Form AEC-417
(4-56)

UNITED STATES ATOMIC ENERGY COMMISSION

COMPLIANCE INSPECTION REPORT

1. Name and address of licensee

Mallinckrodt Chemical Works
Nuclear Consultant Division
Box 6172 Lambert Field
St. Louis, Missouri 63145

2. Date of inspection

June 13, 14, and 15, 1966

3. Type of inspection Reinspection

4. 10 CFR Part(s) applicable

Part 20 and Part 30

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

24-4206-1	10-8-58	10-31-60	Reinspection #9
Amendment 17 (amended in entirety)	1-5-66	10-31-66	

6. Inspection findings (and items of noncompliance)

The only items of noncompliance observed or otherwise noted during the course of this inspection are as set out below:

10 CFR 20.103 - Exposure of Individuals
(a) - in that during the period December 1965 through May 1966 several employees were exposed to airborne concentrations of iodine 131 in excess of the limits prescribed in this section. According to licensee thyroid measurements, the amount of iodine 131 in the employees' thyroids have exceeded the 0.14 microcurie weekly average during this period. (See paragraphs 24 and 29 of report details, and also Exhibits E, G, and H.)

10 CFR 20.106 - Concentrations in effluents to unrestricted areas.
(a) - in that the concentrations of iodine 131 released from the licensee plant into unrestricted areas during the period December 1965 through May 1966 exceeded the limits prescribed by this section. (See paragraph 39, and Exhibit K.)

-Continued-

7. Date of last previous inspection

November 29 and 30, 1965

8. Is "Company Confidential" information contained in this report? Yes ☐ No ☒
(Specify page(s) and paragraph(s))

DISTRIBUTION:

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Headquarters (orig.)

Division of State & Licensee Relations
Headquarters (1 cy)

Edgar C. Ashley (Inspector)

Approved by

Eugene J. Moretti, Radiation Specialist (Review), Region III
(Operations office)

July 13, 1966
(Date report prepared)

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

16-23314-2 U. S. GOVERNMENT

RECOMMENDATIONS SHOULD BE SET FORTH IN A SEPARATE COVERING MEMORANDUM

6. Inspection findings (continued)

10 CFR 20.405 - Reports of Overexposures and Excessive Concentrations

(a) - in that exposures of employees to excessive airborne concentrations of iodine 131 during the period December 1965 through May 1966 were not reported to the Commission as required by this section. (See paragraphs 24 and 30 of report details, and also Exhibits E, G, and H.)

(a) - in that releases of concentrations of iodine 131 in unrestricted areas in excess of ten times of the applicable limits during the period December 1965 through May 1966 were not reported to the Commission as prescribed in this section. (See paragraph 39 of report details, and Exhibit K.)

(b) - in that employees who received exposures to excessive concentrations of radioactive material, iodine 131, were not notified in writing by the licensee of the nature or extent of such exposures as prescribed in this section. (See paragraphs 24 and 31 of report details, and Exhibits E, G, and H.)

(c) - in that the report, dated April 15, 1966, submitted to the Commission, regarding four employees who had been exposed to excessive concentrations of iodine 131 during the first quarter of 1966, did not state the names of the employees involved as prescribed by this section. (See paragraph 32 of report details.)

417 REPORT DETAILS

GENERAL INFORMATION

9. This inspection was conducted on an unannounced basis. The licensee was given no prior notification of this inspection which was conducted on June 13, 14, and 15, 1966.

10. The Missouri State Department of Health was given prior notification of this inspection. However, the AEC representative was unaccompanied during this inspection.

11. The following persons were interviewed during the course of this inspection:

    W. R. Konnecker, Ph. D., Vice-President of Nuclear Consultants Division
    Donald W. Soldan, Manager, Health Physics Department

    All information is presented in substance unless otherwise indicated.

INSPECTION HISTORY

12. The last inspection of this licensee (Reinspection No. 8) was conducted on November 29 and 30, 1965. As a result of that inspection, the licensee received correspondence from the Commission (letter dated February 18, 1966) setting forth three items of noncompliance. These items are listed below with references to the paragraphs in this report that discuss the licensee's corrective action as determined during this inspection:

    (a) From September 1965 through November 1965, an employee was exposed to airborne concentrations of Iodine-131 in excess of the limits prescribed in 10 CFR 20.103(a). According to the licensee's thyroid measurements of the individual, the amount of Iodine-131 in the employee's thyroid averaged about 0.4 microcuries during this period. See paragraphs 24 and 29.

    (b) The employee exposures refered to in Item (a) above were not reported to the Commission as required by 10 CFR 20.405(a). See paragraphs 24 and 30.

    (c) The concentrations of Iodine-131 released from the licensee's plant into unrestricted areas during 1965 exceeded the limits prescribed by 10 CFR 20.106(a). See paragraph 39.

13. Also, in the Commission's letter to the licensee, dated February 18, 1966, the licensee was informed that items of noncompliance similar to those described in Items (a) and (b) above were also noted during Reinspection No. 7 and brought to the licensee's attention in the Commission's notice dated October 22, 1965.

14. Reinspection No. 9, which was conducted on June 13, 14, and 15, 1966, the subject of this report, was conducted primarily to review the status of the licensee's program with respect to each of the above noted items of noncompliance and also to review the licensee's reorganizational status since the acquisition of Nuclear Consultants Corporation by Mallinckrodt Chemical Works on January 5, 1966.

ORGANIZATION AND ADMINISTRATIVE CONTROL

15. The Commission was notified of the acquisition of Nuclear Consultants Corporation by Mallinckrodt Chemical Works in a letter dated December 20, 1965 from W. R. Konnecker and in a letter dated December 22, 1965 from Harold E. Thayer, President, Mallinckrodt Chemical Works. Based on Mr. Thayer's letter of December 22, 1965, License No. 24-4206-1 was amended in its entirety on January 5, 1966.

ORGANIZATION AND ADMINISTRATIVE CONTROL (Cont'd)

16. W. R. Konnecker, Vice-President and General Manager of the Nuclear Consultants Division, Mallinckrodt Chemical Works, gave the AEC representative a copy of the Nuclear Consultants Division's current organization structure. This consists of four pages of organizational charts. Copies of these charts are attached to this report as Exhibit "A".

17. Dr. Konnecker stated that as Vice-President and General Manager of the Nuclear Consultants Division, he holds the highest level of management responsibility insofar as this license program is concerned.

18. Mr. Donald Soldan has been designated as the Radiation Safety Officer for the entire Nuclear Consultant Division's operations. In addition, Mr. Soldan has recently been given the responsibility for corresponding with the Commission with respect to concentrations of radioactive materials, personnel exposures, and other related items concerning the use of licensed material within this license program.

19. At the present time, the licensee is in the process of interviewing people for the purpose of obtaining someone to head up the Film Badge Section of the Health Physics Department. This new employee, when hired, will work under Mr. Soldan's supervision.

20. The licensee representatives stated that some of the people shown on the organizational charts (see Exhibit "A") are new employees and therefore, their names will not show up on the various personnel monitoring records until the latter part of the second calendar quarter of 1966.

PERSONNEL MONITORING - FILM BADGES

21. Up until the end of 1965, the licensee used a double film badge system in order to compare whole body exposures. A film badge service of R. S. Landauer and the licensee's own Nuclear Consultants film badge service was used. In addition to these film badges, the licensee employees also wore dosimeters and wrist badges. During the last previous reinspection conducted on November 29 and 30, 1965, external exposure data was extracted from the licensee's records for the periods from the week of October 11, 1965 through the week of November 15, 1965. This data was shown on Exhibits "A-2" and "A-3" of the Form AEC-417 report dated January 25, 1966 concerning this licensee. During Reinspection No. 9 conducted on June 13, 14 and 15, 1966, external exposure data was extracted from the licensee's records for the periods from the week of November 22, 1965 through the week of December 27, 1965. The complete external exposure data for the Landauer film badge for whole body, the Nuclear Consultants badge for the whole body, dosimeter readings and wrist badge data for the period October 11, 1965 through the week of December 27, 1965 are shown as Exhibit "B" attached to this report.

22. The Nuclear Consultants film badge data for [redacted] for the week of October 18, and week of October 25, 1965 show 490 millirem and 550 millirem, respectively. These two film badge results along with the other weekly film badge results for the fourth quarter 1965 for [redacted] shows that she received an apparent whole body exposure dose for the fourth quarter 1965 of 3175 millirem. The licensee's evaluation of [redacted] two film badge results noted above indicated that the film badge for these two periods showed definite signs of badge contamination. As a result of this investigation, the licensee's recommended reading for the two periods are 230 millirem each. Using the recommended film badge readings for the two periods noted above, the total fourth quarter (1965) whole body exposure dose for [redacted] would be 2595 millirem. A copy of the licensee's evaluation of [redacted] fourth quarter (1965) exposure is attached to this report as Exhibit "C".

23. It should be noted that the Landauer whole body film badge worn by [redacted] during the weeks of October 18 and 25, 1965 (please see paragraph 22 above) showed exposures of 510 millirem and 600 millirem, respectively, for the two periods. These two Landauer film badge results would appear to validate the two Nuclear Consultants badge results for the period in question. Mr. Soldan was contacted by telephone during the week

PERSONNEL MONITORING - FILM BADGES (Cont'd)

23. (Cont'd) of July 4, 1966 in order to find out if the Landauer badges showed evidence of contamination during the subject periods. Mr. Boldan related that he contacted the Landauer film badge people concerning this matter. He further related that the Landauer film badge report for the weeks of October 18 and October 25 did show some contamination on the two film badges for [redacted] A copy of the Landauer film badge report in question as submitted to Region III is attached to this report as Exhibit "D". It appears, from the data available, that [redacted] did not exceed the 3.0 rem whole body exposure limit for the fourth calendar quarter of 1965. Ex 6

PERSONNEL MONITORING - THYROID DATA - 1965

24. Beginning the first part of December 1965, the thyroid counting frequency for all lab personnel of the licensee has been on an almost daily basis. These December 1965 thyroid count results shows that for nearly every lab employee who was counted, the weekly average of 0.14 microcuries in the thyroid was exceeded at one time or another. The licensee representatives were advised that, based on this thyroid count data for the licensee's laboratory employees, it appears that the licensee is in noncompliance with 10 CFR 20.103(a). The licensee representatives were also advised that failure to report these apparent overexposures to excessive concentrations of Iodine-131 to the Commission and to [redacted] and other employees involved, constituted noncompliance with 10 CFR 20.405(a) and 20.405(b). In the case of [redacted] this is a repeat item of noncompliance from the previous reinspection of November 29 and 30, 1965. The December 1965 thyroid data is attached to this report as Exhibit "E".

PERSONNEL MONITORING - URINALYSIS - 1965

25. The licensee representatives stated that they did not have any urinalysis data for licensee employees between the time of the last previous reinspection until the end of December 1965 in that they had not yet established a definite urinalysis program.

PERSONNEL MONITORING - 1966

26. At the time of this inspection, there were 18 licensee employees on a weekly film badge cycle and 21 licensee employees on a monthly film badge frequency. Mr. Boldan stated that all weekly film badge frequency personnel are thyroid counted between two and five times per week while the monthly film badge frequency people are thyroid counted once per month.

27. Early in 1966, the licensee revised his personnel exposure record system. Two new forms were initiated for the recording of dosimeter, whole body, skin, extremities, and thyroid exposure data. One of these new forms is entitled "Quarterly Summary Personnel Exposure Report". One such form is maintained for each individual. This particular form allows the licensee to record the exposure data for that person for each particular week of that quarter and to show the accumulative totals for each of the various exposure data throughout that quarter. A second new form initiated for this purpose is entitled "Weekly Summary Personnel Exposure Report". This second form shows the same data as the individual quarterly personnel forms noted above except that all employees' names are listed on this weekly form in order to know at a glance how each individual compares to another one for that particular week. Copies of these two forms are attached to this report as Exhibit "F".

28. When the new personnel exposure record system (see paragraph 27 above) was begun, the licensee devised a new method for recording the individual results of the various personnel monitoring devices, including thyroid counts. The key to this new system is as follows:

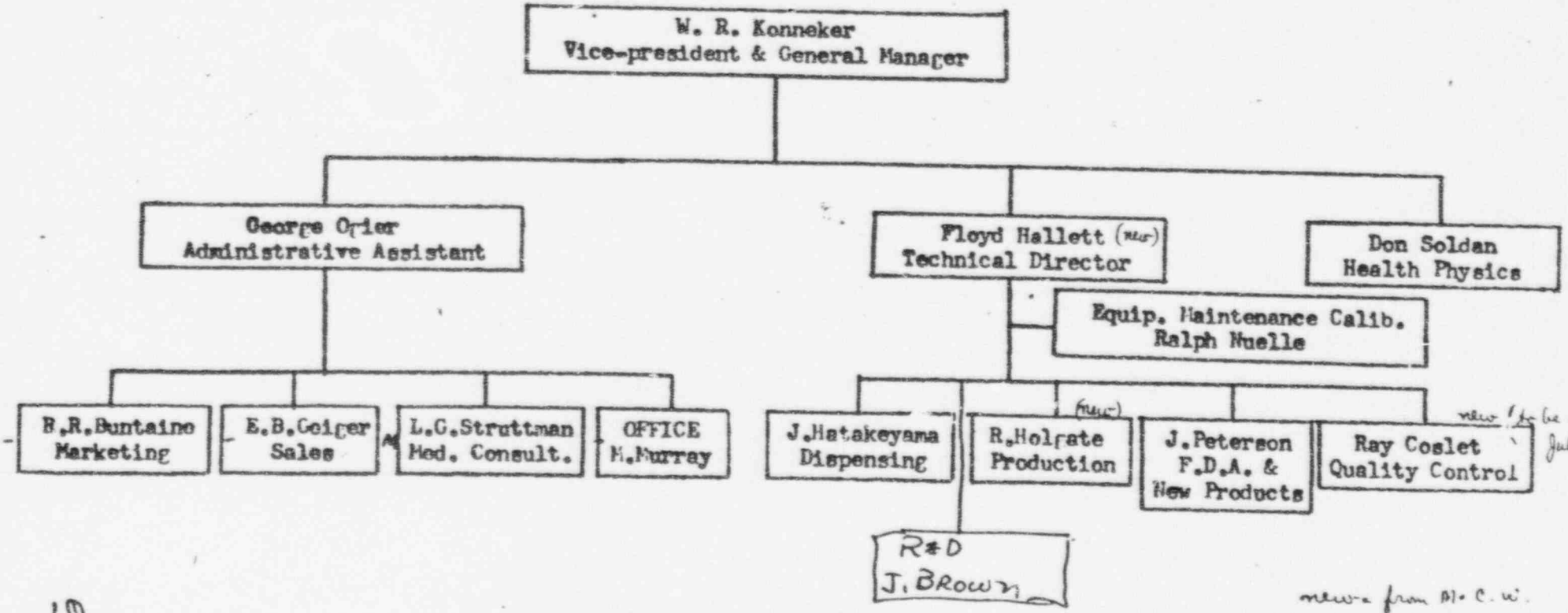


EXHIBIT "A-1"

