

COMPLIANCE INSPECTION REPORT

II - A, II

1. Name and address of licensee American Potash and Chemical Corporation Lindsay Chemical Division 258 Ann Street West Chicago, Illinois	2. Date of inspection - April 30 through May 3, 1962; June 14, 1962; August 16, 1962. 3. Type of inspection Reinspection 4. 10 CFR Part(s) applicable 20 and 40.								
5. License number(s), issue and expiration dates, scope and conditions (including amendments) <table border="1"> <tr> <td>License No. R-234</td> <td>7-1-59</td> <td>7-31-60</td> <td>Reinspection #3</td> </tr> <tr> <td>Amended</td> <td>8-1-60</td> <td>8-31-61</td> <td></td> </tr> </table>		License No. R-234	7-1-59	7-31-60	Reinspection #3	Amended	8-1-60	8-31-61	
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Amended	8-1-60	8-31-61							

(Copies of license and amendment attached as Exhibit A)

6. Inspection findings (and items of noncompliance)

The licensee has a pending renewal application which includes survey revisions which he already has placed in effect.

The only items of noncompliance observed or otherwise noted are:

License No. R-234 (Note - A copy of this license appears as Exhibit A to this report)

10 CFR 20.101 - Exposure of individuals to Radiation in Restricted Areas"

- (a) - in that the licensee has permitted individuals within a restricted area to receive in a period of one calendar quarter in excess of 1.25 rem of whole body exposure (See paragraph 54 and Exhibit E).

10 CFR 20.103 - "Exposure of Individuals to concentrations of Radioactive Material in Restricted Areas"

- LTR mentioned in 54 etc*
 (a) - in that the licensee permitted individuals in a restricted area to be exposed to airborne radioactive material in an average concentration in excess of the limits specified in Appendix B, Table I, 10 CFR 20. (See paragraph 59 and Exhibit G).

- continued -

7. Date of last previous inspection April 19, 20, 21, 24 and June 23, 1961	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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John O. Davis (Inspector)

Approved by:

Roy C. Ragsman, Director
 Region III, Division of Compliance

(Operations office)

August 16, 1962

(Date report prepared)

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

16-75210-2 U. S. GOVERNMENT PRINTING OFFICE

RECOMMENDATIONS SHOULD BE SET FORTH IN A SEPARATE COVERING MEMORANDUM

Continuation Sheet #1
American Potash & Chemical Corp.
West Chicago, Illinois

4/30-5/3/62; 6/14 & 8/16/62.

6. Inspection Findings - continued

License No. R-234 - continued

10 CFR 20.105 - "Permissible levels of Radiation in Unrestricted Areas"

- ✓ (b)(2) - in that the licensee caused levels of radiation in unrestricted areas which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 100 millirems in any seven consecutive days (See paragraph 62 and Exhibits F and G).

10 CFR 20.201 - "Surveys"

- ✓ (b) - in that the licensee did not make adequate surveys thereby resulting in the overexposure of licensee employees to external sources of radiation and to concentrations in excess of permitted values. (See paragraph 63 of Details).
- ✓ - in that environmental samples by location and frequency are not sufficient to show the concentration of radioactive material released into the air in unrestricted areas as a result of the licensee's activities (See paragraph 66 of Details).

10 CFR 20.301 - "Waste Disposal -General Requirements"

- 1-4 F. 6-10-62 ✓ - in that the licensee is disposing of radioactive waste by discharge into a waste pond on his property. Such method is not authorized by the Federal Regulations. (See paragraph 67 of Details).

10 CFR 20.305 - "Treatment or Disposal by Incineration"

- 1-4 F. 6-10-62 ✓ - in that the licensee treats bags contaminated with licensed material by incineration without specific approval by the Commission (See paragraph 63 of Details).

