

COMPLIANCE INSPECTION REPORT

1. Name and address of licensee Mallinckrodt Chemical Works Mallinckrodt/Nuclear Box 6172, Lambert Field St. Louis, Missouri 63145	2. Date of inspection 9-13 & 14-67 and 10-17-67
	3. Type of inspection Reinspection
	4. 10 CFR Part(s) applicable 20 and 30

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

24-4206-1	10-8-58	10-31-60 - Reinspection #12
Amendment 17 (amended in entirety)	1-5-66	10-31-66
Amendment 18	9-15-66	10-31-68
Amendment 19	10-7-66	10-31-68
Amendment 20	10-26-66	10-31-68
Amendment 21	1-6-67	10-31-68
Amendment 22	2-16-67	10-31-68

6. Inspection findings (and items of noncompliance)

10 CFR 20.103 - "Exposures of Individuals to Concentrations of Radioactive Material in Restricted Areas"

- (a) in that from May 1967 through September 1967, several employees were apparently exposed to average weekly airborne concentrations of Iodine 131 in excess of the limits prescribed in 10 CFR 20.103(a). This is based on the licensee's frequent measurement of more than 0.14 micro-curies of Iodine 131 in employees' thyroids. See paragraphs 46-50 of report details.

10 CFR 20.405 - "Reports of Overexposures and Excessive Levels and Concentrations"

- (a) & (b) in that the exposures to Iodine 131 referred to above were not in all cases reported to the Commission within thirty days of the exposures as required by 10 CFR 20.405(a). Also, the exposed individuals were not in all cases furnished a written report of their exposure as required by 10 CFR 20.405(b). See paragraphs 49 and 50 of report details.

- continued -

7. Date of last previous inspection week of April 24, 1967	8. Is "Company Confidential" information contained in this report? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> (Specify page(s) and paragraph(s))
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DISTRIBUTION:

Division of Compliance
Headquarters (orig. & 2 cys)

Approved by:

Edger C. Ashley

(Inspector)

J. M. Allan, Senior Radiation
Specialist, Region III

(Operations office)

October 30, 1967

(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.

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6. Inspection findings

10 CFR 20.201 - "Surveys"

- (b) in that surveys being made of potentially contaminated laboratory uniforms were inadequate to detect the presence of measurable amounts of radioactive material prior to their release to a commercial laundry. See paragraph 30 of report details.

10 CFR 20.201 - "Surveys"

- (b) in that surveys were not made in all cases to detect the presence of radioactive material on articles being disposed through normal trash channels. See paragraph 34 of report details.

10 CFR 20.201 - "Surveys"

- (b) in that surveys were inadequate to detect the existence of a high radiation area in the vicinity of an outside storage area. See paragraphs 53-55 of report details.

10 CFR 20.201 - "Surveys"

- (b) in that no surveys were made from August 18 to September 14, 1967 to determine compliance with 10 CFR 20.103 with respect to the airborne concentrations of radioactive material to which employees were exposed in restricted areas in the licensee plant. See paragraphs 23-25 of report details.

10 CFR 20.203 - "Caution Signs, Labels and Signals"

- (c)(1) in that the outside storage area was not posted to indicate the presence of a high radiation area. See paragraph 53-55 of report details.

10 CFR 20.203 - "Caution Signs, Labels & Signals"

- (d)(2) in that the airborne radioactivity area existing in the production area was not posted as required. See paragraph 26 of report details.

10 CFR 30.3 - "Activities Requiring License"

in that a 100 millicurie Strontium 90 medical eye applicator was transferred to an individual not authorized to receive it. See paragraph 56 of report details.

DETAILS

GENERAL INFORMATION

9. This was an unannounced reinspection of this byproduct material program conducted on September 13 and 14, 1967.
10. Dr. E. A. Fulgrabe, Director, Radiological Health Unit, State of Missouri, was notified of this forthcoming inspection by telephone on September 8, 1967. The inspector was unaccompanied.
11. The following licensee personnel were interviewed during this inspection:
 - Dr. Floyd Mallett, Technical Director
 - Dr. Donald W. Soldan, Manager, Health Physics Department
 - Mr. Walter Bushman, Health Physics Technologist
 - Mr. John Henry, Health Physics Janitor
 - Mr. Larry Harrigan, Sales Services Customer Representative
 - Mr. William Lawsen, Production Supervisor

INSPECTION HISTORY

12. The last previous inspection of this licensee (Reinspection No. 11) was conducted during the week of April 24, 1967. As a result of that inspection, the licensee received correspondence from the Commission (letter dated July 25, 1967) setting forth seven items of noncompliance. In a letter dated August 16, 1967 the licensee replied to the Commission regarding the seven items of non-compliance and corrective steps concerning each of the seven items.
13. Reinspection No. 12 was conducted on September 13 and 14, 1967 and is the subject of this report. Ex 6
14. Reinspection No. 12 was limited primarily to a review of the following items:
 - a. Previous items of noncompliance and corrective action.
 - b. Personnel monitoring.
 - c. Independent measurements.
 - d. Miscellaneous.
 - e. Management discussion on September 14, 1967.

PREVIOUS ITEMS OF NONCOMPLIANCE AND CORRECTIVE ACTION

Each of the seven items set forth in the Commission's letter dated July 25, 1967 are presented in order and denoted by (1), (2), (3), etc.

15. (1) An individual received a whole body exposure of about 1.9 rems during the first calendar quarter of 1967 contrary to 10 CFR 20.101(a). Since no Form AEC-4 had been completed for this individual, his whole body exposure should have been limited to 1.25 rems each calendar quarter.
16. [redacted] is the individual in question. [redacted] formerly worked as a health physics technician at the Mallinckrodt-Uranium Division in Weldon Springs, Missouri. The licensee stated that [redacted] radiation history information was requested in November, 1966, but because of the changing of personnel assignments at the Weldon Springs facility during the process of closing down that facility the subject information was not submitted to the licensee until June 23, 1967.

17. During this reinspection it was noted that [redacted] whole body exposure for the second calendar quarter of 1967 was less than 1.0 rem and that a Form AEC-4 has been completed for [redacted].
18. (2) The radiation exposure referred to in Item (1) above, was not reported to the Commission as required by 10 CFR 20.405(a). Also, the exposed individual was not furnished a written report of his exposure as required by 10 CFR 20.405(b).
19. The licensee stated that a written report was furnished to [redacted] in accordance with 10 CFR 20.405(b) following the inspection conducted during the week of April 24, 1967. The licensee also stated that this report was removed from the licensee's radiation history file of [redacted] after receipt of [redacted] radiation history "which, in fact, verified that no overexposure had occurred." During this inspection, it was pointed out to Mr. Soldan that since the radiation history (and completed Form AEC-4) for the individual was not in the licensee's file at the time that the individual's whole body exposure exceeded 1.25 rems during the calendar quarter, the overexposure did occur no matter what information was obtained after the fact.
20. [redacted] stated that he was furnished a written report of his exposure following the last previous reinspection and that he had this report at home.
21. (3) Contrary to 10 CFR 20.201(b), no surveys were made to determine airborne concentrations of radioactive materials pursuant to 10 CFR 20.103 and 10 CFR 20.106 from December 8, 1966 to March 31, 1967.
22. In the licensee's letter dated August 16, 1967, Soldan stated that such surveys were taken prior to December 8, 1966 and subsequent to March 31, 1967.
23. A review of the licensee's air sample survey records during this inspection revealed that no in-plant air sample data had been obtained pursuant to 10 CFR 20.103 from August 18 to September 14, 1967, which again constitutes noncompliance with 10 CFR 20.201(b). Soldan said no samples were taken between August 18 and September 7 due to a malfunction of the automatic on-off timer which controls the system. At the same time, Soldan stated that the samples could not be turned on and off by hand because the electrician had the electrical box torn apart. It is significant to note here that during a management discussion with Mr. Balliett on September 14, Soldan stated that the air samples were not taken during that time because they (health physics personnel) simply kept forgetting to operate the air sample system manually.
24. In addition, Soldan stated that the air sample cartridges which were put in place on September 8, after the installation of a new timer, had not been changed yet (as of September 14) due to a current shortage of health physics personnel (vacation and death in a family). As a result, no data has been obtained regarding airborne concentrations of radioactive materials in restricted areas between August 18 and September 14 with no indication given as to when the current cartridges would be changed.
25. The licensee's thyroid count records (see paragraphs 46-48) show that two individuals had thyroid burdens of greater than 0.14 microcurie, averaged weekly, during this period when no in-plant air samples were taken.
26. The licensee's air sample data for those air samples taken in the restricted Production Area during the period May 1 to August 18, 1967 show that, on occasion, the weekly average airborne concentration of Iodine 131 was approximately 6×10^{-9} uc/ml, or about 66% of the iodine MPC of 9×10^{-9} uc/ml. This concentration of airborne Iodine 131, when averaged over the number of hours which individuals are in the area, exceeded 25% of 9×10^{-9} uc/ml, the restricted area MPC for Iodine 131. The signs posted at the entryways to the Production Area did not include the words "Caution (or Danger) - Airborne

26. (continued)

Radioactivity Area," which constituted noncompliance with 10 CFR 20.203(d)(2). Each of the three personnel entryways leading to the Production Area were properly posted in accordance with 10 CFR 20.203(d)(2) during this inspection on September 14. Soldan stated he had not read 10 CFR 20.203(d)(1) beyond Subdivision 20.203(d)(1)(i).