6-13-66

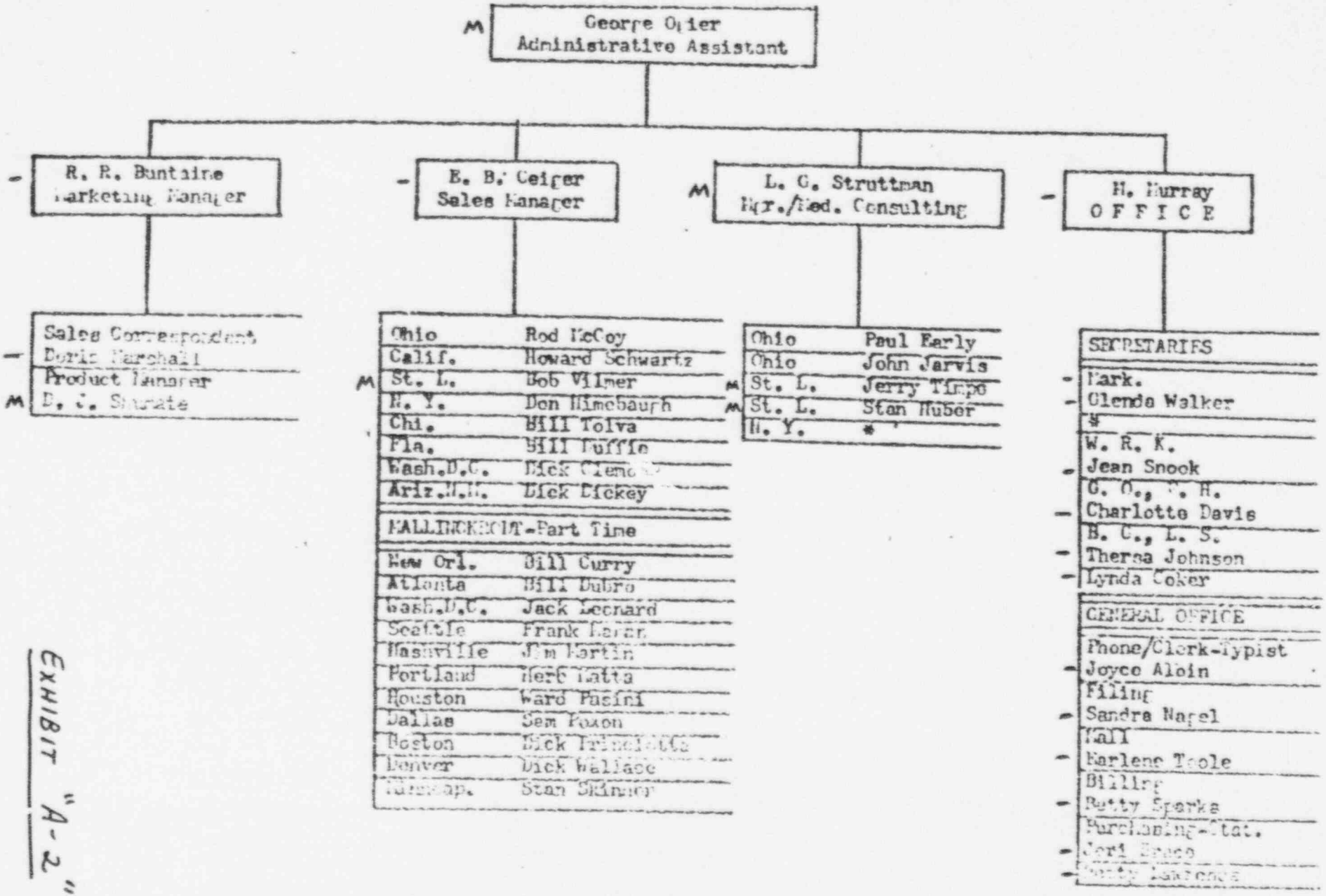

George Otier
Administrative Assistant
R. R. Buntaine
Marketing Manager
E. B. Geiger
Sales Manager
L. G. Struttman
Mgr./Med. Consulting
H. Murray
OFFICE
Sales Correspondent
Doris Marshall
Product Manager
D. J. Shurate
Ohio Rod McCoy
Calif. Howard Schwartz
St. L. Bob Vilmer
N. Y. Don Himebaugh
Chi. Bill Tolva
Fla. Bill Duffie
Wash.D.C. Dick Clemens
Ariz.N.M. Dick Dickey
HALLBROOK-Part Time
New Orl. Bill Curry
Atlanta Bill Dubro
Wash.D.C. Jack Leonard
Seattle Frank Doran
Nashville Jim Martin
Portland Herb Latta
Houston Ward Pasini
Dallas Sam Poson
Boston Dick Trinchetto
Denver Dick Wallace
Tulsa-Ap. Stan Skinner
Ohio Paul Early
Ohio John Jarvis
St. L. Jerry Timpe
St. L. Stan Huber
N. Y. *
SECRETARIES
Mark.
Glenda Walker
$
W. R. K.
Jean Snook
G. O., T. H.
Charlotte Davis
B. C., L. S.
Theresa Johnson
Lynda Coker
GENERAL OFFICE
Phone/Clerk-Typist
Joyce Aloin
Filing
Sandra Nagel
Mail
Marlene Toole
Billing
Betty Sparks
Purchasing-Stat.
Jeri Bruce

EXHIBIT "A-2"

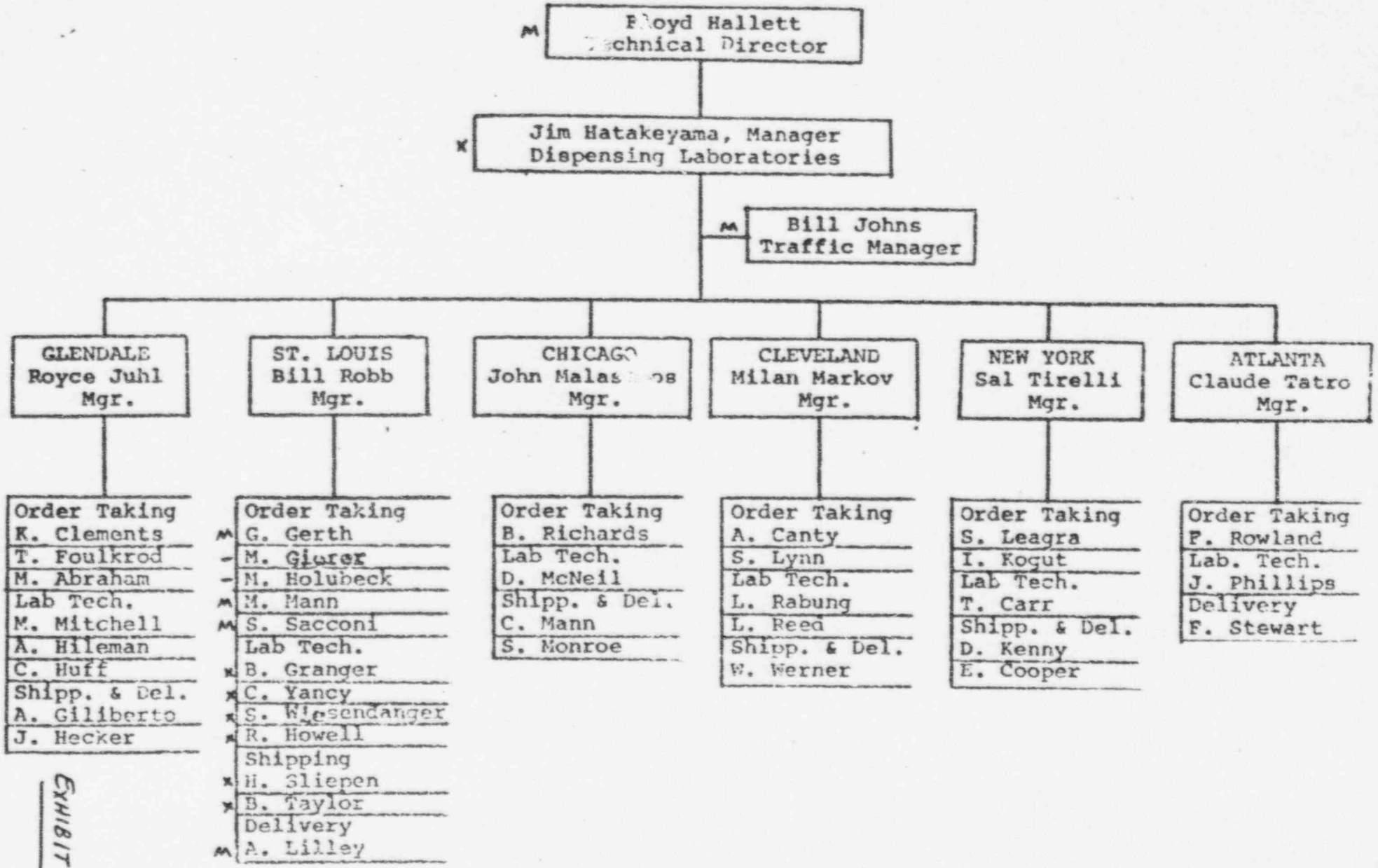


EXHIBIT "A-3"

6-13-66

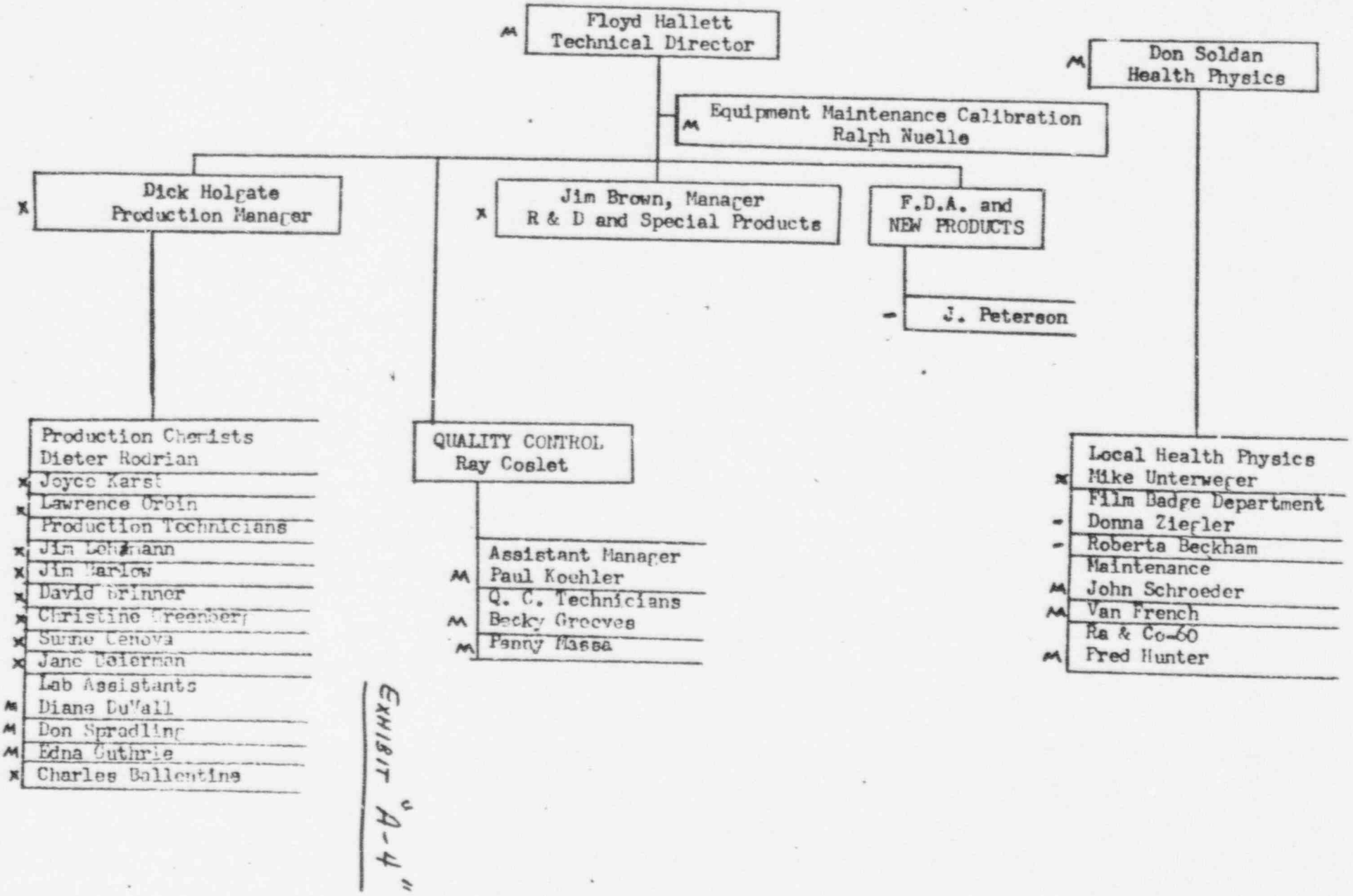


EXHIBIT "A-4"

6-13-66

PERSONNEL MONITORING - 1966 (Cont'd)

28. Dosimeter - 1.0 = 231 mr
Whole Body (FB) - 1.0 = 231 millirem
Skin (FB) - 1.0 = 577 millirem
Extremities (Wrist Film Badge) - 1.0 = 1440 millirem
Thyroid Counts - 1.0 = 0.14 microcuries (average results of between 2 and 5 thyroid counts per week)

The advantage of this new keyed system allows the licensee to view quite rapidly the exposure data sheets and see if an employee is accumulating his exposures at a rate which could put him above the prescribed quarterly limits. For example, if at the end of week No. 5, an individual's accumulated whole body exposure data showed more than 5.0, this would mean that he is accumulating whole body exposure at a rate which could put him above 3.0 rem at the end of 13 weeks. The first calendar quarter of 1966 personnel exposure data (except urinalysis) extracted from the licensee's records, is attached to this report as Exhibit "G". Similarly, the second calendar quarter of 1966 through week No. 8 (week of May 23, 1966) personnel exposure data is attached to this report as Exhibit "H".

29. It should be noted that during the first calendar quarter of 1966 and through the first eight weeks of the second calendar quarter of 1966, (see Exhibits "G" and "H"), that several persons received weekly averaged thyroid counts in excess of 0.14 microcuries which constitutes noncompliance with 10 CFR 20.103(a) (see also paragraph 24 above).

30. In a letter to E. R. Price, SLR, dated April 15, 1966, Dr. Konnecker advised that during the first quarter of 1966, four persons had burdens in excess of 0.14 microcuries at some time during the quarter. In this letter, Dr. Konnecker goes on to advise that the four persons had one time thyroid burdens of up to 0.38 microcuries with all four persons having quarterly thyroid burden averages of less than 0.14 microcuries. Information gleaned from the licensee's personnel exposure data for the first quarter of 1966 shows that a total of 5 persons (not four) showed weekly averaged thyroid burdens on different occasions of greater than 0.14 microcuries. It is noted that one person did have a weekly average at one time of 0.385 microcuries (see Exhibit "G" attached to this report). In addition, Dr. Konnecker's letter dated April 15, 1966 is not considered a timely report of these exposures in that many of the weekly averages of greater than 0.14 microcuries thyroid burdens occurred prior to March 15, 1966. The licensee was advised that failure to report these personnel exposures within 30 days constituted noncompliance with 10 CFR 20.405(a).

