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	May 22 - 26, 1961
	3. Type of inspection Reinspection
	4. 10 CFR Part(s) applicable 20 - 30

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

License No.	Date	Exp. Date	
37-30-2			
amend. 16	5/17/61	5/31/63	(amended in its entirety)
37-30-3			
amend. 2	7/27/60	7/31/62	(amended in its entirety)
amend. 3	8/16/60	7/31/62	
amend. 4	9/15/60	7/31/62	
amend. 5	2/20/61	7/31/62	
GL-112			
amend. 3	5/10/61	5/31/63	(amended in its entirety)

6. Inspection findings (and items of noncompliance)

Radioactive materials at USRC are employed in the production of luminous phosphors, foils, sealed sources and light sources for use in all types of instrument panels, gauges and devices. Approximately 200 people are presently employed at the Bloomsburg plant, about 50 of whom use radioactive material. Two safety committees, the General Plant Safety Committee and the Isotope Committee, are maintained. E. M. Burtsavage serves as Health Physicist and RSO. Numerous direct radiation surveys, smear samples and air samples are taken. Leak tests of sealed sources are performed at prescribed intervals. Film badges, ring badges, pocket chambers, radon breath analyses, and bio-assays are employed for radiation workers. Solid wastes are transferred to ORNL and Nuclear Engineering Company. Low-level liquid wastes are processed in a newly constructed liquid waste disposal facility before discharge to the Susquehanna River. Records of all types are kept by USRC. The following items of noncompliance were observed or noted:

License 37-30-3

No items of noncompliance.

(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))
37-30-3 - 4/13-17/59 37-30-2 GL-112 - 9/20-23/60	Entire report.

DISTRIBUTION:
1 cy - CO-HQ
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Jack R. Roeder - R.W. Van Wyck
(Inspector)

Approved by: Robert W. Kirkman, Director
New York Compliance Area
(Operations office)

August 2, 1961
(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

PART 30 INSPECTION

UNITED STATES RADIUM CORPORATION
4150 Old Berwick Road
Bloomsburg, Pennsylvania'

Dates of Inspection: May 22 thru May 26, 1961 (Announced)

Persons Accompanying Inspectors:

None.

Persons Contacted and Titles:

Mr. E. B. Fisher, President, U. S. Radium Corporation
Mr. C. W. Wallhausen, Vice President in charge of Sales
Mr. H. A. Vaughn, General Plant Manager
Dr. J. G. MacButchin, Director of Radiochemical Research, Chairman of the Isotopes Committee
Mr. E. M. Burtsavage, Health Physicist and RSO
Mr. Robert Carl, Health Physics Technician
Mr. Sheldon Cope, Health Physics Technician
Mr. D. L. Prosser, Manager of Radioactive Products
Mr. Norman Fritz, Supervisor of Adhesive Labs
Mrs. June Neiswender, Secretary to D. L. Prosser

DETAILS

9. Background Information

A. On 10/2/57 an initial inspection of License 37-30-2 (w/amend. 6) was conducted by W. E. Kriegsman of this office. The following items of noncompliance were included in a letter dated 12/19/57 to the licensee:

(1) 20.101 - in that certain employees exceeded the prescribed 13 week dosages.

(2) 20.105 - in that exposures of individuals were not limited to 10% of permissible limits.

(3) 20.201 - in that no airborne contamination surveys had been conducted.

(4) 20.203 - in that a contaminated hood was not properly posted.

ITEM 6 (CONT'D)

Licenses 37-30-2 and GL-112

(1) 20.201 "Surveys"
(b) - in that the licensee failed to adequately evaluate the concentration of tritium in air within the tritium building. (See pages 29 & 30, paragraph 17(2)(b) of report details.)

License 37-30-2

(2) 20.105 "Permissible levels of radiation in unrestricted areas"
(b)(1) - in that a dose rate of 20 mr/hr at contact with the outside rear wall of the Radium Laboratory (an unrestricted area) and a dose rate of 5 to 10 mr/hr at 18" from this wall were detected. (See page 36, paragraph 20(D) of report details.)

(3) 20.203 "Caution signs, labels, and signals"
(b) "Radiation Areas" - in that a radiation area existing at the rear of the Radium Laboratory was not posted as prescribed. (See page 36, paragraph 20(D) of report details.)

(4) 20.401 "Records of surveys, radiation monitoring and disposal"
(b) - in that records of results of smear surveys taken in unrestricted areas were not maintained. (See page 33, paragraph 17(3)(b) of report details.)

Old Part 20

(5) 20.103 "Concentrations in effluents to unrestricted areas"
(b) - in that the licensee exceeded the yearly permissible release of Kr-85 during the calendar year 1960, based on the value of 1×10^{-9} uc/cc. (See page 19, paragraph 13(D) of report details.)

(6) 20.403 "Notifications and reports of incidents"
(b) "Twenty-four hour notification" (2) - in that the licensee, on 31 separate occasions, released Kr-85 to unrestricted areas in concentrations, which, if averaged over a period of 24 hours, exceeded 500 times the allowable limits; and no notification was received by the Commission. (See page 19, paragraph 13(D) of report details.)

(5) 20.22(b) - in that a product containing H-3 was exported to Canada.

In a letter dated 1/13/58, the licensee informed the Division of Civilian Application of the corrective action taken. This was acknowledged by a letter dated 1/30/58 from J. R. Mason.

B. On 4/13 - 4/17/59, a reinspection of License 37-30-2 and initial inspections of Licenses 37-30-3 and -4 was conducted by B. L. Harless and R. S. Cleveland of this office. After some correspondence between L&R and Inspection Headquarters, the following items of non-compliance were included in a letter dated 1/6/60 to the licensee:

(1) 20.201 - in that surveys were inadequate to evaluate the concentrations of radioactive material released from the plant.

(2) 20.201 - in that surveys were inadequate to evaluate the concentrations of radioactive material released from the hoods.

(3) 20.203(c)(2) - in that two high radiation areas (the hot glove box and the silo) were not equipped with interlocks.

(4) 20.203(a) - in that no film rings were supplied to individuals using Sr-90.

(5) 20.101(b) - in that an employee was exposed to H-3 concentrations in excess of the prescribed limits.

(6) 20.401(b) - in that the incident described in (5) above was not reported.

(7) 20.203(f)(1)&(4) - in that several containers were not properly labeled.

(8) 20.401(c) - in that no records were maintained of the release of waste from the plant.

In addition to the above citations, L&R discussed the possible necessity of bio-assays and requested information concerning canal contamination, procedures for handling defective H-3 containing tubes, and the instrumentation that would be used to detect the release of H-3.

In letters dated 2/17/60, 4/13/60 and 5/27/60, the licensee informed L&R of the corrective action taken. In a letter dated 5/13/60, L&R acknowledged that the corrective action was adequate.

It was felt that the above items of noncompliance constituted a hazard and a follow-up inspection was recommended.

C. On 9/20 - 9/23/60, a follow-up inspection was conducted by P. R. Nelson and A. J. Fleming of this office. During this follow-up inspection, an investigation of hand over-exposures was also conducted. The report was transmitted to Compliance Headquarters on 11/10/60, and noted the following items of noncompliance:

(1) 20.201(b) - in that the licensee failed to evaluate the dose rates encountered by employees' hands.

(2) 20.203 - in that an employee was not properly instructed as to working time in the glove boxes.

(3) 20.101(a) - in that four employees received dosages in excess of three times Appendix A.

(4) 20.201(b) - in that surveys were inadequate to evaluate the material exhausted from the hoods.

(5) 20.203(c)(2) - in that the "silo" storage area was not equipped with an interlock.

(6) 20.201(b) - in that surveys were inadequate to evaluate the H-3 released from the Tritium Building.

The memo also recommended that the licensee be required to prepare detailed written instructions for each operation using radioactive materials. In addition, a follow-up inspection was recommended.

In a letter dated 2/9/61, L&R informed the licensee of the above items of noncompliance and also requested that U. S. Radium submit detailed written procedures covering all phases of their radiation program. In a letter dated 3/8/61, the licensee reported the corrective action taken. This letter was acknowledged by L&R's 3/17/61 letter.

D. A complete reinspection of U. S. Radium's facilities, now being reported, was conducted by R. W. Van Wyck and J. R. Roeder on 5/22 - 5/26/61. Reinspection of Licenses 37-30-2 (w/amend. 16), GL-112 (w/amend. 3) and 37-30-3 (w/amend. 5) was conducted. License 37-30-6 was not inspected, nor were Licenses 37-30-4 and -5, both of which expired.

The information which follows refers to all of the inspected licenses unless otherwise indicated.

10. Organization and Administration

A. General

The organization and administration of the United States Radium Corporation (USRC) is essentially the same as noted during the inspection of 4/13 - 4/17/59. Summarized briefly, USRC at Bloomsburg, Pa. is one of four plants throughout the United States, with the home office located in Morristown, New Jersey. All work involving the use of radioactive materials is performed at the Bloomsburg plant which is located on the outskirts of town, near the Susquehanna River.

USRC produces instrument and control dials, air ionizing devices, luminous markers and standards, and all types of luminous dials. Approximately 200 people are presently employed at the Bloomsburg plant, about 50 of whom use radioactive material. The entire plant works an eight hour day, 5 day week.

Work involving the use of radioactive materials is divided into several separate laboratories or entities as follows: the general laboratory area; the tritium and Kr-85 laboratory, the Sr-90 laboratory; the Cs-137 hot cell; three research and development laboratories; the radium laboratory; the polonium laboratory; the dial painting shop; the tritium building; and the isotope storage areas. In addition to these facilities, several other use and storage areas are also available.

Mr. H. A. Vaughn is General Manager of the Bloomsburg Plant. He is directly responsible to Mr. E. B. Fisher, President of USRC, whose office is in Morristown, N. J.

B. Radiation Safety Officer - Health Physics Staff

Mr. E. M. Burtsavage serves as both Health Physicist and Radiation Safety Officer. Burtsavage, whose training and experience have been previously discussed in other reports, has been employed by USRC for about eight years. He has two full time Health Physics Technicians who work for him, Mr. Robert Carl and Mr. Sheldon Cope. Both Carl and Cope have taken the USRC "Radioisotope Technique Course" (which has not been given for about three years) and have received on-the-job training from Burtsavage.

Burtsavage reported that hs is responsible for all Health Physics functions including (1) assigning H. P. surveys, (2) consulting on design of equipment, (3) planning exposures to personnel, (4) reviewing all personnel monitoring records, (5) conducting investigations resulting from incidents involving radioactive materials, and (6) supervising the new waste disposal facility.

C. Safety Committees

The Bloomsburg Division maintains two safety committees: the General Plant Safety Committee and the Institutional Isotopes Committee.

1. The General Plant Safety Committee, which meets monthly and maintains minutes of all meetings, is charged with the responsibility for making recommendations directly to the General Manager for correction of any unsatisfactory conditions involving phases of plant safety including radiation safety. This committee has the authority to shut down any unsafe operation. Members of the General Plant Safety Committee are as follows:

   Mr. H. A. Vaughn, General Manager, Chairman
   Mr. C. H. Clapham, Manager, New Radioactive Products
   Mr. A. Woodring, Production Control of the Laboratory
   Mr. E. M. Burtsavage, RSO and Health Physicist
   Mrs. R. Work, Plant Nurse

2. Condition 13 of License 37-30-2, Condition 11 of 37-30-3, Condition 12 of 37-30-6 and Condition 11 of GL-112 require that all byproduct material be used by, or under the direct supervision of, persons approved by the Isotope Committee, J. G. MacHutchin, Chairman. This Committee is composed of the following members:

   Dr. J. G. MacHutchin, Chairman, Director of Radiochemical Research
   Mr. H. A. Vaughn, General Manager
   Mr. E. M. Burtsavage, RSO
   Mr. D. L. Prosser, Secretary, Manager of Radioactive Products

   It was reported that numerous informal meetings of the Committee are held but only infrequent formal meetings are called. From minutes maintained by MacHutchin, it was noted that the last formal meeting was held on 2/8/61 to review the equipment and

procedures in the Sr-90 facility. The chief functions of the Committee are to consider purchases of isotopes and to review all new procedures and equipment (or changes in procedures) involving uses of radioactive materials. In the event of disagreement among the members, it was reported that the ultimate decision is Vaughns'.

11. Inventory and Uses

A continuous inventory of radioisotopes on hand is maintained by June Neiswender, Secretary to D. L. Prosser, Manager of Radioactive Products. The inventory of radioisotopes possessed as of 4/30/61 and the reported major use of each is presented below:

Isotope	Quantity on Hand as of 4/30/61	Reported Major Use
C-14	54 mc	C-14 is incorporated with phosphor, primarily zince sulfide, for the production of low luminous intensity light sources; e.g., luminous markers. C-14 is chosen specifically since it produces low intensity sources without deteriorating the phosphor. A maximum of 2 mc of C-14 is used per source.
Cs-137	13,000 mc	Cs-137 is used in the production of sealed irradiators having strengths varying from 100 uc to 1 curie each.
Co-60	11,431 mc	Co-60 in the form of metallic pellets is encapsulated into sealed sources having strengths ranging up to 3 curies.
Kr-85	204,800 mc	Kr-85 is used in the production of irradiators having strengths varying from 0.1 mc to 2 curies. These sources are usually formed by encapsulating Kr-85 inside a metal pipe. Kr-85 is also used in the production of light sources wherein the krypton is used to activate a given phosphor. Light sources each contain from 20 mc to 800 mc of krypton.
Ni-63	86.8 mc	Ni-63 is plated on metallic ribbon, segments of which are used as ionization sources in electronic tubes. Specific activities of the ribbons vary from 0.005 uc per square inch to 1 uc per square inch.