27. (4) & (7) No surveys were made of laboratory uniforms potentially contaminated with radioactive material prior to their release to a commercial laundry during the week of April 24, 1967, contrary to 10 CFR 20.201(b) and records were not maintained of surveys which had been conducted (prior) to the week of April 24, 1967, to assure that laboratory coats were not contaminated with radioactive material prior to being sent to a commercial laundry, contrary to 10 CFR 20.401(b).
28. These items are treated collectively in that the licensee now refers to their protective clothing as uniforms which includes pants, shirts, women's dresses, and laboratory coats.
29. The licensee now requires all employees to deposit their used uniforms into a laundry basket by way of a chute-type covered opening in the laundry room wall. This system of laundry turn-in has proved satisfactory due to the permanent tagging of each article with the person's name to whom the article is assigned. Soldan stated that all articles in the basket are surveyed by the "health physics janitor." A new uniform survey record form was initiated on June 14, 1967. A copy of this new form is attached to this report as Exhibit A. The data on the form includes the date of the survey, the number of each of the different articles surveyed and the surveyor's name. A review of these records showed that between 100 and 170 pieces of clothing are released at one time. Soldan stated that less than ten articles are normally found contaminated each time and are not released until later.
30. A visit was made to the laundry room during this inspection. The instrument used for laundry surveys is a table top model Nucleonics Corporation of America, Model No. 3 monitor with a 35 mg/cm² GM probe. At the time of this visit the monitor was set on the 10X scale (15,000 cps) and located on a bench top near a refrigerator used by Quality Control for storage of miscellaneous radioisotopes. Soldan supplied a sample solution of Iodine 131, assayed as 3.5 microcuries (approximately 7.5×10^6 dpm) as of September 14, 1967, which was used to check the laundry monitor for sensitivity. With the monitor set on the 10X scale, which John Henry, the janitor surveyor, said is the normal setting, very little change was noted in the needle deflection after a few seconds with the bottle containing the 3.5 uc of Iodine 131 held in contact with the meter probe. At the same time the monitor response was not rapid when set on 1X scale (1500 cps), also the radiation background from the refrigerator caused the monitor to read nearly full scale on the 1X setting (reason for using 10X scale). Soldan was advised that the insensitivity of the laundry monitor together with the radiation background from the refrigerator would not allow an adequate survey to be made of uniforms contaminated with significant amounts of radioactive material prior to their release to a commercial laundry, and therefore again constituted noncompliance with 10 CFR 20.201(b). In addition, Soldan stated that the term "within permissible limits" as noted on the survey record form meant "nothing detectable on that survey meter."
31. (5) No surveys were conducted of articles contained in waste baskets in the Production Area to establish that they were not contaminated with measurable amounts of radioactive material at the time of their disposal through normal refuse channels or by incineration, contrary to 10 CFR 20.201(b).

32. At the time of the April, 1967 inspection, the subject wastebaskets were being emptied by John Kellerman, Production Technician. Since that time, the emptying and surveying of wastebaskets in the Production Area and the Dispensing and Research and Development Laboratories has been turned over to the Health Physics Department. Soldan stated that only when health physics personnel are not available (vacation, sickness, etc.) is the duty of emptying and surveying Production Area wastebaskets given to Kellerman.
33. The licensee's wastebasket survey records (one form for Production Area and one form for Dispensing and R&D) show that daily surveys are being made of the wastebaskets. The signature of the surveyor on the record form indicates that no contaminated waste was allowed to be disposed of through normal refuse channels.
34. In the presence of Mr. Soldan, the AEC representative performed a cursory radiation survey of the contents of two large metal waste repositories located outside the licensee's restricted areas which were awaiting pick up by a commercial agency. Both containers were full. In the container located on the south side of the building a radiation level of approximately 50 mr/hr was detected at the surface of a paper bag (contents unknown) while in the container located on the north side of the building a radiation level of greater than 200 mr/hr was detected at the surface of a paper hand towel. The licensee representative was advised that apparently not all wastebaskets are surveyed prior to release to normal refuse which again constituted noncompliance with 10 CFR 20.201(b). Mr. Soldan could offer no explanation except to agree that not all items are surveyed before disposal. Soldan said the contaminated articles would be removed from the repositories before he went home that evening.
35. (6) On numerous occasions during March and April 1967, concentrations of radioactive materials, including Iodine 125 and Iodine 131, discharged to the sanitary sewerage system when diluted by the average daily quantity of sewage released by the company exceeded the limits specified in Appendix B, Table I, Column 2 of 10 CFR 20, contrary to 10 CFR 20.303(b)(1).
36. Beginning May 2, 1967, a new liquid active waste analyses and disposal record system was begun. A sample copy of this record form is attached to this report as Exhibit B. A ten ml sample is taken from the liquid waste tank on the day the tank is to be dumped and is counted in a modified single channel analyzer (as previously done). The sample is counted with the analyzer set to detect all gamma energies greater than 10 kev. This count is recorded on the liquid disposal form under the heading (a) "All (I-131)." If this count shows the concentration in the tank to be such as to exceed the average daily diluted permissible concentration based on volume desired to be dumped, total clean water dilution and Iodine 131 MPC of 6×10^{-5} uc/ml, then the analyzer window is narrowed and the sample recounted for only that gamma energy between 349-381 kev. The result of this recount is entered on the form under the heading (b) "I-131." The "All (I-131)" result minus the "I-131" result is entered on the form under the heading (c) "Hg-203," which is the next most restrictive MPC (5×10^{-6} uc/ml) - excluding Iodine 125, which is discussed later in this section. The sample is not recounted any more unless necessary, and according to Soldan, this has not occurred as yet.
37. Pursuant to 10 CFR 20, the following relationships are used to determine the amount of liquid which can be dumped according to the sample analyses:

$$S = \frac{C_a}{MPC(I-131)} \leq \frac{V}{V_p}$$

$$\text{or } S = \frac{C_b}{MPC(I-131)} + \frac{C_c}{MPC(Hg-203)} = \frac{V}{V_p}$$

$$\text{where } \frac{V}{V_p} \text{ must be } = 1 \text{ (unity)}$$

37. (continued)

The volume which is permitted to be dumped from the tank is found by:

$$V_p \leq \frac{V}{S}$$

where V = known total daily volume including dilution. Finally, as M³ = gallon conversion table is used to determine the volume to be dumped, V_p, which must be smaller than V_p. The conversion table must be used because the tank controls measure gallons whereas the diluting water is measured in cubic meters.