31. It was determined during this inspection that the persons receiving the weekly averages in excess of 0.14 microcuries thyroid burden as mentioned above (see paragraph 30) were not notified of these exposures which constituted noncompliance with 10 CFR 405(b).

32. The licensee's representatives were advised that failure to include the names of the individuals in the April 15, 1966 report of exposures constituted noncompliance with 10 CFR 20.405(c).

33. Dr. Konnecker stated that all personnel exposure reports would be submitted in accordance with 10 CFR 20.405 in the future. Dr. Konnecker went on to say that this would include any thyroid counts which averaged greater than 0.14 microcuries in any one week. At the same time, Dr. Konnecker turned over the responsibility of this reporting to Mr. Donald Soldan, the Manager of the Health Physics Department, Nuclear Consultants Division.

34. At the time of this inspection, the licensee's urinalysis data was in rough form. Mr. Soldan stated that the urinalysis data for all persons sampled between January and June 1966 and the licensee's urinalysis procedures discussions, calculations, and requirements would be submitted to the Division of Compliance, Region III, shortly following the inspection. This information, which included an explanation for the tardiness of the information, was submitted to the Division of Compliance, Region III, on June 27, 1966 and a copy of this urinalysis information is attached to this report as Exhibit "I".

AIR SAMPLING

35. Gelman millipore filters with activated charcoal were in use during the last previous inspection. Mr. Soldan stated that these Gelman millipore filters proved unsatisfactory so they tried a new method using disposable syringes with carbon inserts. The disposable syringes did not work out either. Soldan stated that the primary problem with both these systems was that the air flows were unstable. At the present time, the licensee uses a homemade cartridge consisting of a ¼ inch ID polyethelene tube (approximately 1 3/4 inches long) and containing about 1 inch of granular activated coconut charcoal, incorporated with "Lab-por" (polyethelene frit) which holds the charcoals in place. These cartridges are homemade at the licensee's facilities. These homemade samplers maintain an air flow of about 1 liter per minute according to Soldan.

36. During mid-February 1966, the licensee's air sampling frequencies were changed from "grab" to "continuous" and at the same time, the present number sampling point designation system was put into effect. "Continuous" means at least 24 hour sampling time with "on-off" operations being performed manually.

37. In the latter part of April 1966, all "implant" air samples were placed on a programed, automatic on-off system. Under this system, all "in-plant" sampler tubes are connected to a central manifold. The manifold automatically turns on each day, except Sunday, at 8:00 am and shuts off at 5:00 pm the same day, whether or not the sample is changed. These samples are referred to as intermittent samples and are denoted by a new letter designation system. The sampling cartridges are located "head-high" in the various areas.

38. The locations of "continuous", "numbered" sampling points (see paragraph 36) and intermittent "lettered" sampling points (see paragraph 37) are attached to this report as Exhibit "J".

39. Exhibit "K" of this report contains data extracted from the licensee's records during this inspection concerning air concentrations. Exhibit "K-1" comprises all the air sample data collected by the licensee during the period December 3, 1965 through February 15, 1966. As noted in Exhibit "K-1", no roof samples were taken and only two (2) iodine stack samples were taken. During this period, the iodine stack was still considered by the licensee to be an unrestricted area. The iodine stack sample of December 24, 1965 showed 4.6×10^{-8} microcuries per ml (460×10^{-10} microcuries per ml). MPC for soluble Iodine-131 released to unrestricted areas is 1×10^{-10} microcuries per ml. Therefore, it appears the licensee is in noncompliance with 10 CFR 20.106(a). In addition, a spot check of the licensee's air sample data since mid-February 1966 revealed that four environmental (rooftop) samples showed concentrations falling between 1 and 9 times MPC of 1×10^{-10} microcuries per ml with an occasional sample as high as 44 x MPC. Exhibit "K-2" shows the results of two consecutive air sampling dates for "continuous" samples in April 1966. Sample Stations 6, 8, 10 and 11 are rooftop samples and are the only "unrestricted" sample areas at this time. On each of the two sampling dates shown, these "unrestricted" area samples exceed 10 times MPC (MPC for Iodine-131 in unrestricted areas is 1×10^{-10} microcuries per ml) which constitutes noncompliance with 10 CFR 20.405(a).

40. Exhibit "K-2" also shows air sample data from "programmed" in-plant sampling stations collected during periods which encompass the same two consecutive dates in April 1966 as noted above in paragraph 39. These two dates are namely April 21/22, and 22/23, 1966.

41. As noted in Exhibit "K-2", two sets of data are shown for each sample. These are "base" and "Iodine-131 peak" counts. Mr. Soldan stated that "base" means that the analyzer is pre-set to count all energies above 10 kev (gamma) while "Iodine-131 peak" means that the analyzer is pre-set to accept all counts in an energy interval of 315 kev and 415 kev (gamma). Equipment used in these analyses is comprised of a sodium-iodide crystal and a shielded well with a Picker Magnascanner III A and a Nuclear Chicago Model 1810 Radiation Analyzer.

AIR SAMPLING (Cont'd)

42. Soldan stated that "base" concentrations, in microcuries per ml, are considered "official" in that they represent most isotopes possibly present in a sample whereas the "I-131 peak" rejects all energies not in the range of Iodine-131. However, mpc's used for all samples assumes Iodine-131 present.

HEALTH PHYSICS ACTIONS TO REDUCE PERSONNEL EXPOSURES

43. Mr. Soldan spelled out the various actions which the Health Physics Department has taken in attempts to reduce personnel exposures at the licensee's facilities since the last previous reinspection.

44. One problem which arose recently concerned the stabilizer material used in iodine capsules. Until mid-February 1966, the stabilizer substance used in the iodine capsules was cysteine hydrochloride (0.2 per cent solution). Soldan stated that some time in mid-February 1966, the stabilizer substance was changed to ascorbic acid (0.2 per cent solution). This change in stabilizer substances was initiated in the Production Department without the knowledge of Mr. Soldan or Dr. Konnecker, according to Soldan. During this period following February 1966, investigations made by the Health Physics Department to determine the high thyroid counts and high air samples noted in the tagging room, drug and waste storage room, and the high concentrations in the basement areas, revealed the cause to be from the capsules (change in stabilizer). Soldan stated that the capsule substance was changed back to the cysteine hydrochloride in mid-May 1966 and the storage areas of new capsule were changed to ventillated base cabinets under hoods. Soldan stated that the main purpose of this stabilizer is to cut down on the oxidation process which can lead to a breakdown of the sodium-iodide and thereby emit elemental iodine. Ascorbic acid in a dry form is unstable causing a breakdown, whereas, cysteine hydrochloric is relatively more stable in a dry state.

45. A change in the facilities was made in the first part of April 1966 which involved the moving of the air supply unit on the roof away from the Iodine-131 stack to a new position over the edge of the roof level, down about 5 feet from the top of the roof.

46. In about mid-May 1966, a new homemade charcoal filter was placed in the iodine stack. This new filter is 24 inch by 24 inch on the side, by approximately 1½ inch thick. The filter consists of a wood frame with stainless steel mesh top and bottom encasing 1½ inch thick layer of granulated activated coconut charcoal. These are the same small granules which are used in the homemade air sample cartridges now being used. This new 1½ inch thick carbon filter is used in series with an absolute filter in the iodine stack.

47. The iodine capsule sorting machine (located in the basement below the production area) was tied into the iodine exhaust system (I-131 stack) in mid-May 1966. Prior to this time, there was no ventillating exhaust available for the capsule sorting machine.

48. New, unsorted capsules are now stored in the ventillated base cabinet under the sorting machine. Before this time, they were stored in the "open" behind a concrete wall in the sorter room.

49. Newly sorted capsules are now being stored in the drug and waste storage room with all other iodine products and active waste. Prior to this time, the drug and waste storage room did not have any air supply or exhaust. Since this time, the room has a built-in air supply exhaust which gives about one air change per minute. This new supply and exhaust system in the drug and waste storage room was put in on May 20, 1966.

50. Soldan stated that the various Health Physics activities which resulted in the lowering of thyroid counts and air sample results substantiated the fact that high thyroid results were from air-borne activities. Soldan convinced Dr. Konnecker of this fact to a point where Dr. Konnecker readily approves purchases of new air handling equipment, etc., according to Soldan.

HEALTH PHYSICS ACTION TO REDUCE PERSONNEL EXPOSURES (Cont'd)

51. Soldan stated that they are in the middle of planning to correct the sterile room air problems (now running about 2 to 5 x MPC) by installing glove boxes. This particular area is known as air sample station M.

52. While still on the subject of high air concentrations and various thyroid counts data, the subject of [redacted] thyroid counts came into the conversation. [redacted] thyroid counts are consistently at or slightly above weekly averages of 0.14 microcuries. Mr. Soldan stated that [redacted] has just learned recently from her doctor that she has a very enlarged and overactive thyroid. Soldan stated that the licensee will contact her doctor regarding more medical information and will spell out these details regarding exposures, etc., in their answer to Enforcement concerning these inspection results. At this time, Soldan gave the inspector thyroid count data subsequent to week No. 8 (second quarter 1966) for [redacted] This data showed that for the week of May 30, 1966 (week No. 9) [redacted] had an average thyroid count of 87 per cent of 0.14 microcuries and for the week of June 6, 1966 (week No. 10), her average thyroid count was 53 per cent of 0.14 microcuries. Soldan concluded by stating that [redacted] job is now exclusively in the capsule sorting room. During a recent telephone conversation with Mr. Soldan (July 6, 1966) on a different matter, Mr. Soldan related that just very recently [redacted] showed a 77 x 0.14 microcurie thyroid count. Soldan went on to say that upon questioning, [redacted] stated that she had received a diagnostic capsule from her doctor in conjunction with her enlarged and overactive thyroid problem. Soldan ended by stating that they also learned from the doctor that [redacted] thyroid is 45 grams instead of the standard 30 grams.

53. Mr. Soldan stated that there had been two major problems insofar as external exposures were concerned. These were involved in the gold preparation and technetium "cows" operations. These external exposure problems were somewhat reduced with the increased use of lead shielding which were especially designed half-circle curved lead bricks of various outside diameters. Soldan stated that these can be stacked to many various configurations to allow better use of closed glass systems within gloved hoods and make better use of remote handling methods for transferring, heating, storing, etc., inside the closed gloved hoods. Soldan stated with the increased use of these new lead bricks, they have reduced external exposures during gold preparation operations approximately one order of magnitude and have reduced the external exposures from the technetium "cow" operations by about a factor of three (3). Soldan stated that these reduced exposures began showing up in about June 1966.

MANAGEMENT DISCUSSION

54. The results of this inspection were discussed with W. R. Konnecker, Ph. D., Vice-President, Nuclear Consultants Division, Mallinckrodt Chemical Works, and Mr. Donald Soldan, Manager of the Health Physics Department and Radiation Safety Officer. The various items of noncompliance noted during this inspection were discussed with the two licensee representatives mentioned above. These items of noncompliance, as noted above in the various sections of this report, involved high air concentrations in unrestricted areas, high thyroid counts and the failure of the licensee to properly report these high air concentrations and high thyroid counts. At this time, the licensee representatives reiterated the various actions being taken by the Health Physics Department in order to reduce personnel exposures and air concentrations in unrestricted areas. In addition, Dr. Konnecker turned over the responsibilities for reporting all reportable discrepancies to Mr. Soldan, who stated at this time that he would see to it that timely reports in the future are submitted to the Commission concerning all matters. Also, at this time, the licensee

MANAGEMENT DISCUSSION (Cont'd)

54. (Cont'd) representatives expressed their hope that the new addition to their facilities would be completed and approved in the very near future. They stated that with this new facility, they believed that many of their problems will be solved in that the new addition is better designed to handle the radioisotopes used under this license.

Enclosures:
Exhibits A thru K

4th Quarter - 1965

Name	Week of	Landauer Badge (WB)	Nuc. Cons. Badge (WB)	Dosimeter	Wrist Badge
[redacted] (Production-Chemist)	10-11	130	70	120	295
	10-18	210	230	294	1125
	10-25	350	200	247	1400
	11-1	230	160	240	565
	11-8	*	220	282	1100
	11-15	*	235	325	*
	11-22	210	230	232	640
	11-29	*	144	202	518
	12-6	*	130	205	355
	12-13	*	175	269	615
	12-20	*	131	189	562
	12-27	*	100	227	815
Total (mrem)		1130	2025	2832	7990
[redacted] (Research & Development)	10-11	50	75	83	175
	10-18	220	285	193	650
	10-25	220	140	195	200
	11-1	180	140	224	310
	11-8	*	200	148	355
	11-15	*	75	151	*
	11-22	250	145	230	530
	11-29	260	199	245	532
	12-6	60	110	175	530
	12-13	340	415	271	3000
	12-20	260	244	285	1500
	12-27	*	145	61	679
Total (mrem)		1840	2173	2261	8461
[redacted] (Health Physics & Cobalt Room)	10-11	*	45	25	45
	10-18	*	45	82	15
	10-25	*	140	400	30
	11-1	*	245	204	15
	11-8	*	395	483	1400
	11-15	*	175	229	*
	11-22	*	230	220	260
	11-29	*	30	160	30
	12-6	*	45	73	360
	12-13	*	215	61	3450
	12-20	*	60	147	30
	12-27	*	568	164	880
Total (mrem)		-	2193	2248	6515
[redacted] (Production-Chemist)	10-11	70	60	*	75
	10-18	100	105	*	130
	10-25	140	110	83	105
	11-1	220	200	202	310
	11-8	*	140	100	190
	11-15	*	160	166	*
	11-22	*	190	218	640
	11-29	210	170	175	298
	12-6	100	140	306	45
	12-13	330	398	232	840
	12-20	110	0	232	0
	12-27 - Terminated employment prior to 12-27-65 badge period				
Total (mrem)		1280	1673	1714	2633

*No data reported

Ex 6

EXHIBIT "B-1"

Name	Week of	Landauer Badge (WB)	Nuc. Cons. Badge (WB)	Dosimeter	Wrist Badge
[redacted] (Production-Chemist)	10-11	350	210	273	485
	10-18	510	490 (230)	336	1650
	10-25	600	550 (230)	400	2250
	11-1	300	280	338	1150
	11-8	*	230	215	525
	11-15	*	230	206	*
	11-22	230	380	210	1000
	11-29	220	199	176	270
	12-6	160	185	264	650
	12-13	230	200	135	415
	12-20	80	120	87	244
	12-27	*	101	94	849
Total (mrem)		2680	3175 (2595)	2734	9488
[redacted] (Shipping clerk)	10-11	*	160	169	225
	10-18	*	280	114	150
	10-25	*	145	208	120
	11-1	*	110	157	150
	11-8	*	260	185	75
	11-15	*	175	221	*
	11-22	*	[illegible]	153	100
	11-29	*	325	225	165
	12-6	*	105	132	105
	12-13	*	140	200	70
	12-20	*	120	162	75
	12-27	*	110	85	210
Total (mrem)		-	2065	2011	1445
[redacted] (Dispensing)	10-11	180	150	137	415
	10-18	290	165	211	380
	10-25	230	175	176	190
	11-1	250	170	235	415
	11-8	*	190	206	360
	11-15	*	190	177	*
	11-22	220	200	186	290
	11-29	130	112	103	154
	12-6	110	110	166	142
	12-13	260	260	206	305
	12-20	110	190	186	379
	12-27	*	180	201	325
Total (mrem)		1780	2092	2190	3355
[redacted] (Dispensing)	10-11	200	80	179	145
	10-18	210	176	176	290
	10-25	300	160	181	290
	11-1	240	120	220	210
	11-8	*	160	196	190
	11-15	*	30	147	*
	11-22	150	100	142	160
	11-29	120	75	122	310
	12-6	90	75	137	105
	12-13	220	115	196	215
	12-20	110	75	157	170
	12-27	*	57	54	121
Total (mrem)		1640	1222	1907	2206