Isotope	Quantity on Hand as of 4/30/61	Reported Major Use
Pm-147	20,040 mc	Pm-147 is used in the production of beta gauge sources varying in strength from 1 mc to 300 mc per source and for the production of light sources having strengths from 30 uc to 2 mc per source. Promethium sources are produced by the electro-deposition of promethium on metallic planchets.
Sr-90	23,520 mc	Sr-90 is used in the production of Sr-90 foils having specific activities varying from less than 1 uc to approximately 60 mc per square inch, and in the production of light sources containing from 50 uc to 4 mc per source. Sr-90 foils and light sources are supplied to customers as sealed sources.
Tl-204	231 mc	Tl-204 is used in the production of sealed irradiators each containing approximately 200 mc of Tl, and in the production of sealed light sources containing from 1 to 4 mc per source.
H-3 gas	1146 mc	Tritium as a gas is incorporated into glass tubes coated on the inside with various phosphors to produce light sources. Each source contains between 200 to 2000 mc of tritium. Tritium as tritium foil when purchased by USRC is used in the production of ionization devices containing approximately 250 mc per device. The ionization devices are shipped to customers as sealed sources. USRC currently manufactures its own tritium foil which reportedly will be used for the same purpose. H-3 will also be used under License 37-30-6 as tritiated paint for application on timepieces, hands and dials. No work has been conducted as yet.
H-3 (foil-RRC)	212.55 sq.in. assayed about 1 c/sq.in.	
H-3 (foil-USRC)	1,685.8 sq.in. assayed about 1 c/sq.in.	
Ra-226 (as $RaBr_2$)	572 mc	Ra-226 is used in the production of luminescent compounds containing up to 50 uc of radium per gram and in the production of light sources containing up to 100 uc of radium per source. In addition

Isotope	Quantity on Hand as of 4/30/61	Reported Major Use
		to producing luminous compounds for sale, USRC paints Ra-226 phosphors onto various dials and sells these dials. Burtsavage stated that a gram of luminescent phosphor is sufficient for painting approximately 1,000 watch dials. Radium is also used in the production of Ra-Be neutron sources containing up to 200 mc of radium per source.

It was reported by Burtsavage, and confirmed by MacHutchin, that no I-131 work has been performed since 1956.

12. Facilities

Radiation work is conducted in a number of different areas of USRC's plant, but the bulk of the work is performed in the same general area in the main plant building. A diagram of this area is shown in Exhibit "A". Movement of personnel in and out of this area is limited to one entrance, which connects with the sales and administrative office area near this entrance. Immediately inside this entrance is a monitoring instrument which has an end window GM tube and which is used for contamination checks of all personnel leaving this area. Connecting with this entryway is a locker room where radiation workers leave their outside clothing and pick up their work clothes. Connecting with this locker room is a change room where shoe covers are put on upon entry, or removed upon exit. This room is equipped with racks of laboratory coats to be worn over regular clothing by all employees or visitors entering the work area, who are not otherwise required to be completely dressed in work clothes. A sink is provided for personnel to wash hands before leaving the area and a monitoring instrument with end window GM tube is used in checking for hand and foot contamination. A shower is also provided in the change room area. The locker room and change room are respectively about 10 x 12' and 10 x 10' in size.

A. General Laboratory

The general laboratory is a large open area about 50 x 35'. Immediately inside the entrance from the change room are three glove boxes plus several open work benches. These three glove boxes are constructed of wood and provided with transparent plastic faces. Materials were reportedly

placed in each box through an air-locked entrance compartment. Air flow through the exhaust is rated as about 30 cfm per box. Each exhaust is equipped with a fiber glass pre-filter ~~cfm~~ plus an absolute filter. Activities conducted in these three boxes were reportedly limited to work with relatively low energy beta emitters. The first box was reportedly used for work with tritiated compounds which mostly involved trimming of tritiated titanium foils. The second box was reportedly used for work with C-14 labeled compounds. The third box was reportedly used for a variety of activities but mostly for work with small amounts of Tl-204 and Pm-147. A large hood about 3' wide and 15' long, open on both sides was located in the southwest area of the general laboratory. This hood was equipped with horizontally sliding lucite face panels.

Burtsavage stated that all hoods and glove boxes within the general laboratorh were decontaminated and cleaned during June, 1960 and that no handling or processing of radioactive materials was currently being performed in the area. He reported that the general laboratory was presently being used only as a finished product storage, packaging and shipping area.

Sealed sources fabricated by USRC are taken to the northeast portion of the general laboratory where they are transferred through a pass window into the leak test room. This room is separated from the rest of the General Laboratory by an 8' high partition. Sources are monitored for leakage in this room and, after checking out satisfactorily, transferred thru another pass window to the high level counting room. This room is located outside the regular area for handling radioactive materials. The door from the general laboratory to the corridor running past the high level counting room is not regularly used and is set up to be used only as an exit from the radiation work area. The high level counting room is about 12 x 16' and its walls consist of concrete blocks to a height of about 8'.

B. Tritium and Kr-85 Laboratory

The change room leads to an entryway connecting with a large general laboratory area. Immediately off this entryway is a separate room (the H-3-Kr-85 laboratory) devoted to the handling of gaseous H-3 and Kr-85. This gas handling room is about 12 x 15' and is equipped with one large hood about 12' long, plus a sink, several work tables and a desk. A door in the northeast corner of this room serves as an exit to a non-radiation work area in another part of the plant, but this door is never used

for other than emergencies. Closed gas handling systems and associated vacuum pumps are located in the hood. These systems are used for transferring H-3 and Kr-85 gas from shipping containers to various sealed tubes where the isotopes are used to excite phosphors or otherwise serve as radiation sources. A maximum of 500 curies of Kr-85 and 1,000 curies of H-3 are reportedly handled at any one time in these systems.

Present operations were described as involving the filling of glass tubes about 5" long by 1/4" in diameter containing luminous phosphors with between 500 and 2,000 mc of H-3 as gas as an activating agent. Personnel working in this area wear rubber gloves and a complete set of work clothes acquired in the change room. The face of the hood is equipped with large horizontally sliding panels of 3/8" thick lucite. Additional shielding is provided by sheets of lead 20 x 14 x 1" thick, located in front of the Kr-85 apparatus. A heavy lead pot was also provided to hold Kr-85 shipping containers, and an end window GM count rate meter was installed in the exhaust duct to observe possible high concentrations of Kr-85 in the effluent.

C. Radium and Polonium Laboratories

Opening off the north end of the general laboratory area is a door to an anteroom leading to the radium and polonium laboratories. This anteroom is provided with a shoe cover change station, a sink for washing of hands prior to exiting from the area, and an end window GM count rate meter used in checking for hand and foot contamination. This anteroom opens into a large open area used for processing radium compounds and fabrication of sources.

A group of utility and storage rooms are located in the central portion of the radium laboratory. A number of radium handling hoods and glove boxes are located around this central area. A radon safe is located in the center of the east wall of this section between two hoods. Ra-226 in solution as a bromide in amounts up to 200 mc is placed in a vacuum apparatus in this safe and the radon gas is pumped out of the solution and exhausted through the roof to the outside of the building. This operation reportedly removes approximately 50% of the radon from a 200 mc radium solution over a two hour period. This operation is performed about twice a month. Radium solution, from which radon has been largely removed, is then processed in the combination hood-glove boxes along the south side of this center area. The radium is converted to a sulfate and is mixed with appropriate phosphor for use in light sources. Radium impregnated foil is also produced in this area.

One of the utility rooms located in the central portion of the Radium Laboratory was converted to a Po-210 laboratory during 1960. This laboratory is about 8 x 15' and is equipped with two glove boxes. Shipments of $Po(NO_3)_2$ crystals from Mound Laboratory are placed in the first glove box, where the material is converted to a solution. $Bi(NO_3)_3$ is added to the solution, after which powdered Ag is added. The active material plates out on the Ag, the solution is filtered, and the filtrate is dried. After drying, the material is transferred to the second glove box where it is ground into a powder and placed in a die and pressed into a compact. This compact is annealed in an oven, after which an Ag overcoat is placed about the compact. This material is again annealed and then rolled out into foils, whose activity varies from 75 to 2,000 uc per square inch. These foils receive further processing in the open bench area in the northern part of the radium laboratory.

A room located off the northwest part of the radium laboratory is used for weighing of radium activated phosphor employed for various light production purposes, principally for painting luminous dials. A long ventilated work table is provided for manipulating these radium phosphors. Hoods and glove boxes in the radium and polonium laboratory exhaust into a common blower system rated at 10,000 cfm. This exhaust is provided with a pre-filter and an absolute filter.

D. Strontium Laboratory

A corridor leading from the southwest corner of the general laboratory gives access to the entrance of the laboratory in which Sr-90 is processed. The Sr-90 laboratory is entered through an anteroom which separates it from the corridor. A shoe cover change station and an end window GM tube count rate meter station are located in the anteroom. The strontium laboratory itself is about 15 x 20'. It is equipped with 8 glove boxes and two hoods around the walls, plus another hood in the center of the room. The exhausts from these hoods and boxes are equipped with pre-filters and absolute filters. The air flow to the exhaust from each glove box is rated at about 45 cfm. Total air flow through the common exhaust from this laboratory is rated at 4,000 cfm.

The three glove boxes along the east wall of this room are connected internally and with the hoods so that materials may be transferred from one to the other without bringing them out into the room. A shipment of Sr-90 is placed in the northern most of these boxes where initial transfers

and dilutions are performed by remote handling equipment. The maximum amount of activity reportedly processed at any one time is about 100 mc. Working solutions are transferred to the middle box where centrifuging and Y-90 removal operations are conducted. Precipitation and drying of the material are conducted as part of the operations in this box. Dry processed material is transferred to the third box where it is placed in a die, compressed, and baked in an oven. Material is made into a brick form here and sandwiched within gold overlays. This material is then transferred to the adjoining hood where it is compressed in a Watson Stillman press until it becomes a solid metallic form. This is then sandwiched' between additional gold or silver, heated in an oven and again pressed into a compact form. Compacts are next removed from the hood and processed in the press and rolling machine located at the end of the central hood. The foil sources so prepared are then transferred through a window from the last hood in this line into the hood in the leak testing room where preliminary checks are made of the integrity of the protective covering on the foil sources.

The interconnected row of glove boxes along the north wall of this room are used for processing strontium into luminous phosphors. Shipments are introduced into the eastern most of these boxes, where remote handling equipment is used for pipetting and diluting transfers. In the second box, the Sr-90 is precipitated out of solution by mixing with $BaSO_4$. After filtration of the precipitate and combination with the phosphor material, the Sr-90 is transferred to the third glove box, where brightness tests are conducted. This material is then removed from the glove box and transferred to the southern most of the glove boxes on the west wall of the room. Here, the strontium activated phosphor is mixed with the appropriate adhesives and binders and placed in an oven which serves as a closed connection between these two boxes. After baking, the material is brought into the second of these glove boxes, placed in its final housing and sealed, and given a preliminary leak test. The hood in the center of the room is primarily used for storage of material when it is desired to have a positive flow of air away from occupied areas and over the stored items.

The glove boxes in this room were constructed by the licensee and are made of wood. All boxes are equipped with lucite windows at least 1/2" thick and were covered with at least 1/4" of lead sheeting on the outer walls. The boxes are also designed so that supplementary lead brick shielding can be placed along the front of these boxes to provide additional protection for the operators. Specially designed tote boxes of heavy lucite were available for transferring strontium sources.

E. Research and Development Laboratories

A corridor leading from the general laboratory past the strontium laboratory goes to the research and development wing. This consists of three general R&D laboratories and a hot cell facility for handling curie amounts of Cs-137. Each of the R&D laboratories is about 16' square.

The hoods in these rooms exhaust through a common stack rated as discharging about 6,000 cfm. All exhausts are equipped with prefilters followed by absolute filters. R&D #2 is equipped with two hoods, a sink, and several tables, work benches and storage shelves. Current materials in this room were reportedly about 5 mc Ni-63 and 1 mc Co-60. The only current activities were described as low level development studies on processing and use of these materials. R&D #3 is laid out in a manner similar to that of R&D #2. Activities here were described as including preliminary leak testing of tritium and Kr-85 sealed sources. R&D #4 was laid out in a manner similar to the other two R&D laboratories, except that it was equipped with a large gas handling hood in the center of the room. Gas handling operations with H-3 and Kr-85 are conducted in these hoods.