38. In order not to exceed the one curie per year total activity limit, the licensee also keeps a running total of activity dumped as shown in Exhibit B.
39. Other terms used in this analysis method and used in the record forms are explained as follows:

A 2.07×10^{-3} uc Iodine 131 Standard was obtained from Quality Control. (2.07×10^{-3} uc $\times 2.22 \times 10^6 \frac{\text{dpm}}{\text{uc}} = 4.6 \times 10^3 \text{ dpm}$)

This standard was counted for one minute to give 1.33×10^3 cpm for "All (I-131)," therefore:

$$\frac{1.33 \times 10^3 \text{ cpm}}{4.6 \times 10^3 \text{ dpm}} = 29\% \text{ efficiency}$$

γ (uc/cpm) was found by:

$$F = \frac{2.07 \times 10^{-3} \text{ uc}}{1.33 \times 10^3 \text{ cpm}} = 1.55 \times 10^{-6} \frac{\text{uc}}{\text{cpm}}$$

For convenience of terms, all samples are then counted for T (mins) = 1.55

40. Soldan said the efficiency is currently running at about 31%. Also, the "I-131" T (mins) of 6.70 and F(uc/cpm) of 6.7×10^{-6} are due to the much lower efficiency in the narrowed window position of the I-131 energy.
41. Mr. Soldan stated no specific determination of I-125 concentrations is made of the licensee's liquid waste prior to dumping. Two primary reasons were given for this. First, the known quantities of I-125 used (and potentially discharged as liquid waste) is relatively quite small in comparison to all other radioisotopes used (and potentially discharged). Secondly, an attempt has been made to determine I-125 in a mixed solution without success. There seems to be too much Compton scattering at the lower end of the spectrum. Iodine 125 gamma energy is 35 kev.
42. Mr. Soldan was advised that, with the possible exception to Iodine 125, the licensee appears to be discharging liquid wastes in accordance with 10 CFR 20.203.
43. Soldan advised that he would try to determine the concentration of Iodine 125 in the liquid waste and that he has the capability of further increasing the clean water dilution in order to lower the Iodine 125 concentration which might be present.
44. Procedural changes since the April, 1967 inspection have helped reduce the amount of radioactive material discharged as liquid waste, according to Soldan. All Hot Cell glassware is now canned and stored for decay, or is rinsed once in the Hot Cell prior to washing. (Hot Cell rinse water goes to the High Level Tank which hasn't needed dumping yet.) Also, the Quality Control Department used to wash and reuse contaminated culture media bottles. Now a disposable type is used and not reclaimed.

45. The licensee's liquid active waste disposal records show that from May 2 to September 12, 1967, forty-four discharges have taken place involving a total of 135,397 microcuries of activity.

PERSONNEL MONITORING

46. The licensee's thyroid count data was reviewed from the week of May 1, 1967 through the week of September 4, 1967. All those persons showing a weekly average thyroid count of greater than 0.14 microcuries are listed as follows:

(The counting results are recorded as a decimal fraction (or multiple) of 0.14 uc, i.e., 1.0 = 0.14 uc.)

<u>Week of</u>	<u>M</u>	<u>Tu</u>	<u>W</u>	<u>Th</u>	<u>F</u>	<u>Weekly Average</u>
5-1-67 [REDACTED]	1.60	1.89	1.85	6.00	6.70	3.60
5-8-67 [REDACTED]	3.33	4.52	4.26	3.80	3.47	3.87
5-22-67 [REDACTED]	-	-	-	-	1.40	1.40
6-5-67 [REDACTED]	2.82	2.61	1.71	2.01	-	2.28
7-17-67 [REDACTED]	-	3.36	-	-	-	3.36
7-24-67 [REDACTED]	1.75 1.73	- -	- -	- -	- -	1.75 1.73
7-31-67 [REDACTED]	-	-	-	-	1.48	1.48
8-21-67 [REDACTED]	0.50	-	1.41	1.11	1.61	1.17
9-4-67 [REDACTED]	-	0.67	-	4.68	2.92	2.76

Ex 6

47. A dash (-) in the above listing indicates no thyroid count for that person for the day indicated. Also, in the licensee's thyroid count records not included in the above listing, by virtue of the fact that the weekly average was less than 1.0, there were several instances when no thyroid count was taken of a particular person in a given week. At the same time the records do not show any pattern as to when a person's thyroid is counted initially or recounted in a given week.
48. In many instances where the thyroid count is unusually high, notations are made to indicate the presence of personnel contamination at the time of the count. Examples of these notations as related to the data in the above listing is as follows:

48. (continued)

Week of 5-1-67: The Monday 1.60 count (contamination)
The Thursday 6.00 count (gross contamination)

Week of 6-5-67: The Tuesday 2.61 thyroid count is accompanied
by a 2.27 count of the back of the neck.

Week of 7-17-67: The Tuesday 3.36 thyroid count is noted that
hair was counted in the thyroid (counting)
position and showed 1.20.

Week of 8-21-67: The Wednesday 1.41 thyroid count is noted to
show external skin contamination (neck-right
side) (no amount shown).

Week of 9-4-67: The Thursday 4.68 thyroid count is noted by
"By counting only left side of neck, 3.25
was found."

Ex 6

49. The licensee was advised that the exposure of personnel to excess concentrations of airborne Iodine 131, as indicated by thyroid counts in excess of 0.14 micro-curries averaged weekly, constituted noncompliance with 10 CFR 20.103(a). In addition, none of these exposures were reported to the Commission or to the pertinent employees which constituted noncompliance with sections 20.405(a) and 20.405(b) of 10 CFR 20.

50. Mr. Soldan did not give any specific answer or reason as to why these exposures were not reported.

51. The licensee's film badge records were reviewed for the second and third calendar quarters of 1967 through the week of August 28. A summary of this data, which shows that the external radiation exposure limits of 10 CFR 20 have not been exceeded, is given below:

	1967 2nd Qtr	1967 3rd Qtr (thru week of 8/28)
Maximum whole body exposure -	2.471 rems (1)	1.732 rems (2)
Approximate average for all persons	about 1.0 rem	about 550 mrem
Maximum extremity exposure	13.784 rems (3)	9.203 rems (4)
Approximate average for all persons	about 2.0 rems	about 1.0 rem

52. The licensee's urinalysis results were not reviewed during this inspection.

INDEPENDENT MEASUREMENTS

53. Since the April, 1967 inspection the licensee has constructed a small metal building within the fenced-in, restricted area located on the north side of the main building. This metal structure is known as the "Blockhouse" and its original purpose was for the storage of miscellaneous equipment (lawn mower, etc.). Inside the Blockhouse is a cement block enclosure used for the storage of various contaminated items. Using an Eberline Model E-500B survey meter with a 30 mg/cm² GM probe, the AEC representative performed an independent measurement of the radiation levels in the vicinity of the Blockhouse in the presence of Mr. Soldan. The radiation level at the outside surface of the Blockhouse near a

53. (continued)

corner was greater than 200 mr/hr and at 18 inches from the wall, a radiation level of about 110 mr/hr was noted. The Blockhouse was posted with a sign showing the conventional radiation symbol and the words "Caution - Radioactive Materials" only. Mr. Soldan was advised that failure to post the area with a sign showing the presence of high radiation area constituted noncompliance with 10 CFR 20.203(c)(1). Bushman, when asked by Soldan, stated he had surveyed the area around the Blockhouse while working in the area. Also, Bushman could not recall any reading of a few mr/hr at the time. The licensee representative was advised that surveys performed in the Blockhouse area were inadequate to determine the presence of a high radiation area constituted noncompliance with 10 CFR 20.201(b).

54. During the independent survey, Soldan was apparently unaware that the high radiation area existed. Investigation disclosed that several used "KOWS," returned by customers, were stored unshielded just inside the Blockhouse. Soldan stated that these Kows are normally kept in their lead shipping pigs and that the last day or two the area outside the Blockhouse was cleaned up and items rearranged, which probably resulted in the present condition. Also, the high radiation area has not and will not last for as long as 30 days and that the Blockhouse would be posted in accordance with 10 CFR 20.203(c)(1).
55. The only other independent measurements conducted during this inspection are discussed in paragraph 34, above. The same survey meter was used for all the independent measurements.

MISCELLANEOUS

56. During a recent inspection of Good Samaritan Hospital, Vincennes, Indiana, License No. 13-1787-1, it was learned that the hospital had obtained a Beta Therapy Source, Catalog #690, containing 100 millicuries of Strontium 90, from Mallinckrodt Nuclear on or about March 23, 1967. The hospital's license did not authorize the possession of Strontium 90 in any form or amount. An inquiry was made of this matter during this inspection. Mr. Larry Harrigan, Sales Services Customer Representative, stated that the normal procedure for determining a customer's byproduct material authorization is as shown in the licensee's "Nuclear Consultant's Policy Regarding Proof of License." A copy of this policy is attached to this report as Exhibit C. A review of the licensee's file concerning the subject hospital showed copies of the hospital's license up to and including Amendment No. 5 (renewal only), dated January 28, 1966. No information was found regarding the request for or the submission of proof that the hospital was authorized to receive 100 mc Strontium 90, which constituted noncompliance with 10 CFR 30.3. The licensee representative stated that this was an obvious "goof" on their part.
57. Mr. R. C. Barrall, Director, Health Physics, Stanford University, Stanford, California, informed the licensee in a letter dated January 24, 1967, that technetium generators (KOWS) received from the licensee have shown some low level contamination. The letter also included some pertinent comments and a request that the licensee look into these matters. A copy of this January 24, 1967 letter from Barrall to the licensee is attached to this report as Exhibit D. During this inspection it was learned that James A. Peterson, Manager, Product Development, answered Mr. Barrall in a letter dated February 7, 1967. Mr. Peterson's reply assured Stanford University that the matter was being reviewed and that Stanford could expect to see this problem eliminated, or, at least greatly improved on future shipments. Bill Lewsen, Production Supervisor, outlined various procedures concerning the "Kow." Between 2-3 ml of liquid Mo-99 is put onto the alumina media and allowed to sit for about 30 minutes. Then the media is washed once with about 25 ml of hydrochloric acid. A second washing is then made with about 50 ml of saline solution. After the saline solution finishes running through the media, the top and bottom caps are put on the Kow.