Ex 6

EXHIBIT "B-2"

Name	Week of	Landauer Badge (WB)	Nuc. Cons. Badge (WB)	Dosimeter	Wrist Badge
[redacted] (Capsule Production)	10-11	130	75	76	110
	10-18	190	175	69	175
	10-25	170	140	85	215
	11-1	130	110	146	170
	11-8	*	160	130	280
	11-15	*	15	144	*
	11-22	90	265	101	210
	11-29	140	140	96	188
	12-6	100	105	246	175
	12-13	90	75	163	100
	12-20	10	0	*	0
	12-27	*	20	*	35
Total (mrem)		1050	1280	1256	1658
[redacted] (Dispensing)	10-11	210	130	238	175
	10-18	360	415	275	485
	10-25	250	150	337	215
	11-1	220	235	276	250
	11-8	*	140	322	115
	11-15	*	100	304	*
	11-22	100	110	224	230
	11-29	310	210	255	153
	12-6	200	160	219	165
	12-13	330	280	208	260
	12-20	110	120	158	45
	12-27	*	183	199	224
Total (mrem)		2090	2233	3015	2317
[redacted] (Capsule Production)	10-11	130	215	118	450
	10-18	320	310	225	2300
	10-25	310	230	258	870
	11-1	250	175	175	730
	11-8	*	245	179	750
	11-15	*	225	280	*
	11-22	380	360	219	710
	11-29	170	176	166	244
	12-6	130	150	214	290
	12-13	330	245	219	1100
	12-20	180	199	249	562
	12-27	*	206	206	712
Total (mrem)		2260	2736	2508	8718
[redacted] (Production)	10-11	280	230	252	265
	10-18	390	400	257	150
	10-25	420	415	276	(Lost)
	11-1	290	365	183	2100
	11-8	*	400	264	1400
	11-15	*	230	274	*
	11-22	- Terminated employment prior to 11-22-65 badge period.			
	11-29				
	12-6				
	12-13				
	12-20				
	12-27				
Total (mrem)		1380	2040	1506	3915

Ex 6

EXHIBIT "B-3"

INTER-OFFICE MEMO

6-14-66

NUCLEAR CONSULTANTS CORPORATION

To HEALTH PHYSICS FILE From Ralph Nuelle

Subject: Date: 1/10/66

After reviewing the films from the film badges worn by Joyce Karst for the last quarter of 1965 (10/11/65—1/3/66), it is my recommendation from the film interpretation to alter the reported weekly dosages as follows:

DATE WORN	REPORTED READING	RECOMMENDED READING
10/11-10/18	210 mr	210 mr
10/18-10/25	490* (2)	230)-Max. dose (which also cor-
10/25-11/1	550*	230)-responds to the average dose
11/1 -11/8	280 (1)	280 for this individual).
11/8 -11/15	230* (1)	230
11/15-11/22	230	230
11/22-11/29	380	380
11/29-12/6	199 (2)	199
12/6 -12/13	185 (1)	185
12/13-12/20	200 (2)	200
12/20-12/27	120	120
12/27-1/3	N.R.	---
	3,074 mr	2,494 mr

*Films definitely show evidence of badge contamination.

(1) Mostly from harder radiation.
(2) Radiation from front and back of badge.

For the weeks 10/18-10/25 and 10/25-11/1 it is considered acceptable to change the reported dosage to 230 mr as noted in this report. The average dosage for this individual during this quarter came out to be 233 mr. The maximum weekly permissable dosage (considering a 13 week quarter) will be 230 mr. However, if a 12 week quarter is considered, the maximum weekly dosage would be 240 mr.

The film from 12/27-1/3 is not reported (N.R.) since the films are still in use because of lack of fresh film for making up new badges.

REN/js

R. E. Nuelle REN

EXHIBIT "C"

NUCLEAR CONSULTANTS
ATTN RALPH NUELLE
2703 WAGNER PL
MARYLAND HTS MO
63045

MAIN OFFICE
3920 - 216TH STREET
MATTESON, ILL. 60443
PHONE 312-748-7900

R. S. Landauer JR. & CO.

PHONE -

Film Badge Dosimetry Report

PARTICIPANT IDENT. NO.	PARTICIPANT NAME	SOCIAL SECURITY NO.	NOTE (SEE REMARKS SPACE)	TYPE OF EXPOSURE	ISSUE DATE FIRST DAY OF ASSIGNED EXPOSURE PERIOD MO.	DAY	YR.	LAST DAY OF ASSIGNED EXPOSURE PERIOD MO.	DAY	YR.	EXPOSURE TO BADGE THIS PERIOD - IN MILLIREMS (M = MINIMAL) GAMMA & X-RAY	BETA	THERMAL NEUTRON	FAST NEUTRON	TOTAL	RANGE	CALENDAR QUARTER	CUMULATIVE TOTALS (M = MINIMAL) CALENDAR QUARTER (OR 13 WEEKS) *	YEAR TO-DATE
0000	CONTROL		C	1	10	18	65	10	24	65	M				M		4	M	79
0001			C	1	10	18	65	10	24	65	290	M			290		4	690	301
0001			C	2	10	18	65	10	24	65	210				290		4	1100	661
0002			C	1	10	18	65	10	24	65	220				210		4	560	801
0003			C	1	10	18	65	10	24	65		350			220		4	550	1941
0003			C	2	10	18	65	10	24	65	210				570		4	1690	731
0004			C	1	10	18	65	10	24	65		M			210		4	600	1771
0004			C	2	10	18	65	10	24	65	510				210		4	1160	1601
0005			C	1	10	18	65	10	24	65	190	M			510		4	1310	781
0006			C	1	10	18	65	10	24	65	360	M			190		4	650	1721
0006			C	2	10	18	65	10	24	65	320				190		4	1350	891
0007			C	1	10	18	65	10	24	65	390		450		360		4	720	1531
0007			C	1	10	18	65	10	24	65	100				360		4	1050	821
0008			C	2	10	18	65	10	24	65					320		4	790	881
0009															390		4	880	2251
0009															840		4	2250	571
0010															100		4	390	

EXHIBIT "D-1"

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16)

TYPE OF EXPOSURE (COLUMN 3)

NUCLEAR CONSULTANTS
ATTN RALPH NUELLE
2703 WAGNER PL.
MARYLAND HTS MO
63045

MAIN OFFICE
3920 - 216TH STREET
MATTESON, ILL. 60443
PHONE 312-748-7900

R. S. Landauer JR. & Co.

Film Badge Dosimetry Report

PARTICIPANT IDENT. NO.	PARTICIPANT NAME	SOCIAL SECURITY NO.	NOTE (SEE REVERSE SIDE)	TYPE OF EXPOSURE	BADGE DATE (1ST DAY OF ASSIGNED EXPOSURE PERIOD) MO.	DAY	YR.	LAST DAY OF ASSIGNED EXPOSURE PERIOD MO.	DAY	YR.	EXPOSURE TO BADGE THIS PERIOD - IN MILLIREMS (M = MINIMAL) GAMMA & X-RAY	BETA	THERMAL NEUTRON	FAST NEUTRON	TOTAL	RANGE	CALENDAR QUARTER	CUMULATIVE TOTALS (M = MINIM) CALENDAR QUARTER (OR 13 WEEKS)	YEAR-TO-DAT
0000	CONTROL		C	1	10	25	65	10	31	65	60				60		4	60	6
0001			C	1	10	25	65	10	31	65	230		M		230		4	920	12
0001			C	2	10	25	65	10	31	65	350				230		4	1330	152
0002			C	1	10	25	65	10	31	65	220		M		350		4	910	101
0003			C	2	10	25	65	10	31	65	300		M		220		4	770	102
0003			C	1	10	25	65	10	31	65	600				300		4	1910	216
0004			C	2	10	25	65	10	31	65	170		M		300		4	900	103
0004			C	1	10	25	65	10	31	65	250		M		600		4	1460	207
0005			C	2	10	25	65	10	31	65	310				170		4	1910	220
0006			C	1	10	25	65	10	31	65	420		M		250		4	820	95
0006			C	2	10	25	65	10	31	65	140				250		4	1520	185
0007			C	1	10	25	65	10	31	65					310		4	970	114
0007			C	2	10	25	65	10	31	65					420		4	1300	178
0008			C	1	10	25	65	10	31	65					420		4	1100	112
0009			C	1	10	25	65	10	31	65					140		4	1300	211
0009			C	2	10	25	65	10	31	65							4	2670	348
0010			C	1	10	25	65	10	31	65							4	530	71

EXHIBIT "D-2"

(1) (2) TYPE OF EXPOSURE (COLUMN 5) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16)

SEE REVERSE SIDE FOR ADDITIONAL EXPLANATIONS

C Evidence of contamination.

A- Not Returned.

B-1 This film appears to have been damaged by light. The accuracy of any reading given would be effected thereby.

B-2 This film appears to have been damaged by moisture. The accuracy of any reading would be effected thereby.

B-3 This film appears to have been damaged by chemical fogging. The accuracy of any reading given would be effected thereby.

B-4 This film appears to have been manufactured faultily. The accuracy of any reading given would be effected thereby.

B-5 This film appears to have been damaged by heat or pressure. The accuracy of any reading given would be effected thereby.

B-6 This film appears to have been damaged by age fog. The accuracy of any reading would be effected thereby.

B-7 This film appears to have been damaged by an oily substance. The accuracy of any reading would be effected thereby.

DA This film packet appears to have been exposed out of the badge, therefore, the value given is based on a high energy gamma calibration and is valid only if the exposure were due to high energy gamma. If it were due to beta particles, the dosage may be from 1.5 to 20.0 times the reported value. If it were due to lower energy x or gamma rays, the value reported may be from 1.1 to 20.0 times the actual dosage.

DB Although this film packet was slightly lightstruck, the reading appears to be minimal.

DC This film packet is partially lightstruck. There is apparently a dose recorded, however, no exact quantitative determination can be made.

DD This film badge appears to have been shielded during exposure. The dose reported is not an exact quantitative determination, but only an indication that the badge was exposed.

DE during exposure. There ... however, no exact quantitative determination can be made.

DF This film packet appears to have been misplaced in the badge. The dose reported is not an exact quantitative determination, but is only an indication that the badge was exposed.

DG Although this film packet was slightly lightstruck, there seems to be no apparent effect on the reading.

DH The Beta-gamma background on this film badge was too high to give a valid fast neutron reading.

DI This reading is based on 50-150KV x-ray. This film badge appears to be defective, please return badge for replacement.

DJ This film packet is too old to process.

DL This control packet appears to have been placed in a film badge indicating possible misuse. May we remind you that the value of the control films is lost if used for personnel monitoring or other radiation measurement purposes.

DN This rea... chemical... tion.

DO This fil... badge ... readin...

DS Amoun... perman... at custo...

DT ... int... pe...an... tomer's

DZ Other C...

E Irregula...

G Receive...

H Unused.

EXHIBIT D-5

EXPLANATION:

Exposures reported in millirems from gamma and x-ray: 30 KEV to 20 MEV, beta: over 1.5 MEV, neutrons: 1 MEV to 10 MEV. Dosage due to x-gamma-beta or neutruns outside the ... not necessarily in millirems unless arrangements were made for calibration at other energy ranges. Exposures below minimum quantity measurable are recorded "M" ("M" in curre... than 10 millirems x or gamma, 40 millirems hard beta, 20 millirems fast neutron, or 10 millirems thermal neutron. "M" in cumulative total columns means all previous current ... minimal, unless adjustments to these totals have been made at customer's request). Cumulative totals equal sum of non-minimal readings for badges returned for processing and rep... exposures are added as zero. If other than weekly reporting periods are used the 13 week summary will be the nearest interval of greater duration. Calendar quarters are sele... to AEC and state recording requirements considering starting date and length of monitoring periods chosen. Total and cumulative skin dose values given are the sum of both the lo... the high penetrating radiation. (Thus they will be the sum of all previous skin dose plus total body exposures listed). To aid in proper presentation of information for recore... other regulatory bodies, amendments to the cumulative totals (columns 15, 16 and 17) may have been made increasing or decreasing the totals from those originally reported. Su... the request of an authorized representative of the client and are only to reflect supplementary data demonstrating that the film badge exposure originally occurred in such a mar... understate the true dosage to the badge assignee. (Refer to adjustment column). Addition of previous exposure prior to commencement of use of the particular film badge ... reflected in the cumulative totals. Reporting is ordinarily in net exposure and the control film reading is deducted from the personnel film reading. But if the control appears to ... from the personnel packets the densities are normalized to our controls only and a non minimal control reading reported. A control packet reading is given in arbitrary units not necessarily ... x-ray skin dose readings are unreported until after a positive skin dose exposure is recorded. Ring badges are calibrated for high energy gamma and high energy beta only, unle... been made. If ring badges are exposed to other radiation the value may not be dosage in millirems and may require further interpretation.