F. Cesium 137 Hot Cell

An end window GM tube count rate meter and a shoe cover change station are located outside the entrance to the cesium laboratory. The entrance to the cesium laboratory is equipped with an interlock alarm which is activated upon opening the door. Controls for deactivating this alarm are located inside the cesium laboratory. The cesium cell is an open topped cubicle with walls of 16" thick concrete on all sides other than the operating face, which is constructed of 6" thick lead bricks. Lead glass viewing ports are provided in this operating face, which is located on the side by the room entrance. The walls of the cell are about 7' high. An air exhaust canopy leading to a stack, through which the flow was rated at about 4,000 cfm was located directly above the cell.

Cs-137 as a chloride is placed in this cell as received and converted to a sulfate. This material is then absorbed on an ion exchange resin so as to reduce its capability to leak out of the sealed sources and become airborne. Resin material holding the cesium is used to fill various capsules which are sealed and sold as discrete sources. The handling capacity of the cell is rated as about 20 curies. All operations in the cell are conducted by use of a master slave manipulator, whose mechanical linkage passes over the open top of the cell wall.

A chute connects from the back corner of the cell to a shielded glove box in the southwest corner of this room. Here, small cesium sealed sources and/or miscellaneous contaminated equipment can be checked for leakage and processed for decontamination.

G. Radium Dial Shop

On the second floor of the main building is a dial painting shop employing approximately twelve radium dial painters. Each dial painter occupies a separate desk and uses approximately 50 uc of radium activated phosphors at any one time. Each 50 uc batch of phosphors is sufficient for the production of 2,000 watch dials or 1,000 watch hands. In addition to the hand painting operations, six automatic silk screen dial painting devices are located in this shop. Each of these devices is enclosed in a lucite shield having a front flap which lifts up to permit access to the machine. Each machine is ventilated from the rear at an estimated flow rate of 25 cfm. Drying ovens for radium dials are located in a separate room nearby on the second floor.

H. Tritium Building

A separate building, approximately 20 x 40' is used for routine tritium handling operations. Access to the tritium laboratory portion of this building may be gained only by passing through a clothing change area provided with complete protective clothing and shower facilities. A diagram of the tritium building is presented as Exhibit "B".

Six glove boxes were located within the main work area. One box was reportedly used for introduction of a tritium gas cylinder, as received from Oak Ridge, for evacuation and transfer to gas manifold equipment located within an adjacent box. The gas manifold is connected with reaction vessels into which tritium gas is pumped in order to form both titanium tritide foil and tritiated plastic phosphors. The foils are transferred to a third box for final processing. The three additional boxes in this area were reportedly used for research and development with tritium compounds. The tritiated plastic phosphor is transferred to three glove boxes located within a former darkroom for final processing. All glove boxes were equipped with a filtered air intake port and a high efficiency air exhaust filter. All boxes were exhausted through a common header which connects to a positive displacement pump and which reportedly exhausts a total of 600 cfm of air from a stack which extends approximately 12 feet above ground level.

I. Storage Facilities

Five separate outdoor storage facilities are utilized. Three of the facilities, (The Radium Storage Vault, The Stock Solution Storage Building and The Sealed Sources Storage Building) are enclosed by properly posted wire mesh fences. The gates to these fences are locked at all times. The keys are kept by authorized personnel and a duplicate set is kept in the Health Physics Office.

The two other outdoor facilities are the "Silo" and a Wooden Storage Shed. A circular fence, with locked gate, forms an exclusion area of about 40' from the Silo. There is no esclusion fence about the Wooden Storage Shed but the door is kept locked at all times.

Each one of the above storage buildings was entered by the inspector and dose rates within the building were measured. The maximum dose rate encountered was about 50 mr/hr in the Radium Storage Vault. A survey of the other storage buildings revealed dose rates below this level.

All of the above facilities are equipped with interlocks with the exception of the Wooden Storage Shed. Burtsavage reported, and it was confirmed by discussions with MacHutchin, Carl and Cope, that frequent surveys are conducted in this area to ensure that dose rates of 100 mr/hr or over do not exist for periods exceeding 30 days. As noted above, a dose rate of less than 50 mr/hr was detected at the time of inspection.

Any person desiring to enter into one of the interlocked areas must sign a logbook that is kept in the H. P. Office. At the request of the inspectors, the interlock systems in all the storage areas were tested. It was found that upon entry into the storage areas, a loud buzzer sounded in the H. P. Office. It was also noted that opening the doors of the storage building actuated the alarm rather than entry into the fenced in exclusion area.

13. Waste Disposal - Waste Disposal Records

A. Transfers to ORNL and Nuclear Engineering Company

The bulk of all waste material generated by USRC, including solids, liquids and gases, is transferred to ORNL or Nuclear Engineering Company, Kearny, New Jersey. Burtsavage stated that the latter company is employed to receive gaseous waste, radium waste and polonium, none of which will be accepted by ORNL.

Records of these transfers were reviewed by the inspectors. During 1960, 32 shipments were made to ORNL and Nuclear Engineering. These shipments totaled approximately 512 c of H-3, 35 mc of C-14, 710 mc of Co-60, 63 mc of Ni-63, 71 c of Kr-85, 3.8 c of Sr-90, 3 mc of Tc-99, 6 mc of Ru-106, 42 c of Cs-137, 170 mc of Ce-144, 1.5 c of Tl-204, 296 mc of Po-210, 446 mc of Ra-226 and 1 mc of U-238.

B. Treatment of High Level Liquid Waste

Burtsavage reported that high level liquid waste is no longer passed through an ion exchanger, as described in the inspection report dated 6/8/59. He stated that by-product liquid wastes are mixed and solidified with plaster of paris or "nitrocel" and then placed in quart or gallon tin cans. These cans are then placed inside five gallon containers, surrounded with packing material and then shipped as solid waste. Burtsavage said that high level liquid radium waste (reportedly resulting from the screen washing operation) is mixed with "staz-dri" (sugar cane shreds) and placed in similar containers for shipment to Nuclear Engineering.

Burtsavage reported that all handling and solidification of liquid waste is performed by himself, Carl or Cope. Most of the work is performed in hoods.

C. Treatment of Low Level Liquid Waste

Since the 4/13/59 and the 9/20/60 inspections, the licensee has constructed a separate waste disposal building and no longer uses the processes described in these reports for the disposal of low-level liquid waste. This waste disposal facility, located about 400' from the Susquehanna River, was reportedly constructed at the request of the Pennsylvania Department of Health. According to Burtsavage, the facility was completed in March 1961 and two tanks full of liquid wastes were processed and released to the Susquehanna. Shortly thereafter on 4/23/61, after a heavy rainstorm, one wall of the building collapsed and the facility was inoperative for a short time. At the time of this inspection, liquid wastes were being collected (but not processed) and the wall was being repaired.

Burtsavage described the liquid waste disposal operation as follows: All drains from the laboratories, in which radioactive materials are used, have been re-routed. All low-level liquid wastes from the strontium and the radium lab now empty into one 2500 gallon holdup tank (called the

"bone-seeker tank" or "Holdup-B"), while all liquid wastes from the other laboratories (Cs-137, C-14, Co-60, H-3, Ni-63, etc.) empty into a second 2500 gallon holdup tank (called "Holdup-A"). A separate discussion of each tank follows (see Exhibit "E" for a diagram of this system):

(1) Strontium - Radium Tank (Holdup-B)

When this tank becomes full, its contents are pumped into a specially designed evaporator. This results in a sludge and a distillate.

The sludge is removed from the evaporator, placed in five gallon cans and fed into an auxiliary evaporator which takes the sludge to dryness. This resulting residue is disposed as solid waste to ORNL. The distillate from this operation is returned to the original holdup tank.

The distillate from the first mentioned evaporator is pumped into a mixed bed ion exchange column, recycled, and then pumped into a discharge tank. When the discharge tank becomes full, the tank is agitated manually and a one liter sample is withdrawn. This sample is evaporated to about 50 ml, a 25 mc aliquot is removed, and evaporated to dryness on a planchet. The residue is then counted in an internal proportional counter, which has a calculated 50% efficiency. The results are converted to uc/ml and if it is decided that the concentration is within permissible limits, the water is released directly to the Susquehanna River. (Results of these analyses are discussed below.)

(2) Holdup Tank Used for Other Isotopes (Holdup-A)

As noted above, all isotopic wastes other than Ra and Sr empty into a second 2500 gallon holdup tank. When this tank is full, a 20 ml sample is removed (after agitation) and evaporated on a planchet. The planchet is then counted with an end-window GM counter and if activity is detected, the sample is allowed to decay for about 16 hours. It is then recounted in the internal proportional counter and if it is decided that the concentration is within permissible limits, the water is released directly to the Susquehanna River.

From waste release records kept by Burtsavage, the following chronological summary was noted:

4/13/61 - Contents of holdup tank-A (all other isotopes) were assayed. Result was 4.7×10^{-5} uc/cc.

- Contents of holdup tank-B (Ra and Sr) were assayed. Result was 1.9×10^{-4} uc/cc.

- Contents of discharge tank was assayed. Result was 6.6×10^{-7} uc/cc.

- Contents of all above tanks were held.

4/23/61 - Wall of waste disposal facility caved in.

5/3/61 - Contents of holdup tank-B overflowed on the floor of the facility. Contents immediately released to the Susquehanna River at an unknown concentration.

5/5/61 - Contents of holdup tanks A and B and the discharge tank were released to the Susquehanna River. An isotope analysis revealed the following concentrations*:

Tank	Nuclide	Concentration uc/ml	mls released	Total uc
Holdup tank-A	H-3, sol.	1.13×10^{-2}	2.27×10^{6}	2.5×10^{4}
"	Cs-137, sol.	5.07×10^{-4}	"	1.15×10^{3}
Holdup tank-B	Sr-90, insol.	2.54×10^{-5}	9.9×10^{6}	2.51×10^{2}
"	Ra-226, insol.	4.67×10^{-5}	"	4.60×10^{2}
Discharge tank	Sr-90, insol.	3.47×10^{-7}	5.86×10^{6}	2.03
	Ra-226, insol.	5.0×10^{-9}	"	0.03

*These analyses were furnished to this office in a letter dated 6/16/61 from E. M. Burtsavage.

Burtsavage stated that he intended to average all the concentrations over a period of one year as permitted by 20.106(b). He said also that he intended to use the option of Note 1 at the end of Appendix B.

D. Deliberate and Accidental Gas Releases During 1960

Krypton 85

Burtsavage maintains records of both accidental and deliberate releases of gases. Accidental releases are investigated and a report of the release, in memo form,

is kept by Burtsavage. It was reported that deliberate releases of gases are done primarily to recover the expensive glass equipment in which the gases remain after completion of a processing operation.

Exhibit "C" lists the Kr-85 that was disposed both accidnetally and deliberately during 1960. With regard to the column labeled "Amount Permissible to Release/24 Hrs." in Exhibit "C", Burtsavage said that this figure was obtained from flow rate calculations based on a value of 2.7×10^{-6} uc/cc for Kr-85 in unrestricted areas, which was supplied to him by Dr. K. Z. Morgan of ORNL. It was pointed out that under the old Part 20 (1960), Kr-85 was not specifically listed and that the permissible concentration was actually 1×10^{-9} uc/ml, and not the figure supplied by Morgan.

All releases of Kr-85 were through the hoods in Annex #2, #3, or #4, with four exceptions (three from General Lab H and one from the Main Darkroom as indicated by checks on E Exhibit "C"). The hoods in Annex 2, 3 and 4 join a main annex exhaust system, the flow rate of which is 5224 cfm. This flow rate is maintained 24 hours/day, 7 days/week. This results in a daily flow rate of about 2.13×10^{11} cc/day and a yearly flow rate of approximately 7.78×10^{13} cc/year. Based on concentrations averaged over a period of one year (20.106(b), new Part 20 - 20.103(b), old Part 20), the maximum amount of Kr-85 released may be 77.8 mc/year, using the value of 1×10^{-9} uc/cc permitted under the old Part 20. As noted in Exhibit "C", the total amount of Kr-85 released for the calendar year 1960 was 17,470.3 mc. This is for the period 12/29/59 to 12/29/60, assuming that there were no releases on 12/29 - 12/31/59.

Under 20.403 of the old Part 20, any release of licensed material, which if averagedover a period of 24 hours, in excess of 5000 times or 500 times the values listed in Appendix B, Table 2, required immediate or twenty-four hour notification, respectively. Using the value 1×10^{-9} uc/cc for Kr-85, and (1) multiplying this by 5000 and (2) using a daily flow rate of 2.13×10^{11} cc/day for Annexs 2, 3, 4, a calculation reveals that any releases in excess of 1065 mc per day was a Class "A" incident requiring immediate notification. There were no daily releases in excess of the amount. However, using 500 times the permissible amount (20.403(b)), any release in excess of 106.5 mc required twenty-four hour notification. Releases exceeding this amount during 1960 (See Exhibit "C") were made on 1/4, 1/7, 1/11, 1/18, 1/19, 1/26, 1/27, 1/28, 1/29, 2/3, 2/8, 2/9, 2/15, 2/19, 2/23, 2/24, 3/15, 3/18, 3/23, 3/28, 4/1, 4/5, 4/7, 4/11, 4/14, 4/21, 4/25, 5/9, 5/26, 12/28, and 12/29. No notification was ever received by the Commission concerning these releases.