58. The licensee representatives went on to say that it seems possible that during shipment - if the KOW is laid on its side - a small amount of liquid (from the deep alumina media) runs toward the top cap and could leak out when the cap is removed. Also, this occurred at about the same time that the Hot Cells were put into use and procedures were not refined as yet, which may have caused the caps not to have been secured in all cases.
59. The licensee does not consider the KOW as a liquid source.
60. It was further learned that a new "closed" sterile KOW is now being sent out and has almost entirely replaced the subject "open" KOW. At the present time, about 75 "closed" KOWs and 13 "open" KOWs are being shipped per week.

MANAGEMENT DISCUSSION - SEPTEMBER 14, 1967

61. The results of this inspection were discussed with Dr. Floyd Ballett, Technical Director and Donald W. Selden, Manager, Health Physics Department. Dr. W. E. Kouniker, Vice-President was absent during the inspection.
62. Items of noncompliance noted during the inspection were discussed. These items included:
- a. Not all waste is surveyed prior to disposal through normal refuse channels.
 - b. No survey was performed to determine existence of a high radiation area in the vicinity of Blockhouse.
 - c. No sign posted at Blockhouse to indicate the presence of a high radiation area.
 - d. Surveys of potentially contaminated uniforms appeared inadequate to detect significant amounts of radioactive materials prior to release to commercial laundry.
 - e. No in-plant air samples were taken during a three week period.
 - f. Airborne radioactivity areas were not posted as required.
 - g. Several excessive thyroid burdens occurred, which indicated apparent overexposures to airborne concentrations of Iodine 131.
 - h. & i. No reports were submitted by the licensee regarding the several excessive thyroid burdens.
 - j. An unauthorized transfer of byproduct material was made.
63. The licensee's comments, intentions and/or corrective actions concerning these items of noncompliance are given in the order presented above in paragraph 62.
- a. The licensee's two large metal waste repositories will be placed on the Health Physics Department's daily routine survey schedule in order to "catch" anything that gets by the individual container surveys.
 - b. The Blockhouse and vicinity will be added to the Health Physics daily routine survey schedule.
 - c. Selden stated the Blockhouse will be posted as required by 10 CFR 20.203(c)(1).
 - d. The refrigerator, in the laundry room, will be moved to another location in the building. Also, a more sensitive instrument will be procured to allow the detection of significant amounts of contamination prior to releasing uniforms to a commercial laundry.

63. (continued)

- e. Dr. Hallett told Soldan to order a second automatic timer to be ready for use in the event the current timer malfunctions. Also, the air sampling system must be turned on and off manually on schedule in the meantime, if necessary.
 - f. The entrances to Airborne Radioactivity areas were properly posted during the inspection.
 - g. Many of the licensee's records of high thyroid counts are noted to show that personnel contamination is present at the time of the thyroid count. As a result, these are not considered by Soldan to be valid thyroid counts. As discussed above in paragraph 47, thyroid counting is not performed on any definite schedule. Soldan told Dr. Hallett that he has tried to get people to come down to be thyroid counted by contacting the person or the person's supervisor without success, and as a result, people "wander in" or call throughout the work day to ask to have their thyroid counted. Soldan said he has tried it this way because he didn't want to get Dr. Hallett "involved." Dr. Hallett immediately replied that he wanted to be involved and that if he was involved, some of these things would not be problems. At this time, Dr. Hallett told Soldan to make up a list of all persons who routinely have higher than thyroid counts and have these person's thyroids counted every Monday morning before they start work to preclude the possibility of skin contamination at that time.
 - h. & i. Again, no specific answer or reason was given as to why the several excessive thyroid burdens were not reported to the Commission or to the pertinent employees. In November, 1966, Dr. Koneker gave Mr. Soldan the responsibility for reporting to the Commission all of the licensee's over-exposures, excessive levels and concentrations, or incidents.
 - j. The transfer of 100 mc of Strontium 90 to an unauthorized recipient resulted in the failure of the licensee to follow its written procedures concerning this particular customer order.
64. Although not a specific item of noncompliance, the matter of personnel contamination was discussed. Dr. Hallett agreed that something definite had to be done to see that people were surveyed for contamination upon leaving work areas. The use of a hand and foot counter under the control of Health Physics was one possibility discussed, however, no single course of action was decided on at this time.
65. Based on the results of this inspection and the repetitive nature of some of the items of noncompliance and health physics problems noted throughout the inspection history of this licensee, arrangements were made to further discuss these matters with management of Mallinckrodt Chemical Works. This meeting was scheduled to be held on October 17, 1967 at the licensee's facilities.

MEETING WITH MALLINCKRODT MANAGEMENT - OCTOBER 17, 1967

66. On October 17, 1967 Royce E. Grier, Director, Region III, James M. Allan, Senior Radiation Specialist, and Edgar C. Ashley, Radiation Specialist, met with the following Mallinckrodt Chemical Works management to discuss the results of the September 13-14, inspection.

Howard E. Thayer, President
E. E. Aldrick, Vice-President, Pharmaceuticals
Wilfred M. Koneker, General Manager, Mallinckrodt
Nuclear Division
Floyd P. Hallett, Technical Director, Mallinckrodt
Nuclear Division

67. Each item of noncompliance found during the September 13-14, inspection was detailed to the Mallinckrodt representative and the seriousness of the repetitive nature of several was emphasized. In particular, the seriousness of the number of personnel who have in the past and who are continuing to receive thyroid burdens of Iodine 131 in excess of the recommended 0.14 microcuries.
68. Mr. Thayer stated that Mallinckrodt recognizes that these problems do exist at the Nuclear Division and they also recognize that action must be taken to correct the existing problems and to prevent future problems of similar nature to occur. Mr. Thayer stated that prior to our visit on October 17, several meetings had been held at his request in order to analyze what the basic problems were and to plan a course of action to bring this program into compliance.
69. Mr. Thayer stated that with respect to the items of noncompliance found during the September inspection, action had been taken to correct these deficiencies. In addition, Thayer stated action had been instituted to have the complete program reviewed by a health physicist from within the Mallinckrodt Chemical Works.
70. Mr. Thayer then requested Dr. Konneker to discuss what actions had already been taken and those that are to be taken immediately or as soon as can be accomplished. Dr. Konneker discussed these actions from the outline attached as Exhibit F to this report. Additional information in the form of memos implementing many actions were also furnished by Konneker. These are attached as Exhibits F through L.
71. With respect to the thyroid burden problem, Konneker stated that he firmly believes that most of the problem is coming from personnel contamination and problems rather than true thyroid uptakes. Konneker went on that he was not stating this as a reason for having high thyroid counts since he recognized that personnel contamination may well result in thyroid uptakes through absorption or ingestion. In this regard Konneker stated that Mallinckrodt Chemical Works has made arrangements to have Mr. Mont Mason, formerly in charge of health physics at their Weldon Springs, Missouri, uranium facility, temporarily assigned to the Mallinckrodt Nuclear Division in order to review the entire program from a health and safety standpoint. Konneker stated that Mason would review all existing facilities and procedures for adequacy, make recommendations where improvements or changes should be made and also conduct a personnel training program. Konneker advised that Mason has been temporarily assigned this duty for a 3-4 week period, but should the need indicate a longer period of time, the assignment will be extended for whatever period it takes. Konneker stated he felt that they had narrowed the thyroid problem down fairly well to hand contamination problems and that one of Mason's early objections will be to conduct training programs in contamination control.
72. In addition, Konneker stated that in the future when there is any doubt about a thyroid count being valid or not, a report will be submitted to the Commission.
73. Konneker, Thayer and Ballett advised the Region III representatives that Mallinckrodt Nuclear is presently looking for a professional health physicist to take over the position of health physics manager. Konneker stated that Mallinckrodt Chemical Works management had analyzed that some of their problems stem from the present health physics manager (Mr. Soldan) not following through in identified problem areas. Also, Konneker stated that Soldan was not requesting help from management when he had problems with getting cooperation from production personnel and production supervision regarding thyroid counting schedules and contamination control in particular. Konneker advised that he had told Soldan on numerous occasions that when he ran into such problems to bring it to his (Konneker's) attention but Soldan didn't want to get either Konneker or Ballett involved while trying unsuccessfully to handle these matters himself.