THYROID DATA - (MICROCURIES I-131 IN THYROID)
1965 - SUBSEQUENT TO 11-24-65

(1965) Date	[redacted]												
F 12/3	0.322	0.611	0.322	0.252	0.355	0.292	0.217	0.307	0.23		0.41	0.096	0.158
M 12/6	0.216	0.396	0.199	0.207	*	0.234	0.135	0.310	0.30		0.336	*	0.141
Tu 12/7	0.28	0.30	0.15	0.22	0.28	*	0.140	0.24	0.31		0.40	*	0.14
W 12/8	0.26	0.35	0.16	0.23	0.190	0.23	0.18	0.32	0.32		0.38	0.13	*
Th 12/9	0.29	0.43	0.135	0.19	0.22	*	0.20	0.21	0.31		0.51	0.11	*
F 12/10	0.23	0.26	0.12	0.18	0.17	0.20	0.14	0.17	0.31		0.35	0.04	*
M 12/13	0.18	0.31	0.12	0.09	*	0.19	0.11	*	0.141		0.26	*	*
Tu 12/14	0.23	0.36	0.10	0.09	0.12	0.15	0.11	0.17	0.141		0.22	*	0.04
W 12/15	0.21	0.51	0.09	*	0.12	0.16	0.16	0.17	0.142		0.40	*	*
Th 12/16	0.25	0.43	0.12	0.12	0.18	*	0.13	*	0.140		0.41	*	*
F 12/17	*	0.41	0.05	0.07	0.15	0.135	0.12	*	0.141		0.35	*	*
Tu 12/21	0.13	0.43	0.06	0.10	0.60	0.19	0.07	0.49	0.078		0.38	*	*
W 12/22	0.094	0.18	0.061	*	*	*	*	*	0.078		0.414	*	*
Tu 12/28	0.067	0.104	0.032	0.075	0.074	0.043	0.065	0.14	0.020		0.194	*	*
W 12/29	0.072	0.196	0.032	0.061	0.057	0.055	0.050	*	0.024		0.597	*	*
Th 12/30	0.481	0.166	0.028	0.043	0.057	0.079	0.070	0.201	0.022		0.494	0.050	*
F 12/31	0.466	0.192	0.035	0.061	0.061	0.102	0.079	0.127	*		0.498	*	*

--Terminated Prior to 12-3-66--

* No Data Reported

EXHIBIT "E"

Quarter Starting_____ Name_____

Week No.	Dosimeter		Whole Body		Skin		Extremities		Thyroid	
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										

EXHIBIT "F-1"

MCW-NUC-14304-3/66

Week Starting_____ Week Number_____

Name	Dosimeter		Whole Body		Skin		Extremities		Thyroid	
EXHIBIT "F-2"										

MCW-NUC-14303-3/65

1st Quarter - 1966
Personnel Exposure Date

KEY: Dosimeter; 1.0=231 mr. Skin; 1.0=577 mrem.
Whole Body; 1.0=231 mrem. Extremities; 1.0=1440 mrem.
Thyroid; 1.0=0.14 microcuries (ave. results of between 2 and 5 thyroid counts per week)

✓ Name: [redacted]

Week of	Week Number	Dosimeter	F.B. Whole Body	F.B. Skin	Wrist F.B. Extremities	Weekly Average Thyroid
(1-3)	1	*	*	*	*	*
(1-10)	2	*	*	*	*	*
(1-17)	3	.06	.34	*	*	*
(1-24)	4	.82	.28	*	*	.13
(1-31)	5	.95	1.27	*	.30	.33
(2-7)	6	.88	.91	0	.45	.43
(2-14)	7	.90	.46	0	.13	.64
(2-21)	8	1.72	2.03	0	.74	1.26=(0.176 μc)
(2-28)	9	1.65	1.82	0	.76	1.57=(0.220 μc)
(3-7)	10	2.95	2.86	0	.18	2.36=(0.330 μc)
(3-14)	11	2.17	1.88	0	1.04	2.75=(0.385 μc)
(3-21)	12	.10	.32	0	.02	1.65=(0.231 μc)
(3-28)	13	*	.45	0	.07	.87
Totals -		12.20	12.62	0	3.69	--
Totals (rem)		(2.82)	(2.92)	(0)	(5.31)	--

Name: [redacted]

	1	1.08	1.31	*	2.03	.27
	2	1.19	1.31	*	1.00	.01
	3	1.09	1.05	*	1.73	.03
	4	1.86	.95	*	3.01	.10
	5	.45	.45	*	.18	.29
	6	1.02	1.12	0	.71	.16
	7	.42	1.03	0	1.48	.13
	8	1.58	.95	0	.83	.35
	9	1.00	.97	0	.12	.16
	10	1.42	1.25	0	.69	.07
	11	.70	.50	0	.15	.18
	12	.78	1.17	0	.08	.13
	13	--	.65	0	.45	.09
Totals -		11.78	12.71	0	12.46	--
Totals (rem)		(2.74)	(2.96)	0	(17.94)	--

Name: [redacted]

	1	.93	.77	*	.23	.26
	2	1.10	.69	*	.22	.34
	3	.84	.76	*	.14	.41
	4	.88	.66	*	.15	.21
	5	.68	.61	*	.12	.15
	6	.74	1.12	.45	.38	.22
	7	.52	.78	.45	.21	.40
	8	.72	1.04	.29	.71	.29
	9	.76	.71	0	.16	.60
	10	1.23	.78	0	.20	.39
	11	.68	.85	0	.20	.36
	12	.80	.84	0	.20	.30
	13	*	.87	0	.25	.11
Totals -		9.88	10.48	1.19	3.17	--
Totals (rem)		(2.28)	(2.42)	(0.69)	(4.56)	--

*No data reported

EXHIBIT "G"

√ Name: [redacted]

Week of	Week Number	Dosimeter	F.B. Whole Body	F.B. Skin	Wrist F.B. Extremities	Weekly Average Thyroid
(1-3)	1	.06	.11	*	.03	.45
(1-10)	2	.66	.06	*	.14	.44
(1-17)	3	.82	.56	*	.13	.43
(1-24)	4	.62	.34	*	.18	.35
(1-31)	5	.68	.71	*	.16	.56
(2-7)	6	.83	.73	.45	.38	.52
(2-14)	7	.61	.43	.45	.17	.61
(2-21)	8	.89	.87	.13	.26	.65
(2-28)	9	.69	.45	0	.09	1.12=(0.157 μc)
(3-7)	10	.76	1.06	.69	.52	1.91=(0.267 μc)
(3-14)	11	.50	.48	0	.15	2.26=(0.316 μc)
(3-21)	12	.67	.78	0	.19	1.64=(0.230 μc)
(3-28)	13	*	.91	0	.24	1.31=(0.183 μc)
Totals -		7.79	7.49	1.72	2.64	--
Totals (rem)		(1.80)	(1.73)	(0.99)	(3.80)	--

√ Name: [redacted]

1	.60	.64	*	.90	2.24=(0.314 μc)
2	1.02	1.16	*	.49	1.74=(0.244 μc)
3	.88	.68	*	.47	1.37=(0.192 μc)
4	.71	.75	*	.19	.94
5	.65	.68	*	.25	.68
6	1.03	1.22	1.04	1.16	.54
7	1.00	.87	1.04	.59	.45
8	1.10	1.27	.47	2.22	1.50=(0.210 μc)
9	.61	.45	0	.36	.99
10	1.02	1.17	.80	.80	.90
11	.65	.89	0	.51	.66
12	.89	1.62	0	.35	.35
13	*	.87	0	.50	.10
Totals -	10.16	12.27	3.35	8.79	--
Totals (rem)	(2.35)	(2.83)	(1.93)	(12.66)	

En 6

√ Name: [redacted]

1	1.17	1.18	*	.93	2.20=(0.308 μc)
2	1.13	.69	*	.38	1.17=(0.164 μc)
3	1.05	.90	*	.79	1.49=(0.209 μc)
4	1.00	.76	*	.36	1.09=(0.153 μc)
5	.85	.83	*	.30	.83
6	.64	.76	.40	.45	1.40=(0.196 μc)
7	.87	.87	.40	.55	2.02=(0.283 μc)
8	1.43	1.51	.16	.63	1.24=(0.174 μc)
9	.16	.08	0	.02	.92
10	.13	.22	0	.05	.27
11	.11	.35	0	.13	.13
12	0	.48	0	.08	.04
13	*	.56	0	.11	.04
Totals -	8.54	9.19	0.96	4.78	--
Totals (rem)	(1.97)	(2.12)	(0.55)	(6.88)	--

Name: [redacted]

Week of	Week Number	Dosimeter	F.B. Whole Body	F.B. Skin	Wrist F.B. Extremities	Weekly Average Thyroid
(1-3)	1	*	*	*	*	*
(1-10)	2	*	*	*	*	*
(1-17)	3	1.25	1.05	*	.90	0
(1-24)	4	.64	.52	*	.12	.01
(1-31)	5	.89	1.02	*	.40	.50
(2-7)	6	1.39	1.50	1.39	.77	.47
(2-14)	7	1.80	.69	1.39	.37	.59
(2-21)	8	1.42	2.47	1.44	1.72	.42
(2-28)	9	1.49	1.00	0	.20	.20
(3-7)	10	1.58	.87	0	.13	.33
(3-14)	11	.98	.45	0	.26	.63
(3-21)	12	1.51	.99	0	.30	.55
(3-28)	13	*	.67	0	1.02	.40
Totals -		12.95	11.23	4.22	6.19	--
Totals (rem)		(2.99)	(2.59)	(2.43)	(8.91)	--

Name: [redacted]

	1	*	*	*	*	*
	2	*	*	*	*	*
	3	*	*	*	*	*
	4	*	*	*	*	*
	5	*	*	*	*	*
	6	*	*	*	*	*
	7	.35	.35	1.28	*	.14
	8	1.25	1.43	1.28	.59	.06
	9	1.41	.84	0	.20	.32
	10	.89	1.06	0	.35	.28
	11	1.54	.71	0	.42	.37
	12	2.42	2.23	0	1.32	.40
	13	*	1.27	0	.96	.31
Totals -		7.86	7.89	3.84	3.84	--
Totals (rem)		(1.82)	(1.82)	(2.22)	(5.53)	--

EN 6

Name: [redacted]

	1	*	*	*	*	*
	2	*	*	*	*	*
	3	*	*	*	*	*
	4	*	*	*	*	*
	5	*	*	*	*	*
	6	*	*	*	*	*
	7	*	*	*	*	*
	8	*	*	*	*	*
	9	*	*	*	*	*
	10	*	.13	0	*	*
	11	*	.55	0	*	*
	12	*	.65	0	*	.05
	13	*	.78	0	*	.07
Totals -		--	2.11	0	--	--
Totals (rem)		--	(0.49)	0	--	--

Name: [redacted]

Week of	Week Number	Dosimeter	F.B. Whole Body	F.B. Skin	Wrist F.B. Extremities	Weekly Average Thyroid
(1-3)	1	1.02	0.43	*	.58	1.53 (0.214 uc)
(1-10)	2	1.47	.69	*	.44	.68
(1-17)	3	2.06	.39	*	.14	.66
(1-24)	4	1.03	.74	*	.89	.42
(1-31)	5	.75	.4	*	.49	.34
(2-7)	6	1.15	1.12	1.08	2.45	.91
(2-14)	7	.92	.65	1.08	.84	.73
(2-21)	8	1.21	1.17	.66	1.52	.44
(2-28)	9	.88	.91	0	.21	.62
(3-7)	10	1.22	.78	0	.37	.70
(3-14)	11	1.49	.87	0	.46	.83
(3-21)	12	.82	1.58	0	1.04	.74
(3-28)	13	*	1.19	0	1.20	.53
Totals -		14.02	10.97	2.82	10.63	--
Totals (rem)		(3.24)	(2.53)	(1.63)	(15.31)	--

Name: [redacted]

	1	.79	.90	*	.07	.06
	2	.62	.13	*	0	.06
	3	.57	.32	*	.01	.06
	4	.61	.06	*	0	.05
	5	.74	.95	*	0	.06
	6	.89	.50	.09	.01	.06
	7	.29	.49	.09	.01	.06
	8	.63	.28	.13	.03	.06
	9	.74	.71	0	.03	.28
	10	.70	.32	.21	.03	.65
	11	.65	.32	0	.01	.14
	12	*	.54	0	.05	.31
	13	*	.12	0	.03	.11
Totals -		7.23	5.64	0.52	0.28	--
Totals (rem)		(1.67)	(1.30)	(0.30)	(0.40)	--

Ex 6

Name: [redacted]

	1	*	*	*	*	*
	2	*	*	*	*	*
	3	*	*	*	*	*
	4	*	*	*	*	*
	5	*	*	*	*	*
	6	*	*	*	*	*
	7	*	*	*	*	*
	8	*	.96	0	*	*
	9	*	.97	0	*	.28
	10	*	.79	0	*	0
	11	*	.91	0	*	.03
	12	*	.37	0	*	.06
	13	*	1.17	0	*	0
Totals -		--	5.17	0	--	--
Totals (rem)		--	(1.19)	0	--	--

Name: [redacted]

Week of	Week Number	Dosimeter	F.B. Whole Body	F.B. Skin	Wrist F.B. Extremities	Weekly Average Thyroid
(1-3)	1	.18	.61	*	.16	.08
(1-10)	2	1.58	1.87	*	1.01	.09
(1-17)	3	.35	.69	*	.04	.39
(1-24)	4	.07	.19	*	.04	.13
(1-31)	5	.55	.26	*	.05	.13
(2-7)	6	1.02	.27	0	.14	.29
(2-14)	7	3.09	.83	0	.24	.21
(2-21)	8	.46	.56	.36	.26	.29
(2-28)	9	.21	.21	0	.03	.35
(3-7)	10	.25	1.21	0	.22	.44
(3-14)	11	.69	.94	0	.40	.24
(3-21)	12	.71	.39	0	.08	.69
(3-28)	13	*	.21	0	.07	.28
Totals -		9.16	9.24	0.36	2.74	--
Totals (rem)		(2.12)	(2.13)	(0.21)	(3.95)	--

Name: [redacted]

	1	.74	.68	*	.14	.54
	2	1.18	.39	*	.22	.58
	3	.22	.09	*	.01	.57
	4	1.08	.62	*	.06	.19
	5	.83	.71	*	.11	.29
	6	1.12	1.18	1.30	.29	.28
	7	.99	.62	1.30	.14	.42
	8	.88	1.12	1.18	.25	.32
	9	.77	.37	0	.15	.37
	10	.60	.22	0	.46	.24
	11	1.24	.39	0	.06	.31
	12	.90	1.12	0	.08	.20
	13	*	.37	0	.13	.12
Totals -		10.55	7.88	3.78	2.10	--
Totals (rem)		(2.44)	(1.82)	(2.18)	(3.02)	

Em 6

Name: [redacted]

	1	.78	.83	*	.29	.28
	2	.93	.26	*	.19	.50
	3	1.21	.52	*	.16	.56
	4	.81	.47	*	.13	.54
	5	.36	.47	*	.08	.59
	6	.86	.56	.45	.27	.38
	7	.72	.53	.45	.19	.75
	8	.89	.73	.34	.43	.80
	9	.87	2.16	0	.32	1.00 (0.140 μc)
	10	.74	.56	.55	.14	.99
	11	.80	.63	.24	.58	.60
	12	1.00	1.04	0	.11	.38
	13	*	.39	0	.10	.41
Totals -		9.97	9.15	2.03	2.99	--
Totals (rem)		(2.30)	(2.11)	(1.17)	(4.31)	--

2nd Quarter - 1966
Personnel Exposure Data

KEY: Dosimeter; 1.0=231 mr. Skin; 1.0=577 mrem.
Whole Body; 1.0=231 mrem. Extremities; 1.0=1440 mrem.
Thyroid; 1.0=0.14 microcuries (ave. results of between 2 and 5 thyroid counts per week)

Name: [redacted]

Week of	Week Number	Dosimeter	F.B. Whole Body	F.B. Skin	Wrist F.B. Extremities	Weekly Average Thyroid
(4-4)	1	*	*	*	*	*
(4-11)	2	*	*	*	*	*
(4-18)	3	*	*	*	*	*
(4-25)	4	*	*	*	*	*
(5-2)	5	*	*	*	*	*
(5-9)	6	*	*	*	*	*
(5-16)	7	.29	.56	*	.08	.07
(5-23)	8	.79	.61	*	.09	.06
Totals -		1.08	1.17		.17	--

Name: [redacted]

	1	*	*	*	*	*
	2	*	*	*	*	*
	3	*	*	*	*	*
	4	*	*	*	*	*
	5	*	*	*	*	*
	6	*	.43	*	.16	.47
	7	.38	.87	*	.14	1.75=(0.245 uc)
	8	.92	1.08	*	.83	.82
Totals -		1.31	2.38		1.13	--

Name: [redacted]