General Lab H has a flow rate of 5961 ft^3/min. and the main darkroom has a flow rate of 2358 ft^3/min. Although no calculation was made, it appears that the releases through these facilities on 4/28, 8/26, 11/6 and 11/17 required notification also. No notification was ever received.

It should be noted that on 1/1/61, the new Part 20 became effective, thus permitting a concentration of 3×10^{-7} uc/ml of Kr-85 in unrestricted areas. Using this value for Kr-85 and (1) multiplying this by 5000 and (2) using a daily flow rate of 2.13×10^{11} cc/day for annexs 2, 3, 4, a calculation reveals that any release in excess of 320 c/day would require immediate notification. As indicated in Exhibit "C", no releases in 1961 approached this amount. Hence, a 32 c/day release would require twenty-four hour notification (500 times Appendix B), and using 10 times the permissible amount would require notification if 640 mc were released. As indicated in Exhibit "C", no releases in 1961 approached this amount.

The Kr-85 releases of 1/4/60, 1/7/60, 1/19/60 and 11/6/60 were described by Burtsavage as being accidental. In each case the release resulted from the breaking of a krypton-containing piece of glass equipment. In each case an investigation was conducted by Burtsavage and a written report was filed for review by the Isotope Committee. The incidents of 1/19/60 and 11/6/60 were reviewed by the inspector, inasmuch as they involved the release of the Kr-85 into a room rather than into a hood. A short summary of each follows:

(1) On 1/19/60, [redacted] while working in lab annex #4 dropped a lantern containing 309 mc of Kr-85. [redacted] remained in the area long enough to pick up the pieces of broken glass and place them in a jar. A lab monitor in the area was off scale for about one minute (in excess of 50,000 c/m) and then returned to normal background count. Fisher reportedly left the area immediately after picking up the glass. Burtsavage reported that Fisher was reprimanded for not immediately leaving the area. A review of [redacted]'s film badge exposure for this period revealed no overexposure. No attempt was made by the inspector to evaluate the possible dose to the lung through inhalation. It was reported that normal operations resumed within 10 minutes. The flow rate through the hood in this lab is 5224 cfm.

(2) On 11/6/60, [redacted] was working in the Main Darkroom when a flask containing 600 mc of Kr-85 was accidentally broken in the west end. [redacted] immediately left the area. A lab monitor near the hood exhaust stack

read about 17 mr/hr and a calculation revealed a concentration of Kr-85 in the room of 7.05 x 10^{-3} uc/ml. Normal operations were resumed shortly after a survey revealed that the radiation level had returned to normal background. The flow rate in this hood was measured at 2358 cfm.

Hydrogen 3

Listed below are the deliberate and accidental releases of H-3 for 1960:

HYDROGEN -3 GAS LEAKS & DISPOSAL - 1960

Date	Hood	Purge	Accidental Release	Amount Released
Feb. 5	Annex #3	X		5 mc
Mar. 9	Annex #3	X		50 mc
Mar. 10	Annex #3	X		50 mc
Mar. 22	Gen Lab K		X	8200 mc
Jun. 10	Gen Lab H	X		1000 mc
Jun. 16	Annex #4	X		405 mc
Oct. 6	Annex #3	X		450 mc
Oct. 21	Annex #3	X		450 mc
				10,610 mc

Flow rates for above:

Annex #3 - 5224 cfm

Gen Lab K - 1548 cfm

Gen Lab H - 5961 cfm

Annex #4 - 5224 cfm

Regarding the 3/22/60 release of 8200 mc, if averaged over 24 hours, based on a flow rate of 1548 cfm, the calculated concentration of 1.29×10^{-4} uc/cc. This is not 500 times the value of 2.5×10^{-6} uc/cc as listed in the old Part 20. For the calendar year 1960, the total release of H-3 did not exceed 2.5×10^{-6} uc/cc when averaged over one year. A review of all gas release records, supplied by Burtsavage, did not reveal any deliberate or inadvertent release of H-3 from October 1960 through April 1961.

Helium 3

Helium 3, a daughter product of H-3, is also deliberately released to the atmosphere in order to recover the' storage cylinder. Burtsavage reported that in order to ensure that the residual gas remaining in a cylinder is He-3 and not H-3, two tests are conducted. The first consists of passing the gas over uranium pots, at specified temperature and pressure, in an attempt to chemically combine the uranium and the gas. If it is determined that no gas has been absorbed, the contents of the cylinder are assumed to be He-3 and are discharged through the stack of the H-3 building. The second check consists of monitoring the stack, at time of release, with a tritium monitor to ensure that no activity is present.

Listed below are the He-3 releases for 1960:

HELIUM 3 GAS LEAKS & DISPOSALS- 1960

Date	Hood	Purge	H-3 Equivalent
Jan. 11	H-3 Bldg.	X	1200 mc
Jan. 21	H-3 Bldg.	X	6500 mc
Mar. 28	H-3 Bldg.	X	250 mc
Apr. 28	H-3 Bldg.	X	2200 mc
May 17	H-3 Bldg.	X	862 mc
May 24	H-3 Bldg.	X	2000 mc
May 27	H-3 Bldg.	X	260 mc
Aug. 25	H-3 Bldg.	X	6840 mc

Date	Hood	Purge	H-3 Equivalent
Sept. 30	H-3 Bldg.	X	5200 mc
Nov. 8	H-3 Bldg.	X	250 mc
Nov. 17	H-3 Bldg.	X	12500 mc
Nov. 25	H-3 Bldg.	X	15200 mc
Nov. 30	H-3 Bldg.	X	2000 mc
			55,262 mc

H-3 Bldg. - 502 cfm

14. Personnel Monitoring

A. Film Badges

USRC employs a one week cycle film badge service from Radiation Detection Company, Palo Alto, California. Burtsavage reported that 50 employees are provided with a badge and that finger film was worn by personnel whenever hand exposures were of concern. He said that all persons associated with the Cs-137 source fabrication program wore finger badges. Records were reviewed from 8/1/60 through 5/6/61. Forms AEC-4 and AEC-5 are kept for all employees who are under the personnel monitoring program. The maximum body exposure recorded from 8/1/60 through 12/31/60 was 450 mrem and was received by [redacted] from 11/5 through 11/11/60 while reportedly crawling into the cesium hot cell to repair mechanical manipulators. Thirteen week totals were less than 3000 mrem. The second highest body exposure during this period was 300 mrem and was received by [redacted] from 11/5 to 11/11/60. Other exposures were noted to be less than 270 mrem/week and no body exposures exceeding 3 rem/quarter were noted. The four highest total body exposures received during the year 1960 are presented below:

[redacted] - 8635 mrem
[redacted] - 8150 mrem
[redacted] - 7910 mrem
[redacted] - 6070 mrem

The maximum weekly finger badge exposure reported from 8/1/60 through 12/31/60 was 6300 mrem to the left hand badge and was received by [redacted] whose work was reportedly restricted solely to radium handling, during

the week ending 11/11/60. A summary of the maximum weekly exposures to finger badges worn by byproduct material workers during this period is presented below:

Name	Left Hand Badge (mrem)	Right Hand Badge (mrem)	Period Worn
	1600	3800	8/6 - 8/12/60
	3200	3430	9/22 - 9/28/60
	800	3000	8/6 - 8/12/60
	800	2400	8/6 - 8/12/60
	2000	2500	8/27 - 9/2/60
	2400	-	11/5 - 11/11/60
	1300	2300	8/6 - 8/12/60
	2300	-	8/27 - 9/2/60

The five highest total finger badge exposures received from 6/6/60 (finger badges were first worn on this date) through 12/30/60 are presented below:

- Left Hand - 21.930 mrem
- Right Hand - 18.450 mrem
- Right Hand - 18.140 mrem
- Right Hand - 17.820 mrem
- ng - Right Hand - 13.160 mrem

No finger badge exposures were noted which exceeded 15 rem during the last 13 week period in 1960.

The maximum total whole body exposures recorded for the first quarter of 1961 are presented below:

- 2180 mrem
- 1650 mrem
- 1430 mrem
- 1360 mrem
- 1340 mrem

As previously noted, AEC-4's and AEC-5's are kept for all persons under the personnel monitoring program. It was noted that the above values, when added to the accumulated occupational dose, did not exceed 5(N-18).

The maximum total whole body exposures recorded from 4/1/61 through 5/13/61 are presented below:

[redacted] - 1060 mrem

[redacted] - 300 mrem

[redacted] - 290 mrem

The maximum total finger badge exposures recorded for the first quarter of 1961 are presented below:

[redacted] - left hand - 6010 mrem
right hand - 5810 mrem

[redacted] - right hand - 4140 mrem

The maximum total finger badge exposures recorded from 4/1/61 through 5/16/61 are presented below:

- left hand - 3250 mrem
right hand - 1200 mrem

- right hand - 1200 mrem

[redacted] - right hand - 1200 mrem

B. Tritium Bioassays

Burtsavage reported that a weekly tritium urinalysis was performed on each tritium worker, which includes about ten employees. The maximum result noted from 8/1/60 through 12/31/60 was 57 uc/liter and was exhibited by [redacted] in a sample collected on 11/22/60. [redacted] total exposure due to tritium uptake during the last 13 week period of 1960 was estimated to be 681 mrem (calculated on the basis that a concentration of 28 uc's of tritium per liter of urine, if maintained continually, would give rise to a whole body exposure rate of 100 mrem/week). The second highest tritium bioassay noted during this period was 21 uc/liter and was exhibited by Cowan in a sample collected on 12/6/60.

The maximum tritium bioassay noted from 1/1/61 to 5/16/61 was 39 uc/liter and was exhibited by [redacted] in a sample collected on 5/16/61. [redacted] total whole body exposure resulting from tritium uptake during the

first quarter of 1961 was recorded as 288 mrem. Calculated tritium exposures were noted to be incorporated in the total quarterly whole body exposures listed on each tritium worker's form AEC-5.

C. Cesium and Strontium Bioassay

Burtsavage reported that semiannual Cs-137 and Sr-90 urinalyses were conducted on employees who work with these isotopes. A summary of the maximum analyses noted is presented below:

Sample Date	Worker Sampled	Isotope	Result (d/m/liter of urine)
3/60	[redacted]	Cs-137	160,000
		Sr-90	178
11/10/60		Cs-137	5,800
		Cs-137	3,880
		Sr-90	80
3/16/61		Cs-137	38,000
		Sr-90	29

Burtsavage reported that the urinalyses samples collected during March and November of 1960 were sent to Nuclear Science and Engineering Corp., Pittsburgh, Pa., for analysis, while the samples collected during March, 1961 were forwarded to Isotopes, Inc., Westwood, New Jersey, for analysis. He also stated that [redacted] was resampled on May 5 (within 2 days after receiving the Cs-137 results of the sample collected from [redacted] on March 16, 1961) and that the resample was sent to Nuclear Science and Engineering Corp. for a confirmation analysis. He reported that [redacted]'s resample showed 54,000 d/m of Cs-137 per liter of urine. Burtsavage stated that [redacted] activities from 11/60 to 5/61 were investigated and that he (Burtsavage) could not determine the cause of [redacted] cesium uptake. (See Page ⊗ for results of air samples in the cesium hot cell.)

D. Radon Breath Analyses

Burtsavage reported that semiannual breath analyses were conducted on six radium workers, who work exclusively with this isotope. Samples were reportedly analyzed by Dr. Victor Hess, Physicist, Fordham University, New York.

Results were reviewed from October 24, 1960 through April 1961. The maximum analyses reported was 1.3×10^{-12} c/liter and was exhibited in a breath sample submitted by (during October 1960. The next highest result noted was 0.66×10^{-12} c/liter. Burtsavage reported that he considers 10^{-9} uc/ml (1×10^{-12} c/liter) as the tolerance level for radon breath analyses.

15. Review of Applicable License Conditions

License 37-30-2

License Conditions 10, 11, 12 and 13 were reviewed with Burtsavage and MacHutchin and no deviations were noted.

License Condition 14 requires adherence by the licensee to 28 letters and 9 applications dating back to 1956. The applicable and current letters and applications were reviewed in detail with licenseepersonnel. Any noted discrepancies are discussed elsewhere in the report.

Condition 15 of the license pertains to the manufacture, distribution, etc. of generally licensed static eliminators. Their design, specifications, labeling, etc. were reviewed with MacHutchin and no deviations from the licensee's procedures were noted.