Mallinckrodt Chemical Works
License No. 24-4206-1
October 17, 1967

74. Koneker stated that he wanted it made clear that Mallinckrodt was not handing the Commission Mr. Sordan's head in answer to their problems but it was decided someone was needed who could better handle the health physics managers responsibilities.
75. In summation, the Mallinckrodt representatives gave every indication that they recognized their problems and that immediate, positive action was to be taken to remedy each problem area.
76. It is recommended that correspondence regarding this inspection be directed to Mr. Harold E. Thayer, President, Mallinckrodt Chemical Works, 3600 North Second Street, St. Louis, Missouri, 63160. A copy should be directed to Wilfred E. Koneker, General Manager, Mallinckrodt Nuclear Division.
77. Following completion of enforcement action, Region III will conduct an early reinspection.

Enclosures:

Exhibits A thru L

New form begun
6-14-67

MALLINCKRODT/NUCLEAR

1-17-67

E. J. [unclear]

UNIFORM SURVEY

<u>DATE RELEASED</u>	<u>SHIRTS</u>	<u>PANTS</u>	<u>DRESSES</u>	<u>COATS</u>	<u>SURVEYED BY</u>
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
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_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

The above uniforms were surveyed and found to be within permissible limits for release.

COMMENTS

CORRECTIVE MEASURES

EXHIBIT A

REVIEWED BY _____ DATE _____

RADIOACTIVE LIQUID WASTE DISCHARGE RECORD

LW ☒HLW ☐

	a	b	c	d	e
ISOTOPE	ALL(I-131)	I-131	Hg-203	Au-198	Mo-99
N(counts)	48,70	9320			
T(mins)	1.55	6.70			
R(cpm)					
B(cpm)					
R-B(cpm)					
F(uc/cpm)	1.55×10^{-6}	6.7×10^{-6}			
A(uc)	$48,70 \times 10^{-6}$	9320×10^{-6}	$\times 10^{-6}$	$\times 10^{-6}$	$\times 10^{-6}$
v_s (ml)	10	10			
C(uc/ml)	4867×10^{-6}	932×10^{-6}	3935×10^{-6}	$\times 10^{-6}$	$\times 10^{-6}$
MFC(uc/ml)	60×10^{-6}	60×10^{-6}	500×10^{-6}	2000×10^{-6}	5000×10^{-6}
C/MFC		15.5	7.9		

$$S = \frac{C_a}{MFC_a} + \frac{C_b}{MFC_b} + \frac{C_c}{MFC_c} + \frac{C_d}{MFC_d} + \frac{C_e}{MFC_e} \leq \frac{V}{v_p}$$

$$v_p \leq V/S = \frac{60 \text{ M}^3}{23.4} = 2.56 \text{ M}^3$$

$$v_p \geq v_d = \frac{2.27 \text{ M}^3}{\times 264 \text{ gal / M}^3} = 600 \text{ gal}$$

$$A_d = C_a v_d + C_b v_d + C_c v_d + C_d v_d + C_e v_d$$

$$A_d (\text{uc}) = \text{---} + 2,115 + 8940 + \text{---} + \text{---}$$

$$A_d (\text{uc}) = \frac{104,671}{\text{previous}} + \frac{11,055}{\text{daily}} = \frac{115,720}{\text{Total}}$$

DATE August 29, '67 PERFORMED BY Dr. S. Golan

REVIEWED BY _____

EXHIBIT B

7-12-61
HLL

INTER-OFFICE MEMO

NUCLEAR CONSULTANTS CORPORATION

to All Branch Mgrs. from W. F. Konneker

Subject

Date 11/7/66

SUBJECT: NUCLEAR CONSULTANTS' POLICY REGARDING PROOF OF
LICENSE

Ever since Nuclear Consultants started in business some 16 years ago, we have been faced with the problem of complying with AEC regulations and at the same time keeping good public relations with our customers regarding the problem of proof that the customer ordering activity does indeed have a valid AEC license. Please be certain you note the problem is that of proof and not of fact.

There is no question in anyone's mind concerning the fact that we may not sell, give away or otherwise transfer any byproduct material to any customer unless he does indeed hold a valid USAEC or State AEC byproduct license.

For many years we insisted that we receive a copy of the clients license before we would ship or transfer any byproduct material to him. We had considerable difficulty in enforcing such a rule. None of our competition follows this policy and in discussions with top AEC officials, including their legal council, they have stated emphatically their regulations do not require that we have a copy of the license in our files. They only require that we have proof the customer does have a valid license. In the past we have told customers we must have a copy of their license only to have them call the AEC where they have been told they do not have to send us a copy.

I have requested in the past that the AEC strengthen this portion of their regulations and require the purchaser to supply either a copy of the license or a certificate covering all or at least that portion of the license pertinent to the item being ordered. They took this under consideration some six years ago and apparently are still "considering" it.

Irrespective of these problems it is unqualifiably our responsibility to see that byproduct materials from our laboratories are shipped only to licensed users. Nuclear Consultants official position regarding this problem which was stated to the AEC (but not necessarily either approved or disapproved by the AEC) and all branch laboratories well over a year ago is the following.

EXHIBIT C-1

11/7/66

If a customer calls, writes or wires and requests a shipment of byproduct materials and we do not have a current, up-to-date license or amendment which covers the specific item he is ordering (by specific item I mean a specific radionuclide, the amount and the chemical or physical form) in our files, you are to request the following, at least verbally, from him before the shipment is made:

- (1) His current AEC license including amendments.
- (2) The date of expiration.
- (3) The fact that the license does cover the radionuclide in the form and amount that he is requesting.

With this information, if of course it is all reasonable in your opinion, you may make the shipment to the customer after you have received this information and after you have requested that he send you a copy of his license.

The same day or no later than one day after the shipment of this material, a form letter is sent to him for the purchase, detailing exactly what he had purchased, giving him back exactly the same information he gave you and requesting a copy of his license.

For a short time we followed the policy of only repeating this procedure three times before we would refuse further shipments if we did not receive his license. For well over a year now the policy has been; unless we have some good reason to doubt the fact that the customer has a current license, we will continue shipping and continue sending him a form letter hoping that he will in time give up and send us his license. A copy of this form letter is to be placed in the customer's otherwise AEC license file.

This does not get us "off the hook" from the AEC if, following an inspection or an investigation, it turns out the customer did not have a license. We are still technically liable. However, I have had the comments from AEC officials that they did certainly consider this to be the exercise of due diligence to assure ourselves that we were shipping only to licensed users.

I recognize this is an awkward, cumbersome, sometimes annoying procedure, but it is the company's official position and the one you must follow until or unless you may get a ruling from the AEC, or one of you can suggest a simpler yet equally diligent means of monitoring our customers' licenses.

C-2

MEMO
Page Three

11/7/66

The purpose of this memo is merely to restate our existing policy -- I am not here presenting a new one by any means.

W. R. Konneker

WRK/js

CC: F.P.H.
M.L.M.
J.H.
D.W.S. ✓
E.E.A.
J.H.Y.
S.M.T.
C.M.B.

C-3

Stanford University
Health Physics Department
177 Encina Hall
Stanford, California



1-27-67
slb

January 24, 1967

C
O
P
Y

Nuclear Consultants Division
Mallinkrodt Chemical Company
2nd and Mallinkrodt
St. Louis, Missouri

Gentlemen:

Since September the University has initiated a program of inspecting each isotope shipment as it arrives on campus. Each week the Nuclear Medicine Division of the Department of Radiology has been receiving a package containing a technetium generator of your manufacture.

Our inspections have revealed the following problems with your packaging.