	1	*	*	*	*	*
	2	*	1.56	*	*	.01
	3	*	.24	*	.02	.01
	4	*	1.00	*	.46	.77
	5	*	1.14	*	.42	.89
	6	*	.76	*	.21	.50
	7	.54	.68	*	.15	.51
	8	.62	.56	*	.11	.32
Totals -		1.16	5.94		1.17	--

Ex 6

Name: [redacted]

	1	*	*	*	*	*
	2	*	.22	*	*	*
	3	*	.65	*	*	*
	4	*	.16	*	*	*
	5	*	.78	*	*	*
	6	*	.22	*	*	*
	7	*	.45	*	*	.27
	8	*	.48	*	*	.13
Totals -			2.96			--

*No data reported

EXHIBIT "H"

Name: [redacted]

Week of	Week Number	Dosimeter	F.B. Whole Body	F.B. Skin	Wrist F.B. Extremities	Weekly Average Thyroid	
(4-4)	1	*	.69	*	*	.38	
(4-11)	2	*	.69	*	*	.38	
(4-18)	3	*	.41	*	*	.30	
(4-25)	4	*	.65	*	*	.69	
(5-2)	5	*	.97	*	*	.35	
(5-9)	6	*	.79	*	*	.71	
(5-16)	7	.43	.48	*	*	.60	
(5-23)	8	.10	.87	*	.34	.33	
Totals -		.53	5.75		.34	--	
Name: [redacted]							
	1	*	1.41	*	.21	.09	
	2	*	1.30	*	.26	0	
	3	.69	1.17	*	.10	.74	
	4	1.13	1.12	*	.19	.70	
	5	1.11	1.10	*	.19	.74	
	6	1.05	1.41	*	.21	.51	
	7	.86	.95	*	.16	.55	
	8	.57	.74	*	.17	.41	
Totals -		5.46	9.20		1.49	--	
Name: [redacted]							
	1	*	.87	*	.20	*	
	2	*	.79	*	*	*	
	3	*	1.02	*	.05	*	
	4	*	.93	*	.07	*	
	5	*	.93	*	.03	*	Ex 6
	6	*	.95	*	.04	.29	
	7	*	.92	*	.03	.18	
	8	*	.43	*	.05	.10	
Totals -			6.84		.27	--	
Name: [redacted]							
	1	2.47	1.36	*	.98	.88	
	2	2.62	1.49	*	.42	.49	
	3	1.99	.87	*	.87	.37	
	4	1.15	1.00	*	.45	.71	
	5	2.36	1.41	*	.78	.50	
	6	1.48	.78	*	.09	.44	
	7	1.16	.90	*	.62	.30	
	8	.81	1.12	*	.36	.62	
Totals -		14.04	8.93		4.57	--	
Name: [redacted]							
	1	.35	.39	*	.07	.54	
	2	.37	.48	*	.08	.44	
	3	1.42	1.06	*	.66	.62	
	4	.55	.56	*	.12	.67	
	5	1.20	.97	*	.48	.33	
	6.	1.70	1.95	*	.98	.61	
	7	.82	1.08	*	.17	1.59=(0.223 uc)	
	8	1.66	1.30	*	.39	.99	
Totals		8.07	7.79		2.95		

Name: [redacted]

Week of	Week Number	Dosimeter	F.B. Whole Body	F.B. Skin	Wrist F.B. Extremities	Weekly Average Thyroid
(4-4)	1	1.60	.87	*	.30	.38
(4-11)	2	2.00	1.19	*	.43	.21
(4-18)	3	2.15	1.54	*	.69	.42
(4-25)	4	.59	.87	*	.21	.32
(5-2)	5	2.59	1.87	*	1.63	.76
(5-9)	6	1.28	1.06	*	.69	.93
(5-16)	7	.47	*	*	*	.48
(5-23)	8	*	*	*	*	*
Totals		10.68	7.51		3.95	--
Name: [redacted]						
	1	.63	1.10	*	.03	.08
	2	.78	.94	*	.03	.08
	3	.68	1.56	*	.20	.08
	4	.60	1.48	*	.18	.34
	5	.62	.48	*	.06	1.35=(0.189 uc)
	6	.45	1.82	*	.20	.62
	7	.84	1.41	*	.18	.45
	8	.15	.47	*	.08	.26
Totals		4.75	9.26		.96	--
Name: [redacted]						
	1	.79	.85	*	.21	.90
	2	.89	.82	*	.24	1.38=(0.193 uc)
	3	.29	.62	*	.11	1.23=(0.172 uc)
	4	.58	.56	*	.11	1.13=(0.158 uc)
	5	.12	.29	*	.08	1.43=(0.200 uc)
	6	.46	.74	*	.14	1.00=(0.140 uc)
	7	.57	.69	*	.14	1.30=(0.182 uc)
	8	.65	.87	*	.24	.96
Totals		4.35	5.44		1.27	--
Name: [redacted]						
	1	1.06	1.06	*	.59	.11
	2	.91	1.06	*	.69	.03
	3	.98	.87	*	.16	.18
	4	.70	1.62	*	.50	.28
	5	.98	1.30	*	.89	.82
	6	1.07	1.34	*	1.02	.36
	7	1.18	2.24	*	.64	.51
	8	.54	.75	*	.45	.50
Totals		7.42	10.24		4.94	--
Name: [redacted]						
	1	.87	.84	*	.58	.26
	2	1.02	.95	*	.62	1.05=)0.147 uc)
	3	.30	.9[illegible]	*	.39	.76
	4	1.57	1.38	*	.69	1.27=(0.178 uc)
	5		.95	*	.24	1.23=(0.172 uc)
	6		.75	*	.24	.83
	7	1.[illegible]	1.52	*	.55	.82
	8	.6[illegible]	.95	*	.47	.77
Totals -		7.1.	8.25		3.78	

Ex 6

Name: [redacted]

Week of	Week Number	Dosimeter	F.B. Whole Body	F.B. Skin	Wrist F.B. Extremities	Weekly Average Thyroid
(4-4)	1	.63	1.21	*	.60	.40
(4-11)	2	.63	.74	*	.34	.32
(4-18)	3	1.15	1.17	*	.33	.58
(4-25)	4	.24	1.00	*	.26	.64
(5-2)	5	1.03	1.41	*	.55	.89
(5-9)	6	1.43	.87	*	.42	.64
(5-16)	7	*	.98	*	.24	.51
(5-23)	8	*	.52	*	.53	.62
Totals -		5.11	7.90		3.27	--
Name: [redacted]						
	1	1.82	.65	*	.98	.54
	2	1.43	1.02	*	.65	.28
	3	1.40	1.22	*	.35	.60
	4	1.05	1.00	*	.21	.66
	5	1.26	1.52	*	.78	.84
	6	1.84	.87	*	.47	.71
	7	0	0	*	0	.60
	8	.92	1.12	*	.25	.28
Totals -		9.72	7.40		3.69	--
Name: [redacted]						
	1	1.22	.82	*	.13	.19
	2	.86	.43	*	.13	.18
	3	1.33	.69	*	.13	.42
	4	.84	.61	*	.18	.67
	5	1.41	.62	*	.08	1.07=(0.150 uc)
	6	.56	.53	*	.14	.71
	7	.83	.65	*	.14	.66
	8	1.18	1.14	*	.26	.48
Totals		8.23	5.49		1.19	--
Name: [redacted]						
	1	.95	.91	*	.19	.12
	2	1.12	.84	*	.17	.18
	3	.91	.98	*	.24	.31
	4	.70	.76	*	.28	.38
	5	.91	.91	*	.26	.75
	6	.85	.87	*	.26	.57
	7	.71	1.02	*	.26	.54
	8	.61	.81	*	.20	.35
Totals -		6.76	7.10		1.86	--
Name: [redacted]						
	1	*	.31	*	.12	.36
	2	*	.82	*	.20	.18
	3	*	.74	*	.45	.33
	4	*	.45	*	.18	.46
	5	*	.43	*	.11	.79
	6	*	.33	*	.16	.41
	7	*	*	*	*	.44
	8	*	1.75	*	.60	.88
Totals -			4.83		1.82	--

Name: [redacted]

Week of	Week Number	Dosimeter	F.B. Whole Body	F.B. Skin	Wrist F.B. Extremities	Weekly Average Thyroid
(4-4)	1	1.12	.77	*	.11	.70
(4-11)	2	1.14	.83	*	.23	.46
(4-18)	3	.85	.71	*	.17	.62
(4-25)	4	.72	.42	*	.11	1.07=(0.150 uc)
(5-2)	5	.30	.56	*	.04	1.04=(0.146 uc)
(5-9)	6	.33	1.03	.43	.05	.74
(5-16)	7	.25	.72	*	.20	.59
(5-23)[1/]	8	*	.33[1/]	*	.13	.46
Total		4.71	5.37	.43	1.04	--

[1/] Beginning week of 5-23-66, 1.0=200 millirem for remainder of 1966. "Bank" balance is depleted.

ED 6

NUCLEAR CONSULTANTS CORPORATION

BOX 6172, LAMBERT FIELD • ST. LOUIS, MISSOURI 63145 • 314 PErshing 9-8927

LABORATORIES IN ST. LOUIS,
LOS ANGELES AND CLEVELAND
OFFICES IN MAJOR CITIES

June 27, 1966

Mr. Edgar C. Ashley
Region III
Division of Compliance
U. S. Atomic Energy Commission
Oakbrook Professional Building
Oakbrook, Illinois

Dear Mr. Ashley:

Thank you for your patience in waiting for the urinalysis data which is enclosed. The task of calibrating our instrumentation was more tedious than I had expected in that the calibrations had to be performed during periods when the machine was not in use for other health physics work. The data has not as yet been transferred to the typewritten Individual Summary sheets but is in a Monthly Summary form.

I have also enclosed photocopies of our urinalysis procedures and calibration factors to assist you in evaluating the results. The Urinalysis Work Sheets for the month of January are also included. I have no data for the month of December in that I had not yet established the urinalysis program.

If there is any additional information you require, please contact me.

Sincerely yours,

NUCLEAR CONSULTANTS
DIVISION MALLINCKRODT CHEMICAL WORKS

Don Soldan

Donald W. Soldan, Manager
Health Physics Department

DWS:HS
Enclosures

EXHIBIT "I"

NUCLEAR CONSULTANTS
DIVISION MALLINCKRODT CHEMICAL WORKS

FRACTIONAL PERMISSIBLE BODY BURDEN

June, 1966
(Month, Year)

NAME	Au-198	Mo-99	P-32		TOTAL
[redacted]	.03(1)	.29(1)	0(6)		.09
	0(1)	0(1)			0
	.06(1)	.11(1)			.17
	.01(1)	0(1)			.01
	.25(1)	0(1)			.25
	.65(1)	.06(1)			.71
	0(1)	0(1)			0
	.05(1)	.06(1)			.11
	.39(1)	.11(1)	.27(6)		.77
	.52(1)	.11(1)			.63
	.05(1)	.17(1)			.22
	.09(1)	0(1)			.09
	.06(1)	0(1)			.06
	.23(1)	.11(1)	.32(6)		.66
	.01(1)	.23(1)			.24
	0(1)	.06(1)			.06
	.03(1)	.34(1)			.37
	.15(1)	0(1)			.15
	.04(1)	.06(1)			.10

Analysis Method:
(1) Gross Gamma (all energies > 10 Kev)
(2) Gross Gamma (all energies > 660 Kev)
(3) Gross Gamma (all energies > 1 mev)
(4) Specific Gamma (single channel analyzer)
(5) Gross Beta (including K-40)
(6) Specific Beta (chemical separation)

Reviewed by: D W Soldan

NUCLEAR CONSULTANTS
DIVISION MALLINCKRODT CHEMICAL WORKS

FRACTIONAL PERMISSIBLE BODY BURDEN

June, 1966
(Month, Year)

NAME	Au-198	Fe-59			TOTAL
[redacted]	0 (1)	.23 (1)			.23
	.04 (1)	0 (1)			.04
	.02 (1)	.06 (1)			.08
	0 (1)	.34 (1)			.34
	.01 (1)	.40 (1)			.41
	.03 (1)	.23 (1)			.26
	.01 (1)	0 (1)			.01
	0 (1)	.06 (1)			.06
	.01 (1)	0 (1)			.01
	.01 (1)	0 (1)			.01
	.02 (1)	0 (1)			.02
	.01 (1)	.11 (1)			.12
	.02 (1)	0 (1)			.02

Analysis Method:

(1) Gross Gamma (all energies > 10 Kev)
(2) Gross Gamma (all energies > 650 Kev)
(3) Gross Gamma (all energies > 1 mev)
(4) Specific Gamma (single channel analyzer)
(5) Gross Beta (including K-40)
(6) Specific Beta (chemical separation)

Reviewed by:

D W Soldan

NUCLEAR CONSULTANTS
DIVISION MALLINCKRODT CHEMICAL WORKS

FRACTIONAL PERMISSIBLE BODY BURDEN

May, 1966
(Month, Year)

NAME	Au-198	Fe-59	P-32		TOTAL	
[redacted]	.12(1)	0(2)			.12	
	.06(1)	.06(2)			.12	
	.14(1)	0(2)	.13(6)		.14	
	.30(1)	0(2)			.30	
	.42(1)	.11(2)			.53	
	.05(1)	.29(2)			.34	
	.10(1)	.11(2)	.26(6)		.47	
	.25(1)	0(2)			.25	
	.07(1)	.17(2)			.24	Ex
	.13(1)	.11(2)			.24	
	.07(1)	0(2)			.07	
	.25(1)	0(2)	.06(6)		.31	
	.06(1)	.23(2)			.29	
	.06(1)	0(2)			.06	
	.12(1)	.11(2)			.23	
	.18(1)	0(2)			.18	
	.13(1)	0(2)			.13	
	.09(1)	.23(2)			.33	
	.11(1)	.23(2)			.34	

Analysis Method:
(1) Gross Gamma (all energies > 10 Kev)
(2) Gross Gamma (all energies > 660 Kev)
(3) Gross Gamma (all energies > 1 mev)
(4) Specific Gamma (single channel analyzer)
(5) Gross Beta (including K-40)
(6) Specific Beta (chemical separation)

Reviewed by:
DW Seldon

NUCLEAR CONSULTANTS
DIVISION MALLINCKRODT CHEMICAL WORKS

FRACTIONAL PERMISSIBLE BODY BURDEN

April, 1966
(Month, Year)

NAME	Au-198	Fe-59	P-32		TOTAL	
[redacted]	0(1)	.38(2)			.38	
	0(1)	.14(2)			.14	
	.08(1)	.22(2)			.30	
	.27(1)	0 (2)			.27	
	0(1)	0 (2)			0	
	.49(1)	0 (2)			.49	
	.15(1)	0 (2)	.14-(6)		.15	
	.10(1)	0 (2)			.10	
	.05(1)	.30(2)			.35	Ext
	.17(1)	.02(2)			.19	
	.08(1)	0 (2)			.08	
	.29(1)	0 (2)			.29	
	0(1)	.02(2)			.02	
	.02(1)	.21(2)			.23	
	.23(1)	.14(2)			.37	
	.10(1)	0(2)			.10	
	.25(1)	0(2)			.25	

Analysis Method:

(1) Gross Gamma (all energies > 10 Kev)
(2) Gross Gamma (all energies > 650 Kev)
(3) Gross Gamma (all energies > 1 mev)
(4) Specific Gamma (single channel analyzer)
(5) Gross Beta (including K-40)
(6) Specific Beta (chemical separation)