Condition 16 of the license consists of a five part leak test requirement. The requirements of this condition were reviewed in detail with MacHutchin and Burtsavage and no discrepancies were noted other than the fact that leak test records were not being kept in units of microcuries. However, this requirement (Condition 16D) was not added to the license until 5/7/61, which was 5 days before the inspection. The other leak test condition (Condition 14, Amendment 14, issued 6/6/60) required only that records be maintained. Burtsavage reported that doubly encapsulated sources manufactured by USRC are allowed 100 c/m for the outer seal (50% geometry - internal counting) and 1000 c/m for the inner seal (10% geometry - end window GM).

Leak test records are incorporated with sales records and are maintained in three filing cabinets. Norman Fritz and June Neiswender ensure that all sources are properly leak tested. Ten spot checks by the inspector revealed no discrepancies.

License 37-30-3

Conditions 11 through 15 inclusive were reviewed with licensee personnel. No discrepancies were noted. Records of exports are also kept by June Neiswender. No attempt was made by the inspector to ensure that export reports were filed with the Isotopes Branch.

License GL-112

Conditions 11 through 15 inclusive were reviewed with licensee personnel. No discrepancies were noted. With regard to Condition 12 (no air ionizer shall contain more than 50 mc of H-3), MacHutchin reported that every attempt is made to ensure that no unit contains more than 50 mc of H-3. The amount is usually estimated from a material balance.

16. Instructions

All new employees reportedly receive both on-the-job training and oral instruction by Burtsavage before they are permitted to work with radioactive material.'

In addition to the above instruction given to new employees, all employees engaged in isotope work, with one exception, have taken USRC's "Radioisotope Techniques Course". Details of this course have been supplied to L&R. Burtsavage stated that this course has not been given since March 1958.

17. Surveys and Survey Records

1. Direct Radiation Surveys

(a) Restricted Areas

Surveys of direct radiation levels in working areas are conducted routinely by both health physics personnel and by workers in the particular laboratories concerned. Formal surveys are conducted by the health physics staff in all work areas on a weekly and/or biweekly basis. The principal areas checked are those in front of hoods or glove boxes, or other areas where workers spend a considerable portion of their time. This is in accordance with page 2, paragraph (3)(a) of the licensee's 4/28/61 letter which is a condition of License 37-30-2.

Records of these direct radiation surveys conducted in restricted areas are logged in a small notebook. The date, meter used, time, dose rate in mr/hr, and areas surveyed are recorded. These records from 9/60 to 5/61 were reviewed by the inspectors. It was noted that each area was monitored at 6 to 10 day intervals. Two incidents of contamination were revealed. The first occurred in the strontium laboratory on 10/18/60 when it is believed that a heating unit used to dry Sr-90 containing components was inadvertently left on. A small area in the laboratory

was scorched and contaminated with Sr-90. The facility was not used for one week until decontamination was completed on 10/27/60. Burtsavage reported, however, that this facility would not have been used during that week inasmuch as this was the last operation being conducted. The second incident occurred in Lab Annex #5 on 11/22/60 when a spill resulted in a contaminated floor. The area was immediately decontaminated and in operation the next day.

(b) Unrestricted Areas

Burtsavage reported that direct reading surveys in unrestricted areas are frequently taken to ensure compliance with Part 20. Records of these surveys are kept in a special notebook and were reviewed by the inspector.

In addition, film badges have been posted for periods of seven days on outside walls of buildings in order to evaluate dose rates. Records of these evaluations are also kept.

2. Air Monitoring Surveys

(a) Restricted Areas

Air samples in restricted areas are taken approximately every three months in accordance with the 4/28/61 letter. If accidental releases occur, special air samples are taken as required. Air samples during actual operating procedures are not taken routinely, but rather more coincidental with any work that might be in progress.

Concentrations of radon in the air are determined twice yearly by an outside consultant, V. F. Hess. (Hess also takes the Rn breath analyses).

Burtsavage stated that the only instrument used to determine tritium concentrations in air was their Baird Atomic Tritium Monitor, Model TM-1. He added that, except for an occasional use to monitor stack discharges, the instrument was used solely in the tritium building. He reported that the instrument was sensitive to gamma radiation and therefore, was not used in the R&D Labs in the main radioactivity handling area because of the high background which results from the cesium operations. He also reported that high level tritium work is currently restricted to the tritium building.

Burtsavage stated that the tritium monitor has a high activity audible alarm and that the alarm was set to activate at a concentration of 5×10^{-6} uc/cc. However, it was noted during the inspection that the instrument indicated a tritium concentration of 2×10^{-4} uc/cc in the tritium building and that no audible alarm was apparent to the inspectors. Three employees were working in the building at the time that the inspector noted that the instrument indicated the above concentration. A Mr. Iver Allum, who reportedly is responsible for the technical operations associated with the tritium building, stated to the inspectors that the tritium monitor has always acted up and gave erroneous readings. He also said that no one pays much attention to the instrument because of its unreliability. Burtsavage confirmed that the monitor has given faulty readings in the past but stated that he was not aware that the workers had lost confidence in the instrument. The inspector discussed the inadvisability of the employees remaining in the work area under conditions whereby the only monitor available showed an excessive concentration of tritium in air. It should be noted that the area was not posted to indicate the presence of airborne contamination.

On the day following inspection of the tritium building, Burtsavage reported that tritium bioassays confirmed that the monitor reading observed by the inspectors on the previous day was faulty, and that he had taken steps to have the monitor repaired.

Records of air surveys in restricted areas are kept in separate notebooks by isotopes. Notebooks are maintained for the results of Sr-90, Po-210, Ra-226, Rn-222, Cs-137, C-14, H-3 and Co-60 analyses. Air surveys for 1961 (with the exception of the Cs-137 results, which were reviewed from 9/60 on) were reviewed by the inspectors. Summarized below are some of the concentrations noted in the laboratories in which the isotopes are used.

Isotope	Date	uc/ml
Sr-90	1/16/61	3.7×10^{-12}
	2/27/61	2.9×10^{-12}
Po-210	1/9/61	0
	2/6/61	2.5×10^{-12}
	2/13/61	1.1×10^{-12}
	3/13/61	2.2×10^{-13}
Rn-222	4/3/61	3.9×10^{-9}
	"	9.9×10^{-9}
	"	1.2×10^{-8}
	"	1.3×10^{-8}
Ra-226	2/6/61	2.5×10^{-10}
	"	1.5×10^{-9}
	2/7/61	4.3×10^{-10}
	3/15/61	2.4×10^{-10}
	"	2.2×10^{-10}
	3/20/61	1.9×10^{-10}
	"	1.2×10^{-10}

Isotope	Date	uc/ml
Cs-137	9/12/60	1.45×10^{-11}
	12/19/60	6.9×10^{-12}
	1/16/61	1.9×10^{-11}
	2/13/61	4.4×10^{-12}
	3/13/61	5.8×10^{-12}
	5/29/61	1×10^{-12}

It was reported that no work with C-14 or Co-60 had been done in over one year, therefore, no specific air samples were taken (results of H-3 surveys are discussed above). It should be noted that the Ra-226 results exceed the prescribed value of 3×10^{-11} uc/cc as listed in Appendix B, Table I. However, in a column labeled "comments" next to the Ra-226 air sample results, it was noted that the maximum working time per man per day in this area was about 2 hours. Burtsavage reported that he frequently used the option of 20.103(b).

(b) Unrestricted Area Stack Sampling

Burtsavage reported that ten of USRC's twelve exhaust stacks are currently being sampled to determine the concentration of licensed material being discharged to unrestricted areas. He added that two of the twelve stacks do not discharge radioactive material. Burtsavage stated that, effecitve 2/22/61, each of the ten stacks would be sampled at not less than 3 month intervals and that samples would be taken when the respective facility was in operation. Burtsavage also described the techniques followed and pitot tube measurements which were taken to ensure that isokinetic samples were collected. The following samples and results were noted:

Date of Sample	Location of Samples	Stack Discharge cfm	Total air sampled cfm	Results (uc/ml)
2/22/61	Sr-90 sulfate Room Stack	1867	317	2×10^{-12} beta
2/27/61	Cs-137 Hot Cell Stack	756	389	2.2×10^{-12} beta
3/29/61	Sr-90 Hood Stack	8016	357	1.3×10^{-12} beta
4/21/61	Main Annex Stack	5224	271	9.7×10^{-12} beta
4/21/61	Main Radium Sulfate Stack	6232	361	9.1×10^{-12} alpha

Date of Sample	Location of Samples	Stack Discharge cfm	Total air sampled cfm	Results (uc/ml)
4/26/61	Radium Lab, Neutron Hood Stack	207	280	1.4×10^{-11} alpha
5/3/61	Radium Lab, Weight Room Hood Stack	371	340	1.1×10^{-10} alpha
5/8/61	Cs-137 Hot Cell Room Exhaust Stack	623	258	1.1×10^{-11} beta
*5/11/61	Main Tritium Stack	5961	291	2.1×10^{-11} beta
5/15/61	Main Sr-90 Stack	3676	278	1.5×10^{-11} beta

*Results were determined by counting within an internal proportional gas-flow counter which has a reported tritium efficiency of 1%.

Burtsavage said that the above samples were taken during normal or above normal operations but not during known or planned releases. The above sampling program was noted to be as described in Item 1 of a letter to DL&R from J. G. MacHutchin, dated March 8, 1961, which specified the licensee's action to correct a previous item of noncompliance.

3. Area and Equipment Contamination Surveys

(a) Restricted Areas

The licensee's procedures for performing surface contamination surveys are described on page 4 of the 4/28/61 letter. These were reviewed with MacHutchin and Burtsavage and no deviations were noted.

Records of these contamination surveys are kept in seven manilla folders, each of which contained several hundred smear results, most of which were recorded on sketches of the areas. Areas which exceeded the maximum allowable count rates as listed on page 4 of the letter were decontaminated until subsequent surveys revealed that contamination levels were below the prescribed limits.

A separate log for the Cs-137 hot cell is maintained. After each 10 curies of this isotope is processed, the hot cell is closed down and thoroughly washed. A review of the logbook revealed that 18 washdowns had been conducted from 5/18/60 to 5/8/61.

(b) Unrestricted Areas

MacHutchin and Burtsavage stated that smear samples are also taken in unrestricted areas. These areas include the conference room, the reception room, the library, the lunchroom, the rest rooms, hallways, change areas, etc. These surveys are not conducted at prescribed intervals.

The inspectors requested to see the results of these surveys but Burtsavage was unable to produce any records. He stated that inasmuch as most of the results had been negative, no records had been maintained. He added that some results had revealed contamination in certain areas but that these areas were quickly cleaned up. No records of these "positive" results were available.

18. Posting and Labeling

In all use, storage and change areas, numerous prescribed signs were noted to be posted as necessary. Although no high radiation areas were noted during the inspection, all potential high radiation areas were posted accordingly. (An area which was not properly posted is discussed under paragraph 20 "Independent Measurements Made by Inspectors".)

Forms AEC-3 were also conspicuously posted throughout the facilities.

All use and storage containers that were observed by the inspectors were noted to be labeled in accordance with 20.203(f)(1) and (4).

19. Instrumentation

A review of the licensee's instrumentation revealed that all of the instruments listed in the follow-up report dated 11/10/60 are still possessed by USRC. One internal proportional counter has been added.

20. Independent Measurements Made by Inspectors

A. The following table summarizes the results of a smear survey performed by the inspectors within the licensee's general radioactivity handling area. The smears were analyzed by HASL. Refer to Exhibit "D" for location on floor where smear samples were taken.

Results (d/m/100 sq. cms)

Smear	Alpha	Beta
1	60	230
2	100	300
3	89	230
4	270	500
5	150	320
6	450	4300
7	170	4800
8	120	7900
9	150	3000
10	330	1400
11	670	440
12	340	500
13	170	2900
14	240	460
15	1700	6100
16	2200	1400
17	970	780
18	340	263
19	59	160
20	250	320

B. In addition, the following smears were taken on the floor in the licensee's Tritium Building. Refer to Exhibit "B" for location.

	Results (d/m/100 sq. cms)	
Smear	Alpha	Beta
1	1.9	51
2	16	60
3	11	95
4	1400	960

HASL reported that their analyses indicated that there was no tritium present on the above four smears and that the beta count was due to the presence of a more energetic beta emitter.