1. The cow itself is generally received wet on its exterior surface; wipes taken by blotting the moisture have revealed that the cow is contaminated.
2. Generally we have found low level contamination, (a few thousand dpm) on the outside of the lead pig; while on occasion we have found similar but lesser contamination on the wood and on the inside of the cardboard box — however, none has been found on the exterior of the shipping container.
3. We have also noted that the cow is partially filled with a fluid which occasionally leaks out when the cow is being unpacked for installation into the milking device. This leakage appears to be due to the design of the plastic cap which comes off when the cow is removed from the pig. We have noted, in this regard, that there does not appear to be any absorbent packing around the cow to absorb the contaminated fluid in the event of breakage while in transit.

A. J. Miller
1-2300
X 2308

JUN 6 1967

EXHIBIT D-1

January 24, 1967

Nuclear Consultants Division
St. Louis, Missouri

We would appreciate your looking into these matters and making improvements where possible. We are particularly interested in reducing the possibilities of exposure of our personnel to the hazards of contamination when they must unpack or handle the cow.

Very truly yours,

RC Barrall

R. C. Barrall
Director Health Physics

RCB/JAH:mmp

cc: Bureau of Radiological Health - Inspection Department

Our inspections have revealed the following problems with your operation:

1. The cow itself is generally covered with dirt on its exterior surface; when taken by hand, the dirt has revealed that the cow is

2. Generally we have found low level contamination on the exterior of the cow, particularly on the sides of the head and neck. This contamination is generally in the form of a thin layer of dirt and is not easily removed by washing. It is suggested that the cow be washed thoroughly before being handled.

3. We have also noted that the cow is generally covered with dirt on its exterior surface. This dirt is generally in the form of a thin layer of dirt and is not easily removed by washing. It is suggested that the cow be washed thoroughly before being handled.

D-2

October 16, 1967

AEC Inspection - September 18, 1967

Listed below are steps which have been taken since the last AEC inspection to correct the noted deficiencies and to minimize the possibility of their recurrence.

I. Customer License Checks

- A. Memos have been written to emphasize our system for handling solid source items. Mr. Harrigan is responsible for the license check; Mr. Rhoads is responsible in his absence. No order is to be filled unless the work order bears the customer's license number.
- B. A memo was written to Branch Laboratory Managers instructing them to review the written policy memo on the checking of customer AEC licenses and to make certain that they are following it 100%.

II. Thyroid Burdens

A. Sodium Iodide Capsule Production

- 1) Written instructions have been issued specifying that only Mr. Nuelle or a Production Supervisor are authorized to make adjustments on the machine under the hood. Protective head gear will be worn and immediately following, a check will be made for external contamination and thyroid counts.
- 2) The capsule machine operator is to report for a thyroid check every two hours while operating the machine.
- 3) Lok-Caps have been obtained and put into use this week. Preliminary experimental runs showed that these will greatly decrease the capsules coming apart during processing with ensuing spread of activity.

- 4) A request was submitted to the MCW Engineering Department for establishing a project to design a suitable capsule machine. One of the first steps is expected to be a meeting with them for our outlining of the specifications and requirements.
- 5) A micro-dispenser (\$777.50) ordered from Minnitech Labs, Inc., Minneapolis, Minnesota, for evaluation as the dispensing unit for Sodium Iodide I131 Capsules.
- 6) A representative from another firm is to visit us on Wednesday, October 18, to explore the possibility of designing suitable equipment.
- 7) Karl Wolff, the designer and fabricator of our present equipment, is being asked to submit proposed plans.

NOTE: After proposals are received from these different groups, the most satisfactory proposal will be accepted.

B. Thyroid Control - General

- 1) All persons who routinely work with iodine compounds are reporting to Health Physics at 8:00 A.M. for thyroid checks.
- 2) Anyone with a thyroid count of over 0.5, if working with or near iodine processes, is to be checked for thyroid count during the day. It is Production's responsibility to arrange for these checks.
- 3) Respirators have been ordered and will be used on any jobs where airborne iodine is likely to be encountered, e.g. adjusting capsule machine, cleaning iodination glove boxes, etc.
- 4) Bids are being obtained on installation of showers for personnel decontamination, when needed.
- 5) Four additional air sampling stations have been installed in the glove box area where iodinations are carried out.

- 6) A triple check system has been established to make certain that any reportable situations on thyroid or other exposure is made within the 30 day period. A follow up will be made by, (1) Health Physics, (2) Mrs. Davis, and (3) myself.

III. Additional Signs in Production Area

These were posted during the AEC inspection.

IV. Air Sampling Data

A back-up timer has been ordered. In case of any further malfunction of the equipment, the air sampling apparatus will be operated manually.

V. Uniform Monitoring for Laundry

Mr. Ashley had recommended removal of the cause of background radioactivity from the room where used uniforms are checked. This has been done. In addition, a more sensitive instrument is now being used. In view of his question regarding the thoroughness of the hand monitoring job, the necessary equipment has been ordered for assembly of apparatus to permit monitoring each garment by one pass through the apparatus.

VI. Monitoring I¹²⁵ in Liquid Discharge

Routine assay of I¹²⁵ in the liquid waste has been initiated.

VII. Monitoring of Non-Radioactive Waste

- A. A separate area has been constructed to provide low background for use in monitoring non-radioactive waste coming from laboratories.
- B. A routine check is being made every afternoon after the last use of the Dumpsters by Health Physics to confirm that no radioactivity has reached them.

IX. General

Administration

Arrangements have been made to obtain the temporary services of Mr. Mont Mason, formerly in charge of health physics at the Weldon Springs plant. Mr. Mason will review our entire

AEC Inspection
September 18

October 16, 1967
Page 4

health physics program including facilities, equipment, staff, methods, techniques, and training, and will make recommendations as to changes and additions required to bring this function to a totally satisfactory level. It is expected that this will be accomplished by mid-November.

Floyd P. Hallett

FPH:cd

cc: Dr. W. R. Konneker
Mr. E. E. Aldrich
Mr. H. E. Thayer

September 25, 1967

Dave Rhoads

L. W. Harrigan

As you know, all customer orders for solid source material such as Cobium or Strontium-90 Eye Applicators, are initially all channeled through me. In view of this, it is my responsibility to insure that these customers are properly licensed for this material.

In order to avoid any breakdown in this system due to my being absent or on vacation, it would be appreciated if you would assume the responsibility of obtaining the license information on these orders during this period of time.

Thank you for your cooperation and if you have any questions concerning this please contact me.

LWH:jb

cc: Mr. Geiger
Dr. Hallett ✓
Dr. Konneker
Mr. Murray
Mr. Soldan

September 29, 1967

Mr. David Rhoads

Mr. Harrigan's memo of September 25 outlines responsibility and back-up for the customer license check on solid sources. As a routine double check on this necessary step, the following also will be established as policy:

No order for solid sources may be filled unless the customer's license number appears on the work order.

Should an order come through without the number, please contact Mr. Harrigan and hold shipment until this point has been straightened out.

Floyd P. Hallett

FPH:cd

cc: Dr. W. R. Konnaker
Mr. L. Harrigan
Mr. M. L. Murray
Mr. R. L. Holgate (att.)
Mr. D. W. Boldan

cc: Dr. Konneker
Mr. Soldan

October 3, 1967

NOTICE TO ALL PRODUCTION SUPERVISORS

Until further notice, no one with the exception of Mr. Nuelle or Mr. Rodrian is to make any adjustments or otherwise work with the sodium iodide capsule machine mechanism under the hood. The operator may, by using extreme care, remove capsules from the area beneath the hood but, aside from this, is not to open the doors. Mr. Nuelle and Mr. Rodrian will wear appropriate head covering when working on the machine to prevent accidental contamination.

These steps are designed to prevent the possible contamination of Production Department personnel and are to be rigidly enforced.

R. L. Holgate

RLH:cd

cc: Dr. F. P. Hallett
Mr. D. Rodrian
Mr. R. Nuelle

October 5, 1967

Mr. R. L. Holgate

To formalize a point we have discussed and initiated, please establish with Mr. Lawson that any person with a thyroid count over 0.5 who is working with or near iodine processes must be checked a sufficient number of times during the day to insure that the count does not reach a level endangering the person's ability to continue working in the lab.

This is to be a Production Department responsibility -- not Health Physics -- to see that either the checks are made or the person is restricted from working with iodine until they are made.