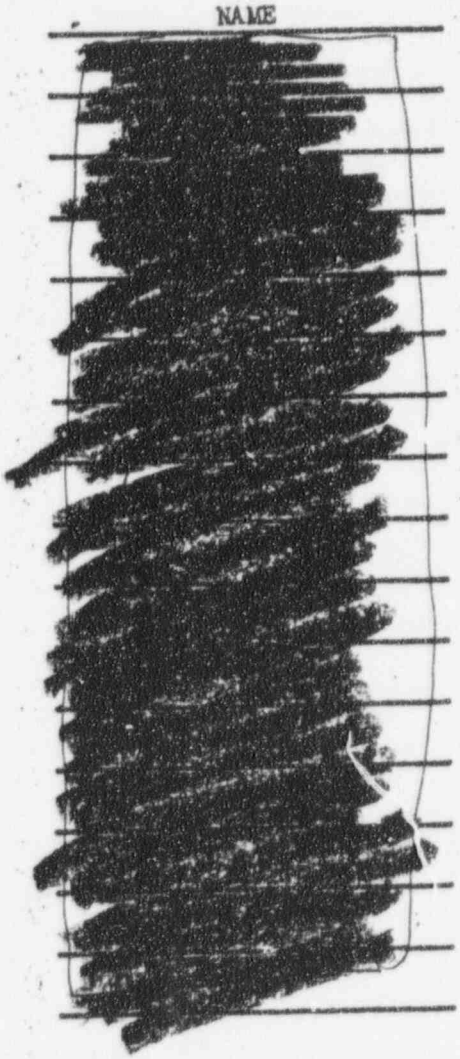
Reviewed by:

D W Soldan

NUCLEAR CONSULTANTS
DIVISION MALLINCKRODT CHEMICAL WORKS

FRACTIONAL PERMISSIBLE BODY BURDEN

March, 1966
(Month, Year)



NAME	Au-198	Fe-59	P-32		TOTAL	
	.12(1)	0(2)			.12	
	.17(1)	.11(2)			.28	
	0 (1)	.33(2)			.33	
	.22(1)	0 (2)			.22	
	.43(1)	0 (2)			.43	
	.66(1)	0 (2)	.08(6)		~~.66~~ .74	
	.36(1)	.32(2)			.68	
	.04(1)	0(2)			.04	
	.06(1)	.23(2)			.29	
	.17(1)	0 (2)	.01(6)		.18	Ex 6
	0 (1)	0 (2)			0	
	0 (1)	~~.21~~ .41 (2)			.41	
	.07(1)	.09(2)			.16	
	.10(1)	0 (2)			.10	
	.56(1)	0 (2)			.56	

Analysis Method:
(1) Gross Gamma (all energies > 10 Kev)
(2) Gross Gamma (all energies > 650 Kev)
(3) Gross Gamma (all energies > 1 mev)
(4) Specific Gamma (single channel analyzer)
(5) Gross Beta (including K-40)
(6) Specific Beta (chemical separation)

Reviewed by:
D W Soelter

NUCLEAR CONSULTANTS
DIVISION MALLINCKRODT CHEMICAL WORKS

FRACTIONAL PERMISSIBLE BODY BURDEN

February, 1966
(Month, Year)

NAME	Au-198	Fe-59	I-131	P-32	TOTAL
[redacted]	0 (1)	.35 (2)			.35
	0 (1)	.07 (2)			.07
	.14 (1)	0 (2)			.14
	.03 (1)	0 (2)			.03
	.15 (1)	.08 (2)			.23
	.25 (1)	.31 (2)		.03 (6)	.59
	.42 (1)	0 (2)			.42
	.27 (1)	0 (2)			.27
		.22 (2)	.21 (4)		.43
	0 (1)	.35 (2)			.35
	0 (1)	.13 (2)			.13
	0 (1)	0 (2)			0
	.06 (1)	0 (2)			.06
	—	—			
	0 (1)	0 (2)			0
	0 (1)	.34 (2)			.34
	.04 (1)	.34 (2)			.36
	~~.07~~ (1)	0 (2)			0
	.07 (1)	.10 (2)			.17

Ex6

Analysis Method:
(1) Gross Gamma (all energies > 10 Kev)
(2) Gross Gamma (all energies > 650 Kev)
(3) Gross Gamma (all energies > 1 mev)
(4) Specific Gamma (single channel analyzer)
(5) Gross Beta (including K-40)
(6) Specific Beta (chemical separation)

Reviewed by:
D W Soldan

NUCLEAR CONSULTANTS
DIVISION MALLINCKRODT CHEMICAL WORKS

FRACTIONAL PERMISSIBLE BODY BURDEN

February 1966
(Month, Year)

NAME	Au-198	Fe-59				TOTAL
[redacted]	0 (1)	0 (2)				0
	.25 (1)	0 (2)				.25
	0 (1)	.19 (2)				.19
	0 (1)	.32 (2)				.32
	.41 (1)	0 (2)				.41

Exb

Analysis Method:
(1) Gross Gamma (all energies > 10 Kev)
(2) Gross Gamma (all energies > 650 Kev)
(3) Gross Gamma (all energies > 1 mev)
(4) Specific Gamma (single channel analyzer)
(5) Gross Beta (including K-40)
(6) Specific Beta (chemical separation)

Reviewed by:

DW Seldon

NUCLEAR CONSULTANTS
DIVISION MALLINCKRODT CHEMICAL WORKS

FRACTIONAL PERMISSIBLE BODY BURDEN

January, 1966
(Month, Year)

NAME	Au-198	Fe-59 ~~Mo-99~~	I-131	P-32	TOTAL
[redacted]	0 (1)	.24 (2)			.24
	0 (1)	0 (2)			0
	.07 (1)	.02 (2)			.09
	.48 (1)	~~.34~~ .38 (2)			.48
	~~.04~~ .31 (1)	.22 (2)			.53
	.25 (1)	.12 (2)			.36
	.87 (1)	~~.78~~ .08 (2)			.95
	.33 (1)	0 (2)			.33
		0 (2)	.07 (4)	0 (6)	.07
	.68 (1)	0 (2)			.68
	.86 (1)	0 (2)			.86
	.19 (1)	.10 (2)			.29
	.06 (1)	0 (2)			.06
	.07 (1)	0 (2)			.07
	.05 (1)	0 (2)			.05
	.23 (1)	.29 (2)			.52
	.34 (1)	.11 (2)			.45
	.04 (1)	0 (2)			.04
	.10 (1)	.04 (2)			.14

Ex 6

Analysis Method:
(1) Gross Gamma (all energies > 10 Kev)
(2) Gross Gamma (all energies > 650 Kev)
(3) Gross Gamma (all energies > 1 mev)
(4) Specific Gamma (single channel analyzer)
(5) Gross Beta (including K-40)
(6) Specific Beta (chemical separation)

Reviewed by:

D W Goldan

NUCLEAR CONSULTANTS
DIVISION MALLINCKRODT CHEMICAL WORKS

FRACTIONAL PERMISSIBLE BODY BURDEN

January, 1966
(Month, Year)

NAME	Au-198	Mo-99	I-131	P-32	TOTAL
[redacted]	.05 (1)	0 (2)			.05
	.17 (1)	0 (2)			.17
	0 (1)	0 (2)			0

Ex b

Analysis Method:
(1) Gross Gamma (all energies > 10 Kev)
(2) Gross Gamma (all energies > 650 Kev)
(3) Gross Gamma (all energies > 1 mev)
(4) Specific Gamma (single channel analyzer)
(5) Gross Beta (including K-40)
(6) Specific Beta (chemical separation)

Reviewed by: D W Soldan

NUCLEAR CONSULTANTS
DIVISION MALLINCKRODT CHEMICAL WORKS

URINALYSIS PROCEDURES, DISCUSSIONS AND CALCULATIONS

The maximum permissible burden in the total body of gamma emitting isotopes is determined by means of the following biological and related physical constants, assumptions and calculations:

See EXCERPTS FROM REPORT OF COMMITTEE II ON PERMISSIBLE DOSE FOR INTERNAL RADIATION (1959)

The water balance of the standard man

Intake (cm^3/day)			Excretion (cm^3/day)		
Foods	1000		Urine	1400	
Fluid	1200		Sweat	600	
Sub total		2200	Feces	200	
Oxidation		300	Sub total		2200
Total		2500	From Lungs		300
			Total		2500

$$P = qf_2 / (1-e^{-\lambda t}) = (M)S$$

For chronic exposure, the following assumptions hold for equilibrium conditions of uptake and elimination from the critical organ:

$t >> T$

$S = 2{,}200\ f_w\ cm^3/day$

$M = MPC_{urine}$

$f_2 = f_w = 1$

$MPC_u = q\lambda/S$

$$MPC_u = q\ uc \times \frac{.693}{T_b\ days} \times \frac{2.22 \times 10^6\ dpm/uc}{2.2 \times 10^3\ cm^3/day} = 700\ q/T_b\ dpm/ml$$

Sample MPC_u Calculation:

	q_o(uc)	T_b (days)	MPC_u (dpm/ml)
Zn-65	60	933	45

$$MPC_u = 700\ q_o/T_b$$

$$= \frac{700 \times 60}{933} = 45\ dpm/ml$$

The ratio M_u/MPC_u appears on the Fractional Permissible Body Burden forms under the listed isotopes. The activity concentrations in the urine sample may be obtained by multiplying these values by the appropriate MPC_u.

$$M_u/MPC_u \times MPC_u = M_u \text{ dpm/ml}$$

In the case where there is a mixture of more than one radionuclide in the urine, and the identity and concentration of each radionuclide is known, the limiting value may be obtained as follows:

If radionuclides A, B, and C are present in concentrations M_a, M_b, and M_c and if the applicable MPC's are MPC_a, MPC_b, and MPC_c, respectively, then the concentrations should be limited so that the following relationship exists:

$$M_a/MPC_a + M_b/MPC_b + M_c/MPC_c = 1.0$$

OR the sum of the fractional permissible body burdens on the Urinalysis Report should be less than unity.

In accordance with the provisions of Part II, Basic Standards of Maximum Permissible Internal Exposure in the 1959 International Commission on Radiological Protection, values in excess of unity are to be expected and are permissible over short intervals as long as quarterly limits are not exceeded.

NUCLEAR CONSULTANTS DIVISION
MALLINCKRODT CHEMICAL WORKS

MAXIMUM PERMISSIBLE URINE CONCENTRATIONS AND LIMITING COUNT RATES FOR GROSS GAMMA DETERMINATIONS

ISOTOPE	*E(cpm/dpm)	q_o (uc)	T_b (days)	MPC_u (dpm/ml)	L (cpm/ml)
E > 10 Kev					
I-125	0.319	5	7	500	160
Hg-197	0.244	20	10	1,400	342
To-99m	0.46	200	1	140,000	64,000
Hg-203	0.299	4	10	280	84
Cr-51	0.0297	800	616	909	27
I-131	0.273	50	7	5,000	1,365
I-131	0.273	0.7	7	70	** 19
Au-198	0.247	30	120	175	43
E > 650 Kev					
Mo-99	0.049	8	5	1,120	55
E > 1 Mev					
Fe-59	0.043	20	800	17.5	0.75
Zn-65	0.040	60	933	45	1.8
Co-60	0.074	10	9.5	736	55

Where q_o (uc) = permissible body burden
T_b (days) = biological half life
MPC_u (dpm/ml) = maximum permissible concentration in urine
L (cpm/ml) = limiting count rate
E (cpm/dpm) = efficiency

$$MPC_u = q_o \text{ uc} \times 0.693/T_b \text{ days} \times \frac{2.22 \times 10^6 \text{ dpm/uc}}{2.2 \times 10^3 \text{ ml/day}} = 700\, q_o/T_b \text{ dpm/ml}$$

$$L = MPC_u \text{ dpm/ml} \times E \text{ cpm/dpm} = MPC_u\, E \text{ cpm/ml}$$

*Efficiency for a 10 milliliter sample in a 9/16" Lusteroid tube in the well crystal.

**If no thyroid measurement is performed, this is the limiting count rate. If the iodine is in a form not taken up by the thyroid gland, as demonstrated by thyroid measurement, the limit is 13,650 cpm per 10 milliliter sample.

NUCLEAR CONSULTANTS
DIVISION MALLINCKRODT CHEMICAL WORKS

MAXIMUM PERMISSIBLE URINE CONCENTRATIONS AND LIMITING COUNT RATES FOR BETA DETERMINATIONS

ISOTOPE	*E(cpm/dpm)	q_o (uc)	T_b (days)	MPC_u (dpm/ml)	L (cpm/ml)
P-32	*.20	6	257	16.3	3.3
P-32	**.15	6	257	16.3	2.5
S-35	*.07	90	90	700	49

*One ml sample freeze dried on 1¼" ss planchet

**Thirty ml aliquot. Phosphorous removed as magnesium ammonium phosphate.

NUCLEAR CONSULTANTS DIVISION
MALLINCKRODT CHEMICAL WORKS

URINALYSIS REQUIREMENTS AND PROCEDURES

Urinalysis Requirements

Urinalyses are required of all personnel whose work functions are such that an uptake of radioactive materials is likely. Production chemists and technicians and dispensing technicians are included in this catagory. Those personnel who are issued weekly film badges should have urinalysis performed on a monthly basis. Personnel issued monthly film badges should have a urinalysis on at least a quarterly basis. A P-32 determination is required of production chemists or technicians working with relatively large quantities of this isotope.

Urinalysis Procedures

1. Gross Gamma Urinalyses. A gross gamma urinalyses is performed by obtaining a gross count rate on all gamma emitters. Two separate sets of data are required for the gross gamma determination. A count is taken on a 10 milliliter aliquot in a scintillation well crystal used in conjunction with a radiation analyzer set to record all gamma energies in excess of 10 Kev. This setting includes all gamma emitters currently in use. A second set of data is taken with the analyzer set to accept all energies greater than 650 Kev. This setting includes the following isotopes: Co-60, Fe-59, Zn-65, and Mo-99. The limiting count rates for these isotopes are considerably lower than for lower energy isotopes such as I-131, Hg-203, Au-198, etc., and therefore require a separate gross gamma analysis. If the limiting count rate at the 650 Kev level is exceeded, a third count at energies greater than 1 Mev is required to exclude the presence of Zn-65 and Fe-59. If the limiting count rates on any of these gross gamma analyses are exceeded, a specific gamma urinalysis will be required for the limiting isotopes.

2. Specific Gamma Urinalyses. Specific gamma analyses are performed on the same 10 milliliter aliquot by setting the analyzer to straddle the photopeaks of the limiting isotopes in the preceding two catagories. If the count rates so obtained are within 10 per cent of the permissible limits, an entry of zero will be recorded on the Fractional Permissible Body Burden reports.

3. Gross Beta Determinations. Gross beta determinations will not normally be performed in that all isotopes in current use, with the exception of P-32 and S-35, have gamma emission associated with them and will be included in the gamma determinations. Of these two isotopes, the permissible body burden and relative quantities of activity handled are such that a determination for S-35 is not necessary.

4. Specific Beta (Chemical Separation). P-32 is chemically separated from all other isotopes by precipitation as magnesium ammonium phosphate in a 30 milliliter aliquot of urine. The precipitate is collected on a filter, washed and dried, and analyzed in a beta detector.