C. The following table summarizes the results of a smear survey (62 smears) performed by the inspectors, mostly in unrestricted areas:

Location	No. of Smears	Results (beta d/m/sample)
Conference Room	2	0, 9.1
Water Fountain	1	3.1
Lunchroom and Library	7	0, 0, 0, 150, 130, 8, 20
Small Darkroom	2	83, 65
Steps to Change Room	2	4.6, 5.4
Top of Door Jamb to Change Room	1	1500
Storeroom and Four Offices	7	43, 10, 33, 38, 2.4 31, 27
Change Room	7	4.8, 73, 180, 110, 110, 33, 22
Large Darkroom	5	65, 14, 68, 51, 0
Inner Lobby Floor	1	16
Floor at Entrance to Kr-85 lab	2	0, 3.5

Location	No. of Smears	Results (beta d/m/sample)
Unrestricted Areas Outside of Blockhouse	5	0, 0, 0, 46, 4.6
Cafeteria	5	4.6, 0, 3.5, 0. 4.6
Office Area	2	0, 0
Sink Outside Radium Lab	1	28
Hand Truck on Lab Loading Platform	1	210
Inside Concrete Mixer	1	0
Floor of Storage House	1	12
Top of Door to Locked Room in Storage House	1	230
Floor in Packaged Waste Storage Facility	1	18
Liquid Waste Disposal Facility	3	26, 4, 0
Silo Storage Facility	3	46, 360, 4
Top of Shipping Crate	1	26

D. A Direct reading survey, using a Nuclear Measurements GM Counter and a Juno Survey Meter, was conducted by the inspectors in all areas considered as unrestricted by the licensee. All dose rates were within the prescribed limits of 20.105, with one exception: On contact with the outside rear wall of the Radium Laboratory, a dose rate of 20 mr/hr was noted at a height of about 5 - 6 feet from the ground. At 18" from the wall a variable dose rate of 5 to 10 mr/hr was detected.

This area was not posted with any signs to indicate the presence of a radiation area.

MacHutchin and Burtsavage were informed of these dose rates. Investigation by Burtsavage revealed that unauthorized storage of radium wastes and a small amount of byproduct wastes in the rear of the radium lab were causing the high readings. These wastes were removed by Burtsavage and a subsequent survey by the inspectors revealed no detectable radiation levels in excess of 0.04 mr/hr, instrument background.

E. Four environmental samples were taken. The results, as analyzed by HASL-NYOO, are as follows:

	Sample	Alpha d/m/sample	Beta d/m/sample
1.	Water sample from discharge tank in waste disposal facility (about 800 ml.)	0.00	22
2.	Earth sample taken outside Cs-137 laboratory (about 50 grams)	0.56	298
3.	Mud sample from Susquehanna River taken near point of discharge of wastes. (about 30 grams)	0.00	9.3
4.	Water sample from Susquehanna River taken near point of discharge of wastes. (about 800 ml)	0.00	1.5

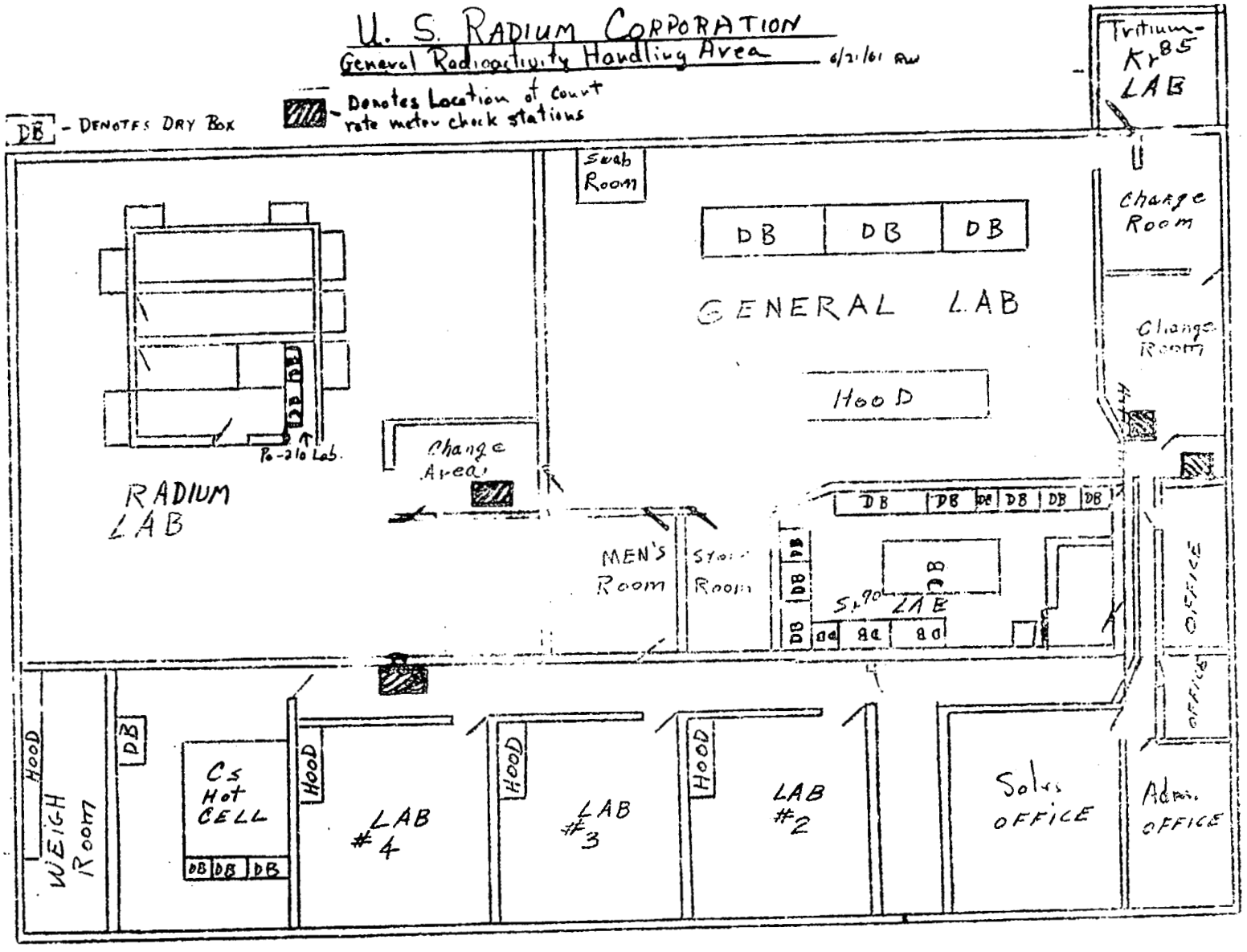
EXHIBIT A

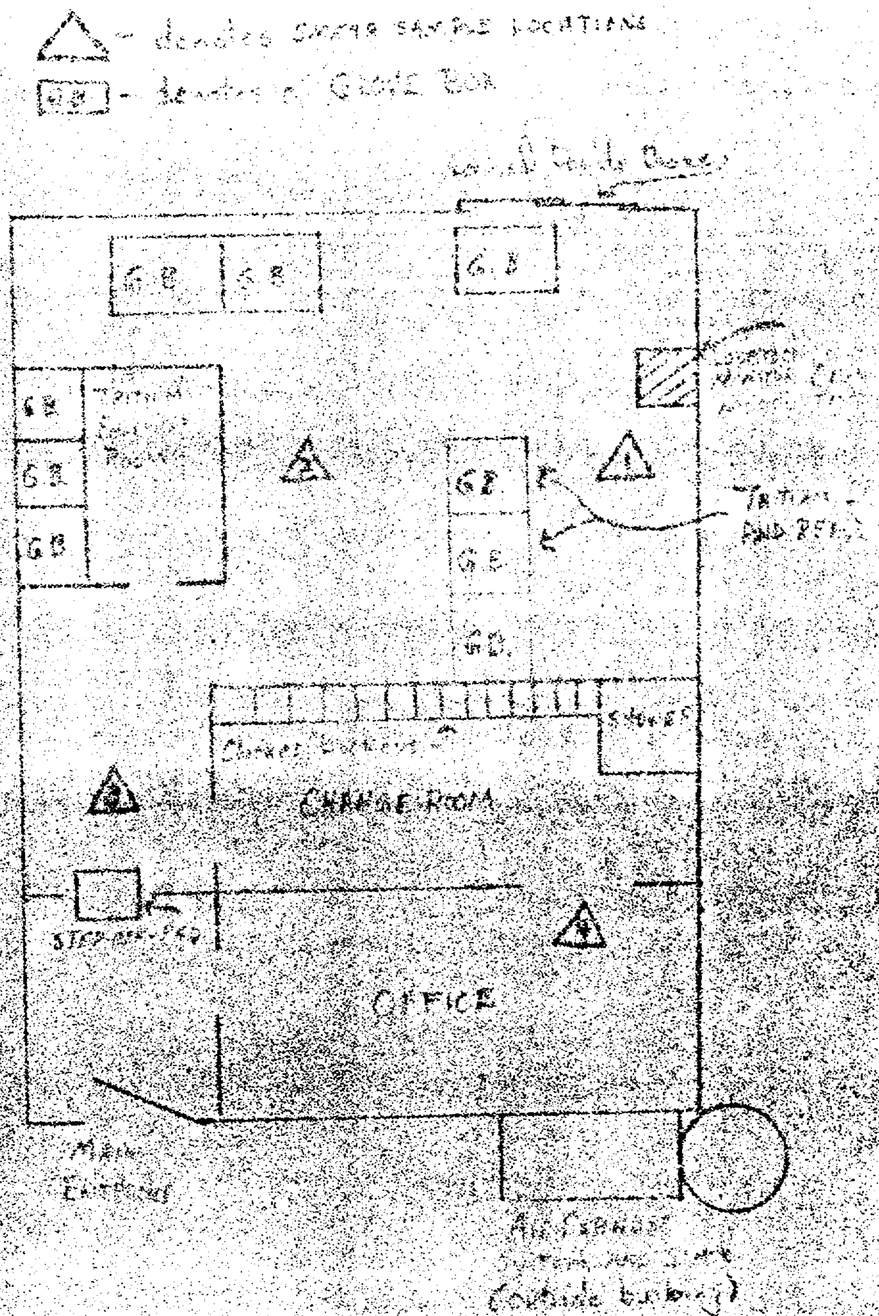
U. S. RADIUM CORPORATION

General Radioactivity Handling Area 6/21/61 RW

DB - DENOTES DRY BOX

- Denotes Location of count rate meter check stations




denotes smear sample locations
denotes a Glove Box
GB
CHANGE ROOM
Shower
OFFICE
STEP-OFF-PAD
Main Entrance

[illegible]

1969

Date	Hood	Purge	Accidental Release	Amount Released	Amount Permissible to Release/24 hrs
Jan. 2	Annex #4	X		50 mc	726 mc
Jan. 4	Annex #3		X	520 mc	726 mc
Jan. 5	Annex #4	X		50 mc	726 mc
Jan. 7	Annex #3		X	500 mc	726 mc
Jan. 8	Annex #4	X		50 mc	726 mc
Jan. 11	Annex #3	X		100 mc	726 mc
Jan. 11	Annex #4	X		622 mc	726 mc
Jan. 11	Annex #4	X		50 mc	726 mc
Jan. 13	Annex #3	X		90 mc	726 mc
Jan. 14	Annex #4	X		50 mc	726 mc
Jan. 18	Annex #3	X		480 mc	726 mc
Jan. 18	Annex #4	X		50 mc	726 mc
Jan. 19	Annex #4		X	309 mc	726 mc
Jan. 26	Annex #3	X		600 mc	726 mc
Jan. 27	Annex #4	X		200 mc	726 mc
Jan. 28	Annex #3	X		360 mc	726 mc
Jan. 28	Annex #4	X		610 mc	726 mc
Jan. 29	Annex #4	X		200 mc	726 mc
Feb. 5	Annex #3	X		280 mc	726 mc
Feb. 8	Annex #3	X		580 mc	726 mc
Feb. 9	Annex #4	X		200 mc	726 mc
Feb. 15	Annex #4	X		600 mc	726 mc
Feb. 19	Annex #3	X		556 mc	726 mc
Feb. 23	Annex #3	X		500 mc	726 mc
Feb. 23	Annex #4	X		500 mc	726 mc
Feb. 24	Annex #3	X		250 mc	726 mc
Mar. 15	Annex #3	X		500 mc	726 mc
Mar. 18	Annex #4	X		400 mc	726 mc

Date	Room	Barrie	Accidental Release	Amount Released	Amount Remaining
Mar. 16	Annex #4	X		1.0 mc	726 mc
Mar. 22	Annex #2	X,		25 mc	726 mc
Mar. 23	Annex #2	X		310 mc	726 mc
Mar. 28	Annex #2	X		550 mc	726 mc
Apr. 1	Annex #2	X		600 mc	726 mc
Apr. 5	Annex #4	X		500 mc	726 mc
Apr. 7	Annex #4	X		240 mc	726 mc
Apr. 7	Annex #3	X		240 mc	726 mc
Apr. 11	Annex #2	X		300 mc	726 mc
Apr. 14	Annex #4	X		600 mc	726 mc
Apr. 18	Annex #2	X		5 mc	726 mc
Apr. 19	Annex #2	X		80 mc	726 mc
Apr. 21	Annex #2	X		2.9 mc	726 mc
Apr. 21	Annex #2	X		20 mc	726 mc
Apr. 25	Annex #2	X		488 mc	726 mc
Apr. 28	Gen Lab H	X		100 mc	574 mc
May 2	Annex #2	X		64 mc	726 mc
May 6	Annex #4	X		104 mc	726 mc
May 9	Annex #3	X		436 mc	726 mc
May 9	Annex #4	X		290 mc	726 mc
May 11	Annex #2	X		2.6 mc	726 mc
May 26	Annex #4	X		188 mc	726 mc
Aug 17	Annex #4	X		100 mc	726 mc
Aug. 26	Annex #3	X		5 mc	726 mc
Aug. 28	Gen Lab H	X		243 mc	574 mc
Nov. 6	Main Dk Rm	X	X	600 mc	389.4 mc
Nov. 15	Annex #3	X		3 mc	726 mc
Nov. 17	Gen Lab H	X		650 mc	574 mc
Nov. 28	Annex #3	X		15 mc	726 mc

