the previous inspection report, was being performed on a semi-annual basis for all personnel engaging in radium operations. The analyses, according

to Burtsavage, have been made by Dr. V. Hess. Burtsavage commented that he used the body burden for radon, i.e., 1×10^{-12} c/l or 1×10^{-9} uc/ml, as a purely "go/no go" basis for determining when individuals would be removed from operations involving the use of radium (i.e. if an individual exceeded 1×10^{-9} uc/ml he would be removed from this work until rechecks indicated a decrease in his body burden). If levels 5 to 10 times greater than body burden were observed, the Health Physics staff would conduct an investigation to determine the cause.

Stack Sampling - Unrestricted Areas

58. A summary of the techniques of sampling exhaust air in the various stacks at USRC has been made on pages 31 and 32 of the previous inspection report. There are now 14 exhaust stacks, ten of which are sampled every three months.

59. Burtsavage stated that the stacks exhausted air from various glove boxes and hoods located in areas in which byproduct material was used, from radium laboratories and from other processing areas where harmful fumes or gases were emitted. Those stacks that were periodically sampled, exhausted air from various areas in which licensed material was used, and according to Burtsavage the sampling was made during a four hour period while work with byproduct material was being performed. According to Burtsavage each of the 14 exhaust stacks was equipped with both a pre-filter and an absolute filter. The air passed through both before emerging into the atmosphere. Burtsavage stated that he was going to install a secondary absolute filter in most of the stacks used in the byproduct material shops. Detailed records were maintained of all air samples taken in these stacks. A review of the records indicated no instances where the limits of Part 20 were exceeded. Examples extracted from the records maintained by Burtsavage are as follows:

a. Sr-90 Laboratory - Air sample of 9/14/62: A 247 minute air sample was taken while 2.4 c Sr-90 solution and .1 c Sr-90 foil was being handled in the hood for a 2½ hour period. Analysis of the filter paper indicated the presence of 1.66×10^{-11} uc/ml Sr-90 in the air exhausted to the atmosphere. A 2 hour and 50 minute room sample taken during the handling of the Sr-90 indicated the presence of 1.32×10^{-12} uc/ml Sr-90 and a trace of radium (1.16×1^{-12} uc/ml).

b. Cesium-137 Hot Cell - A four hour sample was taken 3/26/62 during a period when no work was in progress. Approximately 1 c of Cs-137 was present as a contaminant in the hot cell. Analysis of the stack sample indicated the presence of 5.5×10^{-10} uc/ml cesium in the exhaust air. A room sample taken concurrently with the stack sample indicated the presence of 5.25×10^{-10} uc/ml cesium-137 and 1.6×10^{-12} uc/ml radium-226 in the Cs laboratory. Burtsavage said that the stack sampling system was designed such that the air passed first through a filter paper, then a chamber manometer, and finally passed back into the stack through the pump.

c. "BH" Bake Room - A four hour sample taken on 8/30/62 while 150 uc of radium-226 was present in the room (no person present). Results of the stack samples indicated the presence in the exhaust air of 3.43×10^{-12} uc/ml radium-226 and a trace of tritide particles (8.28×10^{-12} uc/ml). A simultaneous room sample showed the presence in room air of 4.15×10^{-13} uc/ml radium.

60. According to Burtsavage, the procedure for counting tritium particulates involved first putting an absorber on the filter paper, counting the sample, removing the absorber, and recounting and analyzing the results for 18 KEV tritium beta. Burtsavage stated that all tritium shops were subjected to both stack and room sampling. Burtsavage stated that he used either a Nuclear Measurements PC-2B or PC-2C instrument for counting the stack and room air samples. Samples were counted for about 15 minutes.

Area Surveys

61. Burtsavage stated that the Health Physics staff of USRC had made numerous area surveys of all unrestricted and restricted areas throughout Plant #1. The area surveys included both the use of radiation detection instruments and smear sampling. Many of the records of such surveys were reviewed during the inspection. In addition, the inspector made independent instrument surveys and took selective smear samples from various locations at the plant. Two independent air samples were taken. Comments on the review of USRC survey records and the results of the inspector's surveys are noted in the following paragraphs. As indicated below, the results of the inspector's surveys are contained in the attached exhibits.

Unrestricted Areas

62. In summary, USRC records indicated that radiation levels existing outside the liquid waste processing plant (building 4, Exhibit "B") were in most instances less than 1 mr/hr and never exceeded 2 mr/hr. According to Burtsavage the surveys were made on a bi-monthly basis. Surveys conducted exterior to the prepared waste shipment building (building 5, Exhibit "B"), about the fence surrounding the silo (building 6, Exhibit "B"), and the fences surrounding the various storage vaults (buildings 7 and 8, Exhibit "B") were in all instances less than 2 mr/hr. The inspector's instrument survey corroborated these results.