Floyd P. Hallett

FPH:cd

cc: Dr. W. R. Konneker
Mr. D. W. Gordan

EXHIBIT G-2

RADIOPHARMACEUTICALS

ST. LOUIS, MO.

PURCHASE ORDER

Ord. By R.J. Farlow
Del. To RUT
Account 698-100-219

No. N 00674

DATE: 5/14/67

VIA:

ORDER CODE:

Elm Lilly & Co.
Indianapolis Ind.

Attn: Mr. Warren LeVander

SHIP 10/14/67

RECEIVING INSTRUCTIONS

DESCRIPTION

QUANTITY

200M	21	Red Opaque Lok-Capsule	1.95/M	390.00
200M	21	Blue Opaque Lok-Capsule	1.95/M	390.00
200M	21	Yellow Opaque Lok-Capsule	1.95/M	390.00
200M	21	Green Opaque Lok-Capsule	1.95/M	390.00
200M	21	Orange Opaque Lok-Capsule	1.95/M	390.00

TAXES FROM MISSOURI SALES TAX -
REGISTRATION NUMBER 115-3733

CONFIDENTIAL

EXHIBIT G-4

7. VENDOR FILE

ACKNOWLEDGEMENT OF REQUEST FOR ENGINEERING SERVICE

Date October 6, 1967

Initiating Dept. Production - Hollingshead Nuclear

Request No. _____

For information, contact:

R. L. Hart

Project Engineer

R. H. Ruppel

Eng. Job No. E-25-01

Title Section Inside Engineering

Bldg. No. M.H.G.

Est. Starting Date Week of Oct. 16, 1967

Priority URGENT

At the start of the job, the Project Engineer will arrange a meeting to discuss the scope of the work. The cost of preliminary engineering will be estimated after the initial conference.

For information about the scheduling of the job, please contact Chief Engineer or Engineering Department Supervisor listed.

MCW-13002-R. 8/65

EXHIBIT G-5

Diagnostic Capsule Solution Dispenser

Specifications

The system is to deliver small measured volumes of a solution consisting of the radioactive isotope Iodine-131 as NaI in water. All parts in contact with the solution must be non corrosive.

No elastomer seals are to be used because of radiation damage. The system should be self priming and leakproof. The delivery is to be adjustable between 10 and 20 mm^3 and reproducible between $\pm 2\%$. The repetition rate is to be one delivery per second. Maintenance should not be required for 250,000 deliveries. The delivery lines and mechanism and the stock solution container should all be lead shielded.

Carl Walz

"Design for Tomorrow" - at least 5 y. old.

11-1-61
11-1-61
11-1-61

20 mm^3 : .020cc

per the volume of .025 ml.

Suggestions:

DW Golden

Piston diameter = $1/16$ ins = 1.5875 mm

" area = $\pi/4 (1.5875 \text{ mm})^2 = 1.979 \text{ mm}^2$

Stroke (max) = 10 mm = 0.394 ins

Volume (max) = $10 \text{ mm} \times 1.979 \text{ mm}^2 = 19.79 \text{ mm}^3$

corrosion
resistant
materials
Sorbogen
Piston and cylinder, stopcock, fittings and
tubing - 316 stainless steel

Seals - Rhodium plated gold "O" rings

Electro Development (ELDEC)

14701 Keswick St., Van Nuys Calif.

Double action air cylinder

Air Equipment Company - St. Louis

An air cylinder rotates the stopcock 120° through a linkage. No motion is imparted to the dispensing piston during the initial phase of the downstroke. The dispensing piston is driven full in during the last 0.2 to 0.4 inches of the air piston downstroke. The stopcock is caused to rotate on the upstroke after which the dispensing piston is withdrawn between 0.2 and 0.4 inches. This cycle is repeated during each dispensing operation

EXHIBIT G-7

SS spacer

Gold "O" rings

Stopcock and
Piston shown
ready for downstroke

DISCHARGE

Adjustment

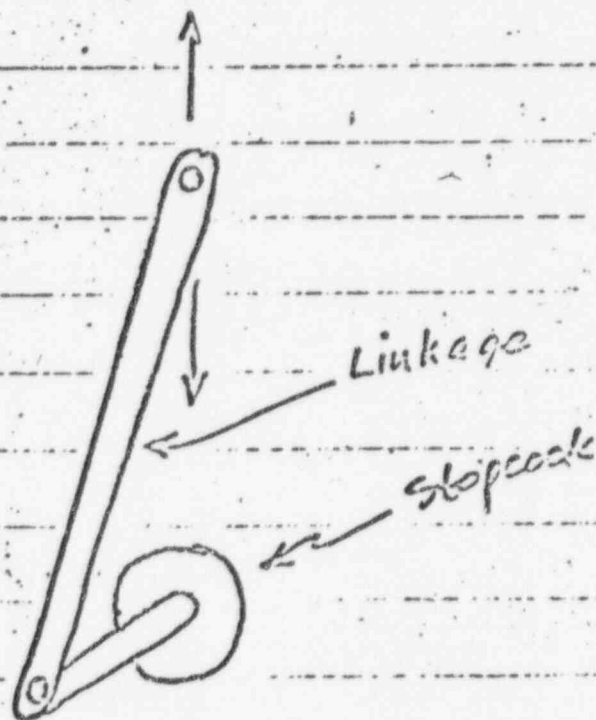
Air cylinder
piston

Adjustable stops for
limiting upstroke

INLET



Dispensing
piston



Linkage

stopcock

DW Solder

June 15, 1967

EXHIBIT G-8



AIR EQUIPMENT COMPANY
AIR & HYDRAULIC EQUIPMENT SPECIALISTS



AIR EQUIPMENT COMPANY
AIR & HYDRAULIC EQUIPMENT SPECIALISTS



HIGHEST QUALITY FEATURES FOR OUTSTANDING PERFORMANCE

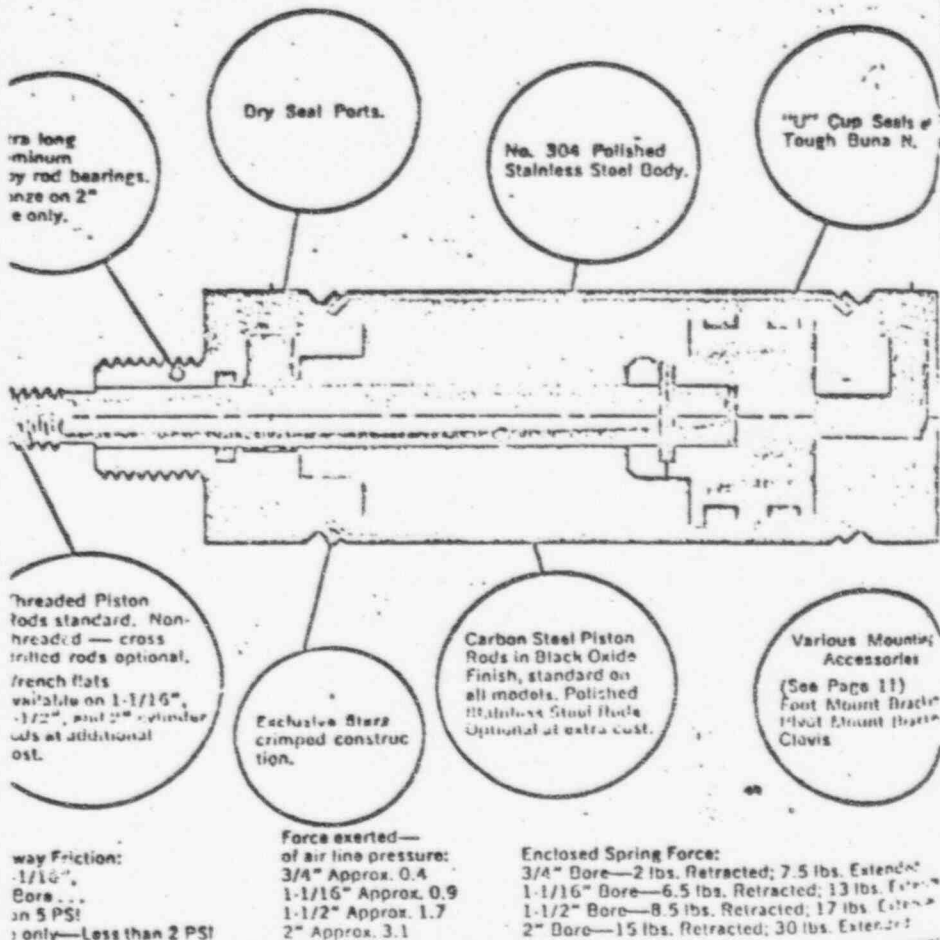


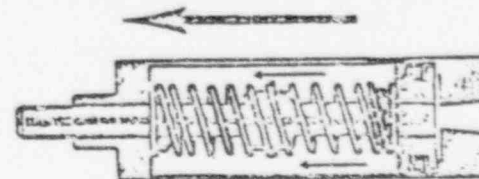
EXHIBIT G-9



CYLINDER TYPES

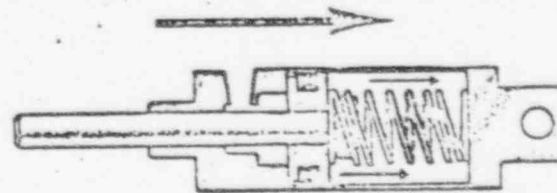
SINGLE ACTING-PUSH TYPE

Air or fluid "pushes" the piston rod through end of cylinder in this type. An enclosed spring returns rod to its normal position when air or fluid pressure is exhausted.