Date	Hood	Purge	Accidental Release	Amount Released	Amount Permissible to Release/24 hrs
28	Annex #4	X		500 mc	726 mc
29	Annex #4	X		700 mc	726 mc

1961

(all releases through Annex #2, #3, or #4)

Date	Purge	Accidental Release	Amount Released
1/16	X		500 mc
2/24	X		600 mc
3/15	X		375 mc
3/16	X		100 mc
4/5	X		150 mc
4/7	X		40.1 mc
4/20	X		250 mc
4/24	X		500 mc
4/27	X		250 mc
5/1	X		300 mc
5/19	X		300 mc

Flow Rates

Main Dark Room	3258 cfm
Annex #2, #3, #4	5274 cfm
General Lab H	5961 cfm

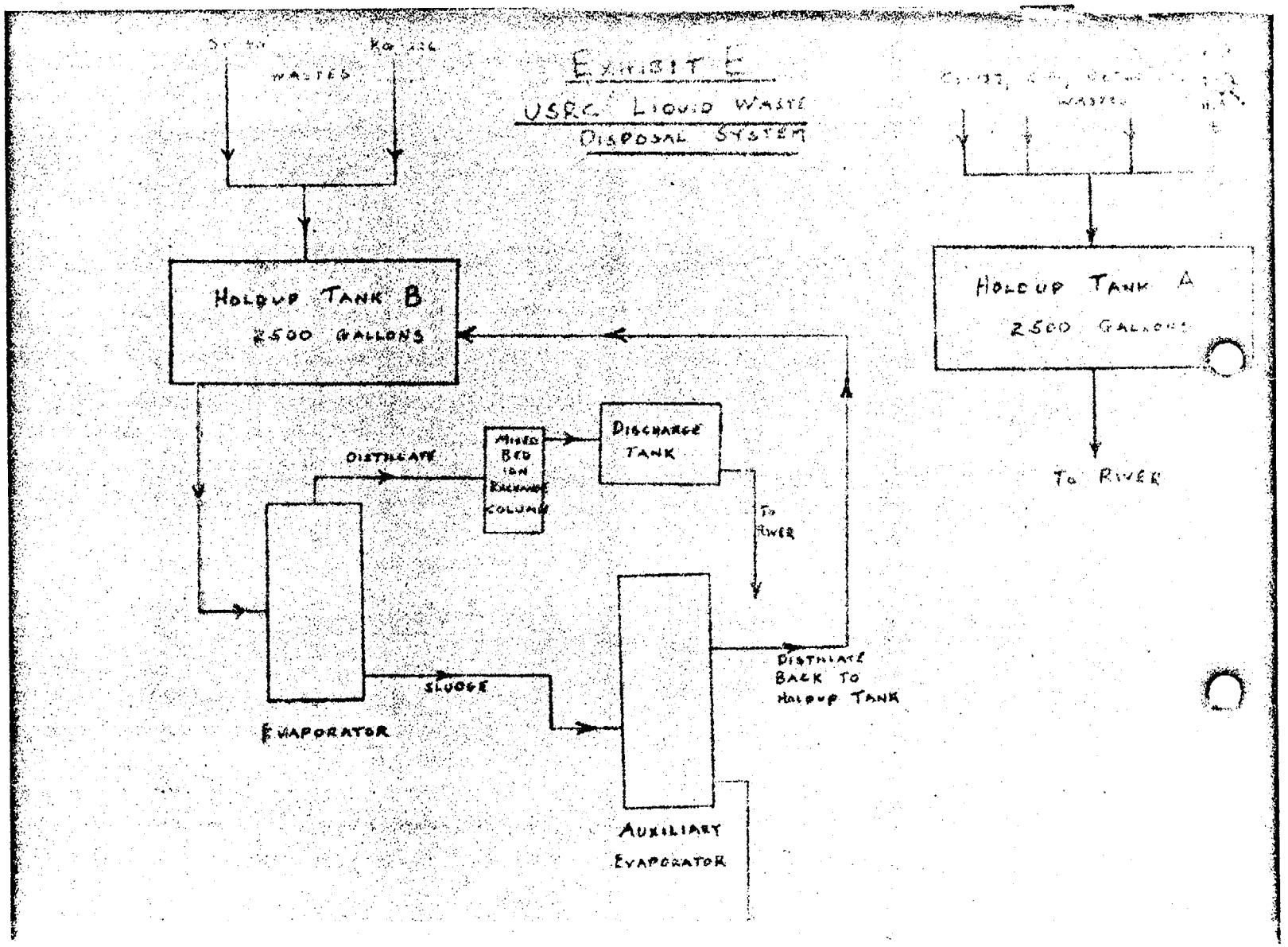
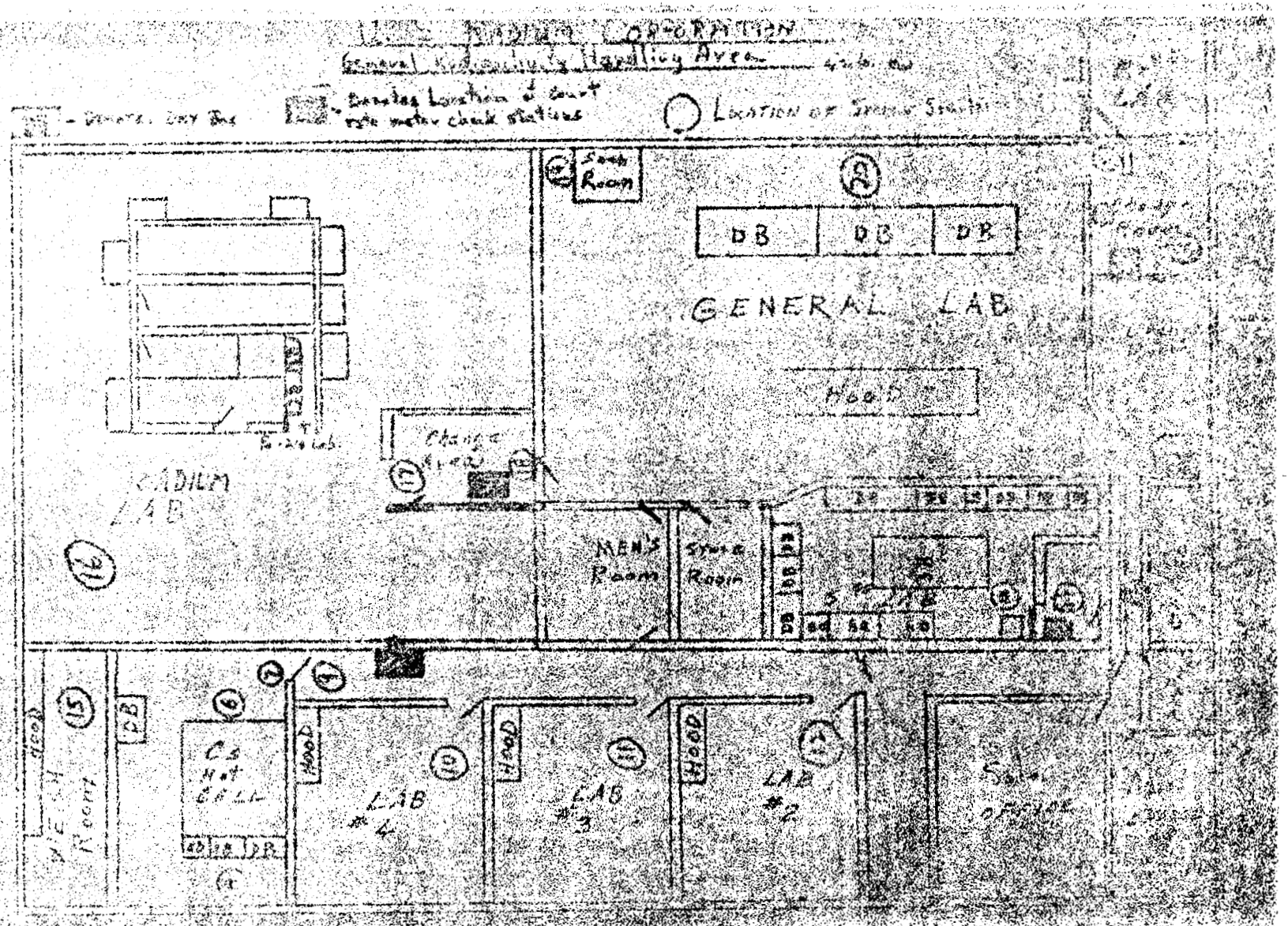


EXHIBIT E
USRC LIQUID WASTE
DISPOSAL SYSTEM
WASTED
HOLDUP TANK B
2500 GALLONS
HOLDUP TANK A
2500 GALLONS
TO RIVER
DISTILLATE
MIXED BED ION EXCHANGE COLUMN
DISCHARGE TANK
TO RIVER
SLUDGE
EVAPORATOR
DISTILLATE BACK TO HOLDUP TANK
AUXILIARY EVAPORATOR


Location of Smoke Stack
Food Room
DB
DB
DB
GENERAL LAB
Hood
Change Room
RADIUM LAB
MEN'S Room
Smoke Room
Hood
Hood
Hood
LAB #4
LAB #3
LAB #2
Room
DB
DB

Page Added 2005 -
Copies of Previous 6 pages
at different (darker)
machine setting

△ - denotes SWIPE SAMPLE LOCATIONS

GB - denotes a GLOVE BOX

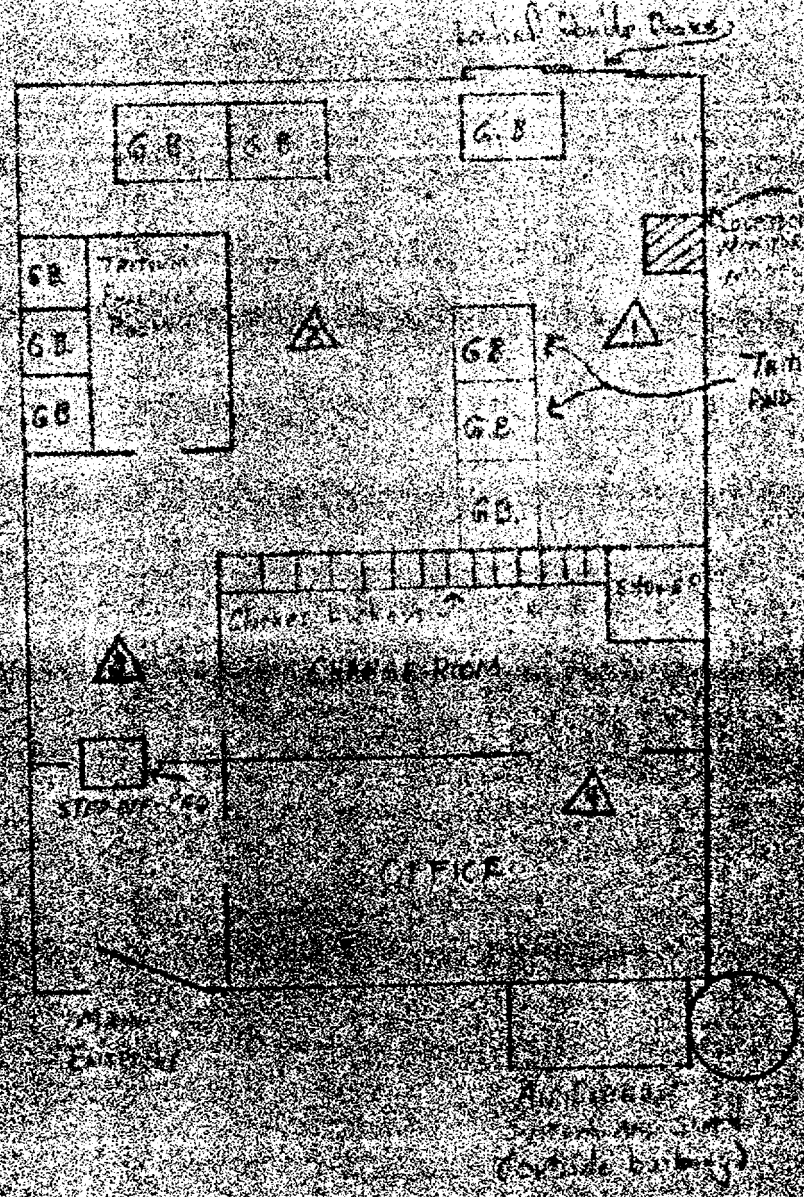


EXHIBIT [illegible]