63. Areas in the main building that were surveyed included the library, sales office, engineering offices, research and development dark room, passageways along the front offices and passageways approaching the restricted area. (Refer to Exhibit "C" for location of some of these areas.) The records indicated that with the following exceptions, levels were much less than 2 mr/hr. A note on the record of a survey performed during February 1962, indicated that one spot on the wall of the dark room, separating this room from the Krypton laboratory, had a radiation level of 5 mr/hr. Subsequent investigation revealed the radiation was emanating from several 50 mc Kr-85 sources stored in a hood adjacent to the wall. Corrective action was taken by shielding the sources with lead sheets. The additional shielding reduced the radiation level to less than 2 mr/hr. In addition to the instrument surveys, film badges were also placed in the above mentioned areas and exposed for a period of 168 hours. The film badge processor's reports indicated the average exposure to the badges to be substantially less than 2 mr/hr.

64. Records of the surveys performed in the unrestricted areas outside the main building (building 1, Exhibit "B"), showed that with one exception radiation levels averaged approximately 1 mr/hr. The exception noted was on the south wall adjacent to the cesium laboratory, and according to Burtsavage was a result of activity from the cesium ion exchanger and storage tank located in a small structure located outside the Cs-137 laboratory. Levels of 5 to 6 mr/hr existed several feet outside the laboratory for two days on each of 8 different occasions during 1962. The radiation field existed during the period when the ion exchange unit was functioning and extracting

the high level contaminants from the liquid wastes. As also noted in paragraph 47, three ion exchange columns, employing a resin, have been used to extract the high level cesium. High level wastes (i.e. ion exchange column resin) were removed as a solid waste, and the low level waste effluent piped to the evaporator building. In addition to the temporary levels of 5 mr/hr an additional level of 16 mr/hr was noted as continually occurring at the surface of the wall in the corner between the cesium laboratory and the ion exchange building. This level existed at the location denoted "G" in Exhibit "D". This reading is not to be confused with the reading noted by the inspector as existing at "G". Burtsavage noted that this field probably resulted from residual contamination in the drain pipes. No effort had been made to provide additional shielding or to remove the residual contaminants in order to reduce the radiation levels in this area.

65. Numerous smear samples had been taken by USRC of the unrestricted area in the main building. These smears were monitored with an internal proportional counter and as noted in the records the average smear indicated less than .02 dpm alpha and from 3 to 10 dpm beta-gamma per 100 cm^2 wiped.

66. Results of the instrument survey made by the inspector, on 11/14/62, of the unrestricted areas on the first floor of the main building and outside the building, are shown in the attached Exhibit "C" and "D". Locations of the smear samples are shown in Exhibit "E" with the results of the smears given in Exhibit "I".

67. As noted in Exhibits "C" and "D", the radiation survey made by the inspector confirmed the presence of radiation levels in excess of 2 mr/hr on the outside wall of the cesium laboratory, revealed an additional field greater than 2 mr/hr outside the window, and revealed a high radiation field on the roof above the cesium laboratory. The hot spot in the corner of the outside wall of the laboratory was monitored and the level noted to be 16 mr/hr. A radiation level of 12 mr/hr was detected 3' above the ground and 1' out from the corner (location G, Exhibit "D"). Burtsavage said that the 16 mr/hr reading was approximately at the location of an elbow in the pipe leading from the ion exchange column to the evaporator building. He stated the high levels probably resulted from the accumulation of Cs-137 insolubles in the elbow of the pipe.

68. A radiation level of 12 mr/hr was noted at the surface of the window on the outside wall of the cell (denoted D in Exhibit "D"). The radiation field was apparently emanating from a source within the cell and approximately was conical in shape, diverging as the distance from the window increased. Approximately 10' from the building (measured in the driveway adjacent to the building), the radiation level was 2 mr/hr (surface noted F in Exhibit "D").

69. The meter survey on the roof above the hot cell indicated surface levels greater than 200 mr/hr and levels of 130 mr/hr, 3' above the roof and approximately 3' away from the corner of the housing containing the filters from the cesium exhaust system. This radiation resulted from 10 c of Cs-137 chloride solution present in the hot cell. The radiation level decreased as the distance from the filter housing increased such that at a radius of approximately 20' in all directions from the filter housing, it was noted to be 5 mr/hr. Various radiation levels detected have been noted as A, B, and C in Exhibit "D". A 2 mr/hr line was not established because of the presence of obstructions and inaccurate readings of a survey instrument. Burtsavage stated that the roof above the hot cell was constructed of only wood and tar paper; no shielding was present.