NUCLEAR CONSULTANTS
DIVISION MALLINCKRODT CHEMICAL WORKS

URINALYSIS PROCEDURE

The new scaler in current use may be set to obtain a direct read out in disintegrations per minute as follows:

Preset a counting time equal to the reciprocal of the efficiency. Determine the background count on a 10 ml aliquot of tap water for this time. Enter this number in the background subtract section of the scaler. Obtain the net count on a 10 ml urine sample. The count so obtained is numerically equal to the disintegration rate in the total sample. Divide this rate by the volume to obtain the activity concentration. This concentration divided by the maximum permissible concentration is the value entered on the Fractional Permissible Body Burden Report form.

N (c) = number of counts
t (m) = counting time in minutes
E (cpm/dpm) = efficiency
D (dpm) = disintegration rate
V (ml) = volume
R (cpm) = count rate
M_u (dpm/ml) = disintegration rate per unit volume
MPC_u (dpm/ml) = maximum permissible concentration
FPBB = Fractional Permissible Body Burden

$$D \text{ dpm} = \frac{N \text{ c}}{t \text{ m}} \times \frac{1/E \text{ cpm}}{\text{dpm}} = \frac{N \times 1/E}{t} \text{ dpm}$$

Where $t = 1/E$

$$D \text{ dpm} = N \text{ dpm}$$

$$M_u \text{ dpm/ml} = \frac{D \text{ dpm}}{V \text{ ml}} = \frac{N \frac{\text{dpm}}{\text{ml}}}{V}$$

Where $V = 10$

$$M_u \frac{\text{dpm}}{\text{ml}} = .1 \; N \frac{\text{dpm}}{\text{ml}}$$

$$FPBB = M_u/MPC_u = .1 \; N/MPC_u$$

January

NUCLEAR CONSULTANTS DIVISION
MALLINCKRODT CHEMICAL WORKS

URINALYSIS WORK SHEET

1/E = 4.05

NAME	SAMPLE VOLUME	TOTAL COUNTS	TIME (MINS)	GROSS CPM	NET CPM	0.90 DEV.	E	ANALYSIS ISO(MET)	DPM ML
[redacted]	10 ml	3,200	6.91	463	0	13	.247	Au-198(1)	0 ± 5.4
	"	"	6.81	469	0	14			0 ± 5.7
			6.95	460	0	13			0 ± 5.4
			6.41	499	28	15			11.3 ± 6.1
			4.71	678	207	19			84 ± 7.7
			5.32	601	130	18			53 ± 7.3
			5.51	580	109	17			44 ± 6.9
			3.78	846	375	25			152 ± 10.1
			5.21	614	143	18			58 ± 7.3
			2.33	1373	902	40			366 ± 16.2 I-131
			4.18	765	294	22			119 ± 8.9
			3.79	844	373	25			151 ± 10.2
			5.76	555	84	16			34 ± 6.5
			6.44	496	25	14			10.1 ± 5.7
			6.35	503	32	15			13 ± 6.1
			6.51	491	20	14			8.1 ± 5.7
			5.57	572	101	17			41 ± 6.9
			5.18	617	146	18			59 ± 7.3
			6.54	489	18	14			7.3 ± 5.7
			6.24	512	41	15			16.6 ± 6.1

FORMED BY D W Soldan DATE 1-6-66

IEWED BY _____ DATE _____

January

NUCLEAR CONSULTANTS DIVISION
MALLINCKRODT CHEMICAL WORKS

EX 6

URINALYSIS WORK SHEET

NAME	SAMPLE VOLUME	TOTAL COUNTS	TIME (MINS)	GROSS CPM	NET CPM 0.90 DEV.	E	ANALYSIS ISO(MET)	DPM ML
[redacted]	10 ml	3,200	6.52	491	20 ± 14	.247	Au-198(1)	8.1 ± 5.7
	"	"	5.88	544	73 ± 16	"	"	30 ± 6.5
	"	"	6.88	465	0 ± 13	"	"	0 ± 5.4
	one tap water	32,000	67.89	471	0 ± 14	"	"	0 ± 5.7
	"	1600	63.21	~~38~~ 35.3	0 ± ~~3.2~~ 3.0	.049	E> 6.0 Ku-(1)	0 ± ~~2.5~~ 2.0
	10 ml	160	5.85	27.4	2.1 ± 3.6			4.3 ± 7.3
			6.91	23.1	0 ± 3.0			0 ± 6.1
			6.29	25.5	0.2 ± 3.3			0.4 ± 6.7
			6.94	23.1	0 ± 3.0			0 ± 6.1
			5.88	27.2	1.9 ± 3.5			3.9 ± 7.1
			6.08	26.4	1.1 ± 3.4			2.2 ± 6.9
			6.15	26.0	0.7 ± 3.4			1.4 ± 6.9
			6.34	25.2	0 ± 3.3			0 ± 6.7
			6.64	24.2	0 ± 3.1			0 ± 6.3
			6.75	23.7	0 ± 3.1			0 ± 6.3
			6.63	24.1	0 ± 3.1			0 ± 6.3
			6.12	26.2	0.9 ± 3.4			1.8 ± 6.9
			6.76	23.7	0 ± 3.1			0 ± 6.3
			6.69	23.9	0 ± 3.1			0 ± 6.3
			6.66	24.0	0 ± 3.1			0 ± 6.3

RFORMED BY D W Soldan DATE 1-6-66

VIEWED BY _____ DATE _____

January

Ex 6

NUCLEAR CONSULTANTS DIVISION
MALLINCKRODT CHEMICAL WORKS

URINALYSIS WORK SHEET

NAME	SAMPLE VOLUME	TOTAL COUNTS	TIME (MINS)	GROSS CPM	NET CPM	0.90 DEV.	E	ANALYSIS ISO(MET)	DPM ML
[redacted]	10 ml	160	5.73	27.9	2.6	±3.6	.049	E7 6DKU(2)	5.3 ± 7.3
			6.08	26.3	1.0	±3.4			2.0 ± 6.9
			6.34	25.3	0	±3.3			0 ± 6.7
			6.22	25.7	0.4	±3.3			0.8 ± 6.7
			6.70	23.8	0	±3.1			0 ± 6.3
			7.00	22.9	0	±3.0			0 ± 6.1
			6.44	24.9	0	±3.2			0 ± 6.5
[redacted]	30 ml	3402	60	65	0	±~~5.5~~ 6.7	0.15	P-32(6)	0 ± 0.4
	30 ml	371	6	62	0	±3.2	0.15	"	0 ± 0.7
[redacted]	10 ml	1756	~~175~~ 10	175	0	±~~6.2~~ 6.5	.121	I-131(4)	0 ± ~~5~~ 5.4
	10 ml	5553	~~555~~ 10	555	400	±~~122~~ 12	"	"	334 ± 9.9

FORMED BY D W Goldan DATE 1-6-46

IEWED BY _____ DATE _____

6-14-66

INTERMITTENT AIR SAMPLING STATIONS

Designation		Description
New	Old	
A	(1)	Iodine capsule hood
B	(2)	Iodine dispensing hood
C	(3)	Iodine production hood
D	(4)	Moly production hood
E	(5)	Mercury production hood
F	(6)	Gold production hood
G	(7)	Technetium production hood
H	(Disp)	Dispensing laboratory
I	(8)	Drug and waste storage room
J	(11)	Lab cold air return
K	(14)	Capsule sorting room (bsmt)
L	(15)	Cobalt room (bsmt)
M	--	Sterile room
N		
O		
P		
Q		
R		
S		
T		
U		
V		
W		
X		
Y		
Z		

EXHIBIT "J-1"

6-14-66

CONTINUOUS AIR SAMPLE STATIONS

Designation		Description
New	Old	
1	(13)	Iodine stack
2		Production stack
3		Dispensing stack
4		
5		
6		Environmental
7		
8		Environmental
9		
10		Environmental
11		Environmental
12	(17)	Auxiliary air supply
13	(18)	Makeup air supply
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		

Samples 1-26 are through roof manifold.

EXHIBIT "J-2"

6-14-66

CONTINUOUS AIR SAMPLE STATIONS (cont'd)

Designation		Description
New	Old	
27	(9)	Basement cold air return
28	(10)	Stairwell cold air return
29	(12)	Office cold air return
30	(16)	Combustion air supply
31		Furnace room

EXHIBIT "J-3"

"Grab" Air Sample Data for Period 12-3-65 thru 2-15-66

Date of Sample	Location of Sample	Most Likely Contaminate	Concentration (uc/ml)
12-3-65	Dispensing	Mixed	3.72×10^{-9}
12-6-65	Dispensing	Mixed	6.40×10^{-9}
12-7-65	Capsule Sorter	I-131	1.80×10^{-9}
12-15-65	Production Lab.	Mixed	5.80×10^{-8}
12-24-65	*I-131 Stack	I-131	4.60×10^{-9}
12-29-65	Tagging	I-131	11.60×10^{-9}
12-29-65	Production Lab.	Mixed	7.88×10^{-9}
1-5-66	Storeroom	Mixed	8.10×10^{-9}
1-5-66	Tagging	I-131	5.71×10^{-9}
1-6-66	Dispensing	Mixed	4.40×10^{-11}
1-11-66	Capsule Sorter	I-131	2.10×10^{-9}
1-19-66	Production Lab.	Mixed	2.60×10^{-9}
1-25-66	Quality Control	Mixed	1.90×10^{-9}
1-31-66	Dispensing (near sink)	Mixed	2.40×10^{-11}
2-3-66	*I-131 Stack	I-131	5.06×10^{-9}
2-4-66	Storeroom	Mixed	1.23×10^{-10}
2-7-66	Tagging	I-131	0 (< BKGD)
2-8-66	Production (near Mo-99 Hood)	Mo-99	7.90×10^{-9}
2-9-66	Tagging	I-131	4.10×10^{-9}
2-10-66	Product (near Hg Hood)	$Hg^{197/203}$	5.60×10^{-9}
2-15-66	I-131	I-131	1.90×10^{-9}

*I-131 Stack considered "unrestricted" during this period.

'Continuous' Air Sample Data (normally 24 hour collection)

Sample Station		4-21/4-22 "Base" (uc/ml)	4-21/4-22 "I-131 peak" (uc/ml)	4-22/4-23 "Base" (uc/ml)	4-22/4-23 "I-131 peak" (uc/ml)
1		314.64×10^{-10}	31.46×10^{-9}	45.50×10^{-9}	4.86×10^{-9}
2		1478.39×10^{-10}	14.68×10^{-9}	72.50×10^{-9}	3.67×10^{-9}
3		117.30×10^{-10}	7.74×10^{-9}	16.36×10^{-9}	4.27×10^{-9}
6*		7.73×10^{-10}	11.45×10^{-10}	44.00×10^{-10}	5.96×10^{-10}
8*		13.39×10^{-10}	7.04×10^{-10}	27.70×10^{-10}	4.60×10^{-10}
10*		10.90×10^{-10}	6.07×10^{-10}	23.30×10^{-10}	3.98×10^{-10}
11*		12.97×10^{-10}	64.97×10^{-9}	15.90×10^{-9}	3.77×10^{-9}
12		53.96×10^{-10}	3.70×10^{-9}	19.80×10^{-9}	2.29×10^{-9}
13		14.21×10^{-10}	0.56×10^{-9}	1.70×10^{-9}	0.46×10^{-9}
27	(est)	68.00×10^{-10}	8.89×10^{-9}	4.94×10^{-9}	1.89×10^{-9}
28	(est)	45.00×10^{-10}	4.39×10^{-9}	4.12×10^{-9}	1.40×10^{-9}
29	(est)	87.00×10^{-10}	4.83×10^{-9}	10.00×10^{-9}	1.08×10^{-9}
30	(est)	10.00×10^{-10}	0.91×10^{-9}	3.40×10^{-9}	0.94×10^{-9}

'Programed' In-Plant Air Sample Data

Sample Station	4-19/4-22 "Base" (uc/ml)	4-19/4-22 "I-131 peak" (uc/ml)	4-22/4-23 "Base" (uc/ml)	4-22/4-23 "I-131 peak" (uc/ml)
A	62.32×10^{-9}	59.69×10^{-9}	28.60×10^{-9}	14.80×10^{-9}
B	57.10×10^{-9}	56.89×10^{-9}	21.80×10^{-9}	9.95×10^{-9}
C	129.21×10^{-9}	144.32×10^{-9}	25.50×10^{-9}	11.80×10^{-9}
D	46.61×10^{-9}	39.39×10^{-9}	63.10×10^{-9}	6.94×10^{-9}
E	36.48×10^{-9}	37.00×10^{-9}	62.60×10^{-9}	5.79×10^{-9}
F	42.82×10^{-9}	32.09×10^{-9}	64.50×10^{-9}	6.17×10^{-9}
G	38.33×10^{-9}	25.91×10^{-9}	52.40×10^{-9}	5.79×10^{-9}
H	32.75×10^{-9}	21.69×10^{-9}	45.60×10^{-9}	8.75×10^{-9}
I	68.84×10^{-9}	52.06×10^{-9}	50.60×10^{-9}	17.30×10^{-9}
J	26.37×10^{-9}	25.91×10^{-9}	34.60×10^{-9}	4.24×10^{-9}
K	25.98×10^{-9}	27.06×10^{-9}	18.20×10^{-9}	12.60×10^{-9}
L	24.66×10^{-9}	17.82×10^{-9}	17.70×10^{-9}	2.80×10

*Four 'unrestricted' roof area Sample Stations.

"Grab" Air Sample Data for Period 12-3-65 thru 2-15-66

Date of Sample	Location of Sample	Most Likely Contaminate	Concentration (uc/ml)
12-3-65	Dispensing	Mixed	3.72×10^{-9}
12-6-65	Dispensing	Mixed	6.40×10^{-9}
12-7-65	Capsule Sorter	I-131	1.80×10^{-9}
12-15-65	Production Lab.	Mixed	5.80×10^{-9}
12-24-65	*I-131 Stack	I-131	4.60×10^{-8}
12-29-65	Tagging	I-131	11.60×10^{-9}
12-29-65	Production Lab.	Mixed	7.88×10^{-9}
1-5-66	Storeroom	Mixed	8.10×10^{-9}
1-5-66	Tagging	I-131	5.71×10^{-9}
1-6-66	Dispensing	Mixed	4.40×10^{-9}
1-11-66	Capsule Sorter	I-131	2.10×10^{-11}
1-19-66	Production Lab.	Mixed	2.60×10^{-9}
1-25-66	Quality Control	Mixed	1.90×10^{-9}
1-31-66	Dispensing (near sink)	Mixed	2.40×10^{-9}
2-3-66	*I-131 Stack	I-131	5.06×10^{-11}
2-4-66	Storeroom	Mixed	1.23×10^{-9}
2-7-66	Tagging	I-131	0(<BKGD)
2-8-66	Production (near Mo-99 Hood)	Mo-99	7.90×10^{-10}
2-9-66	Tagging	I-131	4.10×10^{-9}
2-10-66	Product (near Hg Hood)	Hg 197/203	5.60×10^{-9}
2-15-66	I-131	I-131	1.90×10^{-9}

*I-131 Stack considered "unrestricted" during this period.