KRYPTON - 85 GAS TRAPS & DISPOSAL - 1960, 1961

1960

Date	Hood	Purge	Accidental Release	Amount Released	Amount Permissible to Release/24 hrs
Jan. 2	Annex #4	X		50 mc	726 mc
Jan. 4	Annex #3		X	520 mc	726 mc
Jan. 5	Annex #4	X		50 mc	726 mc
Jan. 7	Annex #3		X	500 mc	726 mc
Jan. 8	Annex #4	X		50 mc	726 mc
Jan. 11	Annex #3	X		100 mc	726 mc
Jan. 11	Annex #4	X		622 mc	726 mc
Jan. 11	Annex #4	X		50 mc	726 mc
Jan. 13	Annex #3	X		90 mc	726 mc
Jan. 14	Annex #4	X		50 mc	726 mc
Jan. 18	Annex #3	X		490 mc	726 mc
Jan. 18	Annex #4	X		50 mc	726 mc
Jan. 19	Annex #4		X	309 mc	726 mc
Jan. 26	Annex #3	X		600 mc	726 mc
Jan. 27	Annex #4	X		300 mc	726 mc
Jan. 28	Annex #3	X		360 mc	726 mc
Jan. 28	Annex #4	X		610 mc	726 mc
Jan. 29	Annex #4	X		300 mc	726 mc
Feb. 1	Annex #3	X		200 mc	726 mc
Feb. 8	Annex #3	X		300 mc	726 mc
Feb. 9	Annex #4	X		200 mc	726 mc
Feb. 15	Annex #4	X		600 mc	726 mc
Feb. 19	Annex #1	X		856 mc	726 mc
Feb. 21	Annex #1	X		300 mc	726 mc
Feb. 23	Annex #4	X		500 mc	726 mc
Feb. 24	Annex #3	X		250 mc	726 mc
Mar. 15	Annex #3	X		500 mc	726 mc
[illegible]	Annex #4	X		[illegible]	[illegible]

Date	Hood	Purge	Accidental Release	Amount Released	Amount Permissible to Release/24 hrs
Mar. 18	Annex #4	X		120 mc	726 mc
Mar. 22	Annex #2	X		25 mc	726 mc
Mar. 23	Annex #2	X		310 mc	726 mc
Mar. 28	Annex #2	X		550 mc	726 mc
Apr. 1	Annex #2	X		600 mc	726 mc
Apr. 5	Annex #4	X		500 mc	726 mc
Apr. 7	Annex #4	X		240 mc	726 mc
Apr. 7	Annex #3	X		240 mc	726 mc
Apr. 11	Annex #2	X		300 mc	726 mc
Apr. 14	Annex #4	X		600 mc	726 mc
Apr. 18	Annex #2	X		5 mc	726 mc
Apr. 19	Annex #3	X		50 mc	726 mc
Apr. 21	Annex #3	X		2.5 mc	726 mc
Apr. 21	Annex #2	X		20 mc	726 mc
Apr. 25	Annex #3	X		488 mc	726 mc
Apr. 28	Gen Lab #[illegible]	X		100 mc	574 mc
May 1	Annex #[illegible]	X		84 mc	726 mc
May 5	Annex #[illegible]	X		104 mc	726 mc
May 8	Annex #[illegible]	X		370 mc	[illegible] mc
May 9	Annex #[illegible]	X		550 mc	[illegible] mc
May 21	Annex #[illegible]	X		[illegible] mc	[illegible] mc
May 29	Annex #[illegible]	X		[illegible] mc	[illegible] mc
Aug. 17	Annex #[illegible]	X		100 mc	[illegible] mc
Aug. 26	Annex #[illegible]	X		5 mc	[illegible]
Aug. 28	Gen Lab #[illegible]	X		245 mc	574 mc
Nov. 8	Main [illegible]	X		900 mc	[illegible] mc
Nov. 15	Annex #[illegible]	X		5 mc	726 mc
Nov. 17	Gen Lab #[illegible]	X		550 mc	574 mc
Nov. 28	Annex #[illegible]	X		15 mc	726 mc

EXHIBIT "C"

Date	Hood	Purge	Accidental Release	Amount Released	Amount Permissible to Release/24 hrs
20	Annex #4	X		500 mc	726 mc
29	Annex #4	X		700 mc	726 mc

1951

(All releases through Annex #2, #3, or #4)

Date	Purge	Accidental Release	Amount Released
1/16	X		500 mc
2/24	X		600 mc
3/15	X		375 mc
3/16	X		100 mc
4/3	X		150 mc
4/1	X		40.1 mc
4/20	X		250 mc
4/24	X		500 mc
4/27	X		250 mc
5/1	X		300 mc
5/19	X		300 mc

Flow Rates

[illegible] 2[illegible] cfm

Annex #2, #3, #4 [illegible] cfm

General Lab [illegible] 5951 cfm

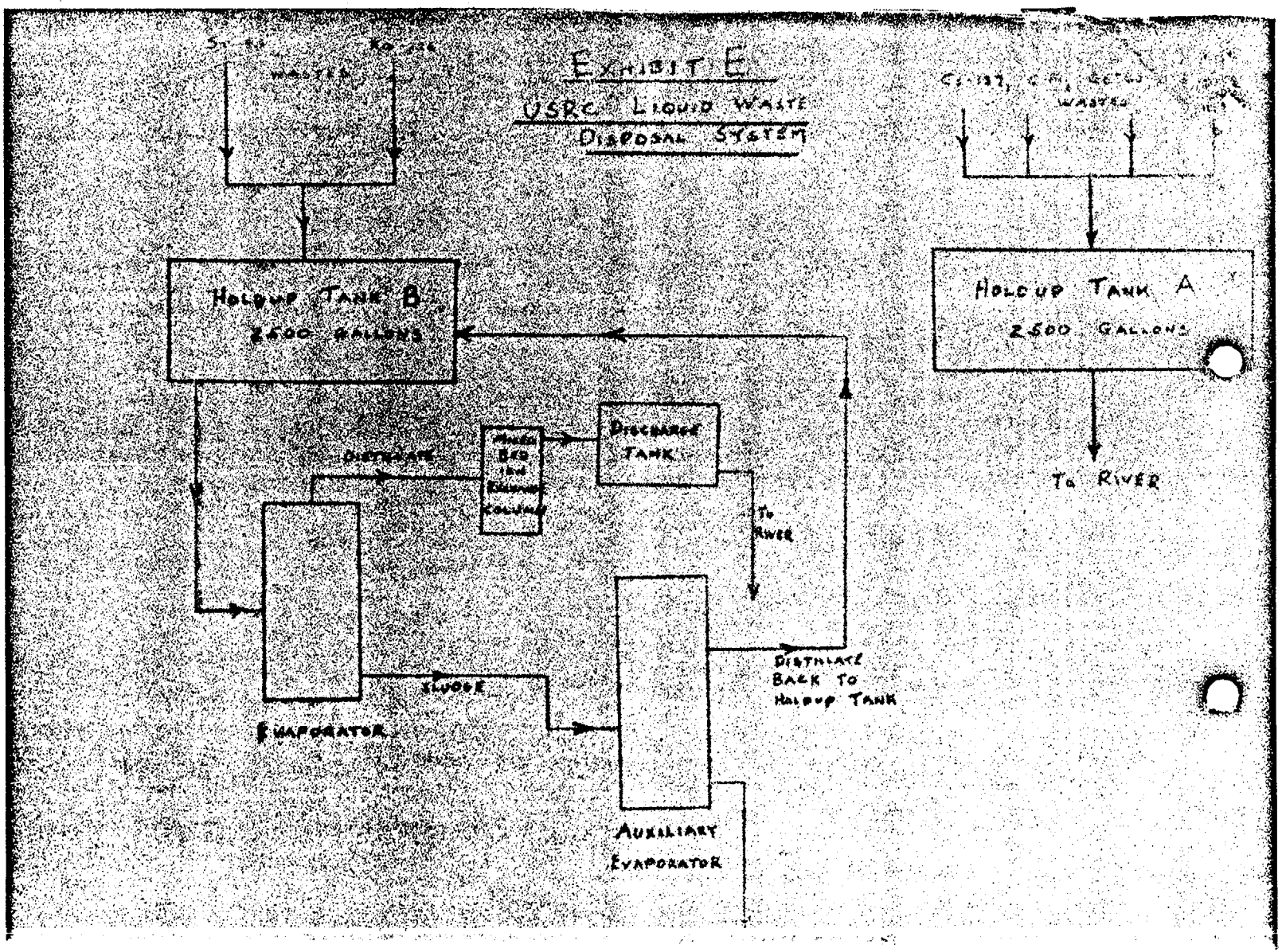
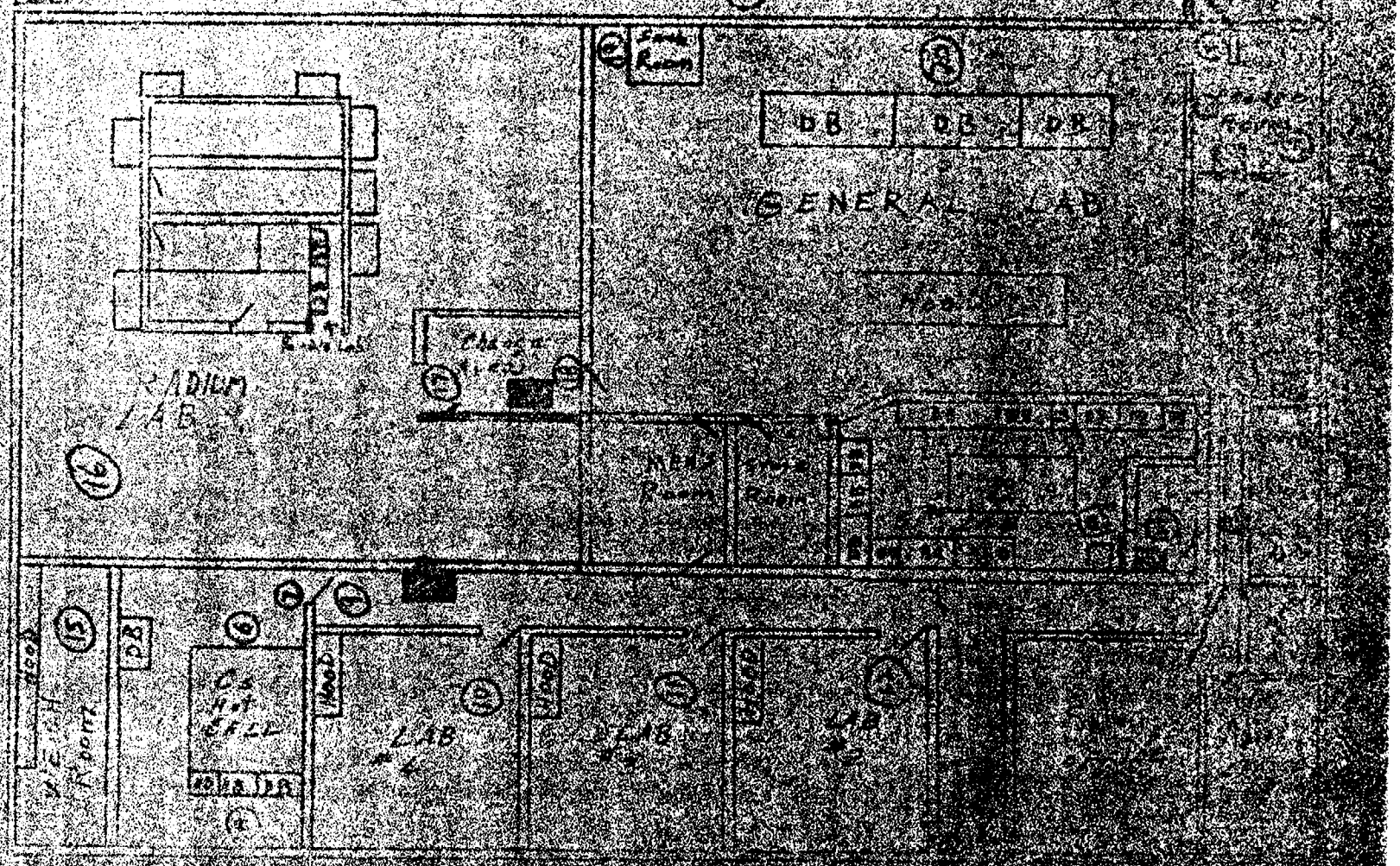


EXHIBIT E
USRC LIQUID WASTE
DISPOSAL SYSTEM
WASTES
HOLDUP TANK B
2500 GALLONS
HOLDUP TANK A
2500 GALLONS
TO RIVER
DISCHARGE TANK
DISTILLATE
TO RIVER
SLUDGE
EVAPORATOR
DISTILLATE BACK TO HOLDUP TANK
AUXILIARY EVAPORATOR


DB
DB
DR
GENERAL LAB
RADIUM LAB
Gas Hot Cell
LAB #4
LAB #3
LAB #2
Hood
DR