Burtsavage stated that a comprehensive radiation survey had never been performed of the roof above the hot cell. He added the radiation levels had been approximated and known to be greater than 2 mr/hr. All stacks, vents and the structure containing electrical equipment were noted to be posted with "Caution - Airborne Radioactive Area" signs. No "Caution - Radiation Area" signs were noted. Burtsavage stated that he considered the roof a restricted area, but conceded he had not established positive control over access to the roof. A ladder was noted leaning against the building and was capable of reaching the roof. Two doors from second floor laboratories leading to the roof area had not been equipped with any sort of a control device which would prevent access to the roof or energize an alarm system to warn either those entering the area or the Health Physics staff when entry would be made to the roof.

Restricted Area

70. Tritium Building - Burtsavage stated that personnel working in the tritium building, principally Allam, performed all smear tests within the building, counted the smears and recorded them in a logbook kept in the building. The log was reviewed weekly by the Health Physics Department. This log-book was not reviewed during the inspection. Burtsavage noted that he was attempting to hold the contamination level outside glove boxes and hoods in this building to 20 dpm, adding that it was difficult to keep realistic low levels, hence an occasional allowance of 100 dpm would be made. He added that workers were living with greater than 100,000 dpm beta inside some of the glove boxes in this building. No attempts had been made to reduce the level of contaminants below this figure.

71. Main Building - General Laboratory and Laboratory Annex - Burtsavage stated that radiological instrument surveys were made of these restricted areas at approximately four day intervals. Records of all surveys were maintained and available for inspection. A review of some of these records indicated the following to be typical entries:

a. Kr-85 laboratory - 15 mr/hr at the surface of the hood in which several 50 mc were usually stored and less than 5 mr/hr in areas normally inhabited by employees.

b. General laboratory - 15 to 50 mr/hr at hood and glove box interfaces during handling operations and less than 5 mr/hr in the general working area.

c. Radium laboratory - approximately 50 mr/hr at hood interfaces and approximately 100 mr/hr in select areas when employees would be working with radium.

d. Sr-90 laboratory, radium hand painting room, and laboratory annex room numbers 2, 3, and 4 - background less than 5 mr/hr during operations involving radioactive materials.

e. Po-210 room - an occasional 200 to 800 mr/hr alpha with most levels less than 10 mr/hr alpha radiation.

f. Cesium laboratory (laboratory annex 35) - occasional 100 to 500 mr/hr levels at the hot cell surface while work was in progress, with general radiation levels in the room approximately 5 mr/hr.

Burtsavage stated that work in high radiation areas normally did not exceed several hours per week. He said he was attempting to limit background radiation levels to which employees would be exposed to less than 5 mr/hr.

72. Burtsavage stated that daily smear samples were made of the above areas by the Health Physics staff. Logs containing the results of these surveys were available at the time of the inspection, but were not reviewed.

73. Locations and results of the smear samples and results of the instrument surveys taken by the inspector at the time of the inspection are shown in Exhibits "E", "I" and "C", respectively. Smear samples did not reveal the presence of hazardous amounts of radioactive contaminants. Radiation levels less than 5 mr/hr were noted in work areas in the cesium laboratory normally frequented by employees engaged in fabrication operations. Radiation levels were not considered hazardous, inasmuch as employees did not inhabit the cesium laboratory for more than 10 hours in any one week. Surface levels around the hot cell were higher than 5 mr/hr, however, personnel do not remain in these locations for extended periods of time. With the exception of several locations where byproduct material (or products containing same) were stored, the radiation levels in most work areas was less than 2.0 mr/hr. According to Burtsavage, only in exceptional cases will employees be in these areas for the entire 40 hour work week.

74. Main Building, Second Floor Tritium and Radium Shops - periodic instrument surveys and smear samples were made of the radium hand painting shop and records of the results maintained by USRC Health Physics Department. These records were not reviewed during the inspection. The results of the instrument survey and smear samples taken by the inspector are given in Exhibit "F" and "I", respectively.