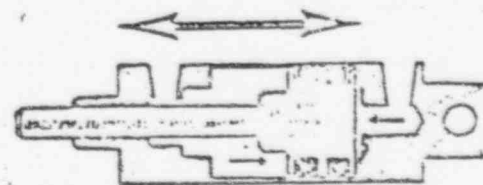
SINGLE ACTING - PULL TYPE (REVERSE ACTION)

In a "pull" type cylinder, air or fluid entering the front of the cylinder pushes the piston rod back into the cylinder creating a pulling action. An enclosed spring returns rod to its normal position when air or fluid pressure is exhausted.



DOUBLE ACTION - PUSH AND PULL TYPE

In a "push and pull" type cylinder air or fluid enters the cylinder at either end pushing the piston in either direction.



STARZ MODEL DESIGNATIONS ARE CODED AS FOLLOWS:

- S — Single Acting—Push type.
- SR — Single Acting—Pull type (Reverse action).
- D — Double Acting—Push—Pull.
- P — Pivot Mount.
- 2U — Two End Mounts.
- 2R — Two End Rods.
- — Solenoid Operated Valve
- — Non-Resetting (Bleed rod)
- — Stainless Steel Rod (Standard only)

First number in model code indicates bore size:

- 7—3/4" Bore
- 6—1-1/16" Bore
- 5—1-1/2" Bore
- 4—2" Bore

Last number in model code indicates stroke length in inches

Example: S 7 5 indicates

Single Acting Push type Non-Resetting, Pivot Mounting, with a 5" stroke

RADIOPHARMACEUTICALS

ST. LOUIS, MO.

PURCHASE ORDER

No. N 00850

VENDOR CODE:

MINNETON LAB., INC.
 6140 DAY AVE. 12ND.
 MINNEAPOLIS, MINN. 55416

ATTN: MR. R.L. LARSON
 SALES ENG.

DATE:

10/10/67

VIA:

SHIP

Ord. By P. Folgate
 Del. To - 1030
 Account 65-1-100
 INVOICE # 278-1-110
 T-80 636
 24-1-111

QUANTITY	DESCRIPTION		RECEIVING INSTRUCTIONS
1	B-2	MICRO-DISPENSER ON APPROVAL COMPLETE WITH FOLLOWING: CYLINDER FOR CYCLE PISTON MOUNTING BASE WITH CLAMPS STRAINER ADAPTER DISPENSING NOZZLE & TUBING ACTUATOR	APPROX. \$777.50

EXHIBIT C-10

8. NUMERIC FILE

NUCLEAR

RADIOPHARMACEUTICALS

ST. LOUIS, MO.

PURCHASE ORDER

No. N 00779

Ord. By D. F. SOLDIN
Del. To SAME
Account 65-C-033-311

VENDOR CODE:

SAFETY INCORPORATED
3306 CLIVE STREET
ST. LOUIS, MISSOURI 63103

DATE: 10/5/67

VIA:

H. P. FILES

SHIP

QUANTITY	DESCRIPTION	RECEIVING INSTRUCTIONS
3	655-1 with Acme Full Face Piece Respirator 282-OV-B Canister \$31.10/ea.	
6	282-OV-B Replacement Canisters 3.40/ea.	

EXHIBIT H

6. ORIGINATOR

October 16, 1967

Mr. D. W. Soltan

As you will recall, we informed Mr. Ashley that in the event of another malfunction of the air sampling equipment, these samples would be obtained manually. Should this recur and you have any difficulty in fitting the additional work into the Health Physics schedule, please notify either Dr. Konneker or myself. It is essential that we be notified immediately so that steps can be taken prior to missing any dates on which the data must be recorded.

Floyd P. Hallett

FPH:cd

cc: Dr. W. R. Konneker

EXHIBIT I

MARYLAND HEIGHTS, MO.

NUCLEAR

RELATING TO THIS ORDER

RADIOPHARMACEUTICALS

ST. LOUIS, MO.

PURCHASE ORDER

No. N 00748

Ord. By D. Colgan
Del. To SJED
Account 65C-033-311

VENDOR CODE:

AMERICAN ELECTRONIC CORP.
230 SUNNY AVENUE
BICKSVILLE, L.I., N.Y.

DATE: 9/28/67
VIA:

SHIP

QUANTITY	DESCRIPTION				RECEIVING INSTRUCTIONS
4	912 MB-3	G.M. TUBES	153.00	1212.00	

EXHIBIT J-1

6. ORIGINATOR

RADIOPHARMACEUTICALS

ST. LOUIS, MO.

PURCHASE ORDER

No. N 00749

Ord. By D. Golden
Del. To name
Account 650-033-311

VENDOR CODE:

NATIONAL LEAD PRODUCTS
1015 LOCUST
ST. LOUIS, MISSOURI

DATE: 9/23/67

VIA:

SHIP

QUANTITY	DESCRIPTION	RECEIVING INSTRUCTIONS
8	2 x 4 x 8 LEAD BRICKS ABOUT 26 Pounds/Brick \$25./100 Pounds \$52.00	

EXHIBIT J-2

6. ORIGINATOR

RADIOPHARMACEUTICALS

ST. LOUIS, MO.

PURCHASE ORDER

No. N 00747

Ord. By D. F. SCLDAN

Del. To SMC

Account 65C-033-311

VENDOR CODE:

WATER REPAIR SERVICE
157 BEADING AVENUE
HASTLAND HEIGHTS, MISSOURI

DATE: 9/23/67

VIA:

SHIP

QUANTITY	DESCRIPTION	RECEIVING INSTRUCTIONS
1	STEEL CHASSIS FOR LAUNDRY MONITORING PLODE \$40.00	

EXHIBIT J-3

6. ORIGINATOR

NUCLEAR

RADIOPHARMACEUTICALS

ST. LOUIS, MO.

PURCHASE ORDER

No. N 00777

Ord. By D. A. Solder
Del. To NAME
Account 405-1-830
24-C-111
65-C-032

VENDOR CODE:

BUSCH BUILDING CORP.
1266 AVENUE
ST. LOUIS, MISSOURI

DATE: 10/3/67
VIA:

SHIP

QUANTITY	DESCRIPTION	RECEIVING INSTRUCTIONS
	CONCRETE BLOCK WALL FLOOR TO CEILING, WOODEN DOOR, METAL FRAMES, LOCK & KEY 1609.50 CAN BE STARTED IN ONE WEEK	

EXHIBIT K

6. ORIGINATOR

October 16, 1967

Mr. D. W. Soldan

I would like for us to establish a firm procedure to avoid omitting necessary jobs because of absences in the Health Physics Department. When such absences occur, it will be necessary for you, or in your absence Mr. Bushman, to review the assignments of the missing person and make certain that they are allocated to other members of the staff. This should be done as early in the day as possible, either upon notification by the absent person or arbitrarily at 9:00 A.M. it should be assumed that the person will not be in that day.

If for any reason it is not possible to reassign all of the essential jobs, either I or Dr. Konneker are to be notified immediately.

By carrying out this procedure it is expected that we will avoid completely any situation where we would have gaps in our required records for such items as Dumpster checking, other hot and cold waste checking, wipe tests, air sampling, etc.

Floyd P. Hallett

FPH:cd

cc: Dr. W. R. Konneker

EXHIBIT L