75. The Health Physics staff, daily, at the end of each work day took, at random, six to 10 smears within the tritium production room. The smears were counted with a proportional Nuclear-Chicago counter kept in the laboratory. Results of the smears were recorded in a logbook placed on top of the counter. The logbook was reviewed at the time of the inspection. Notations made in the book indicated that the daily background count was approximately 260 cpm. Gross counts from various smears ranged from 100 to 5000 cpm and the net dpm ranged from 200 to 10000, assuming approximately 2 disintegrations per count. Burtsavage noted that any smear indicating in excess of 4000 cpm, required an immediate decontamination on the part of the laboratory staff. Notification to the laboratory staff was made, in writing, and required action on the morning following the smear survey. The locations with high counts would be checked again the following day to ascertain the results of decontamination. The following is an example of an entry made in this logbook. Date of smear 11/2/62 (results are given in dpm and represent a smear of 100 cm^2):

a.	exterior surfaces of the glove box denoted #2 in Exhibit "F"	- 640
b.	trash can lid located under same glove box	- 1040
c.	work table denoted #4, Exhibit "F"	- 300
d.	packaging table denoted #5, Exhibit "F"	- 600

Burtsavage stated USRC safety regulations required that each tritiated dial fabricated by the company be wipe tested and determined to be free of removable contamination prior to being individually packaged. The packaging consisted of a transparent plastic envelope, sealed by stapling.

76. Etching Plant, Waste Storage and Radium Shop - During the inspection a smear sample was made in the waste storage room (see Exhibit "H") and radiation meter surveys made of waste storage barrels and boxes located in the room. Results of the survey are noted in Exhibit "H". In summary, no container had a surface reading greater than 50 mr/hr, the background level in the room was approximately 5 mr/hr, and radiation levels on the surface of exterior walls was, in most cases, substantially less than 2 mr/hr.

77. The background radiation level in the radium screening room as noted during screening operations, was slightly less than 2 mr/hr. The average surface count of alphas, as detected by Pennsylvania Health Department probe was 600 counts per minute. Results of the inspector's smear sample and instrument survey are noted in Exhibit "H". As noted in this exhibit, the AEC inspector took one air sample in the screening room.

78. During the inspection the inspector noted that a small area in an unused room located in the southwest corner of the building, was used by company employees as a lunchroom. This area was located outside the west end of the H-3 Research and Development Laboratory and was in close proximity to the waste storage room. On 11/14/62 three employees were observed eating lunch at a table located in the area. An instrument survey indicated the radiation level at the lunch table was less than 1 mr/hr. One smear of the table was made (results - entry 2, Exhibit "I") and an analysis of the smear indicated 200 dpm removable beta contamination.

79. Solid Waste Processing and Packaging Area - The building used for the processing and packaging of solid wastes, a small unheated shed denoted as building #5 Exhibit "B", was surveyed and several smears taken on 11/14/62 by the inspector. (Smear results are given in Exhibit "I"). An instrument survey was made to determine the levels of radiation on the outside surfaces of four barrels and one wooden box, all labeled as containing cesium, strontium and radium. The survey indicated no surface levels exceeding 40 mr/hr. Average surface readings of the containers was 30 mr/hr. Smears of the waste containers indicated the presence of 200 dpm removable beta contamination.

80. The instrument survey revealed the presence of 3 hot spots on the concrete floor of the building. The survey indicated 4 mr/hr gamma and 50 mr/hr beta at contact, and 3 mr/hr beta at 12" from each of the three spots. Burtsavage said that he thought this was the result of a cesium spill and added that he would eventually chip out the concrete in order to remove the contamination. A smear taken by the inspector (sample No. 6 Exhibit "I") indicated removable contamination of 20,000 dpm beta, 18,000 dpm gamma.

81. Waste Storage Silo - No smear samples were taken inside the silo used by USRC for the storage of solid wastes contained in a various assortment of small packages. These containers are stored here prior to being repackaged in 55 gallon drums. An instrument survey of the silo and exterior environs showed radiation levels of 50 mr/hr existing 18" from the accumulated assortment of packages, 20 mr/hr at the outside surface of the silo, and less than 1 mr/hr outside the exclusion fence surrounding the silo.

82. Evaporator Building - One smear sample, entry No. 5, Exhibit "I", was taken on a work table in this building, and an analysis indicated 230 dpm removable beta contamination. Meter surveys taken within the building indicated radiation levels substantially less than 2 mr/hr.

Review of H-3 Release on 10/27/61

83. Pursuant to a request made in the memo from L. Dubinski, CO:HQ, to E. R. Price, DL&R, dated 12/14/61, a review was made of the USRC incident involving the accidental release of 75 curies of tritium on 10/27/61. A technician, [redacted] was engaged in the process of activating aircraft "Exit" signs when, due to an improperly closed valve, 75 c of H-3 gas escaped to a hood and was exhausted through the hood venting system. Burtsavage stated that he could add nothing to the information previously submitted in his 11/14/61 letter to the Director, DL&R, and in the 12/8/61 memo from CO:I to CO:HQ.