DETAILS

General Information

9. An announced inspection of the licensee was conducted on April 30 through May 3, 1962. The licensee was again visited on June 14, 1962 and August 16, 1962. This inspection embraced both the licensee's research and development facility at West Washington and Wood Streets, West Chicago, Illinois and the licensee's production facility at 258 Ann Street in West Chicago, Illinois. Arrangements for the inspection were made by a telephone call to Dr. Robert Healy, licensee's radiation safety officer on April 26, 1962. W.E. Twaler, Region III, accompanied J. O. Davis.
10. The AEC representatives were accompanied during this inspection by Mr. Lou Krepert and Mr. James Bates, Illinois Department of Public Health on April 30, May 1 and 2. Mr. Robert French of Illinois Department of Public Health was present on April 30, May 1, 1962 and June 14, 1962.
11. The licensee was represented during this inspection by Dr. Robert M. Healy, Radiation Safety Officer and Mr. Edward Maryniw, Radiation Technician.

All information in this report is reported in substance, unless otherwise indicated.

Inspection History

12. On March 20 and 21, 1956 the Lindsay Chemical Company was visited by representatives of the Division of Inspection, Headquarters and of the Health and Safety Laboratory New York Operations Office. This initial visit to this licensee was not in the form of an inspection against any license held by the Lindsay Chemical Company; rather, the purpose of this initial visit was to determine the inspection requirements for manufacturers and processors of thorium ores. As a portion of this initial visit, the licensee was supplied by the Atomic Energy Commission with the results of air samples taken. The visit had included independent radiation surveys and independent air sampling. Representatives of the Lindsay Chemical Company had accompanied the Commission's representatives on March 20 and 21, 1956 and adopted the Commission's techniques for their own sampling and surveying program.
13. The initial inspection of this licensee was performed by the Chicago office on December 3 - 12, 1957 and April 9, 1958. The only item of noncompliance discussed in this report was airborne radioactivity in excess of the limits established in Schedule B, Table I, Column I, 10 CFR 20.
14. A reinspection of June 12, 1959 reported no items of noncompliance. The licensee was so informed by letter of September 4, 1959 from the Division of Licensing and Regulation.
15. A second reinspection was conducted on April 19 through 24 and June 23, 1961. The inspection recommended citation against License No. 12-4932-1 for failure to post an isotope storage area, and against license No. R-234 for failure to conduct adequate radiation surveys; for failure to post airborne radioactivity areas; for failure to post Form AEC-3; and, for failure to maintain records in the same units used in the Federal Regulations. These items of noncompliance were transmitted to the licensee by a letter of March 26, 1962 from the Division of Licensing and Regulation. A letter of April 27, 1962 completed enforcement action by informing the licensee that the items of noncompliance would be reviewed during a reinspection of his facility.

PROGRAM

16. The licensee's facilities constitute the West Chicago Plant of the American

16. Continued

Potash and Chemical Corporation. This plant produces rare earth and thorium compounds. The rare earth compounds contain less than 0.25% of thorium as an impurity. According to the licensee, this West Chicago Plant produces 95% of the thorium compounds produced within this country.

17. License No. R-234 is the license possessed by this licensee under which he processes thorium ores. With regard to the manufacture and sale of such products, this license specifies no possession limit. The licensee states that approximately 30 tons of monazite sand are used daily in the production of rare earth and thorium compounds. The licensee seeks to maintain an inventory of approximately 20,000,000 pounds of the monazite sand at all times. This sand consists of approximately 45% rare earth oxides and 6% thorium oxide.
18. The licensee states he has received no approximately 12% Thorium Oxide. License No. R-234 permits procurement of 20,000 pounds of such material for development of recovery techniques.
19. The licensee's thorium production was curtailed from April 7, 1961 to January 18, 1962. Full-scale production was resumed on approximately February 15, 1962.

Process

20. A flow diagram of the licensee's chemical process for the treatment of the monazite sand and the extraction of the rare earths and thorium has been submitted to the Division of Licensing and Regulation of the Atomic Energy Commission. The licensee states that he considers information within this flow diagram as "Company Confidential" information. The licensee demonstrated to the AEC representatives at the time of the inspection a copy of this diagram. Due to the fact that this information is "company confidential" a copy or description of this chemical process is not included as a portion of this inspection report. The flow diagram, as such, is not pertinent to determinations of safety and/or compliance. From this flow diagram, the licensee identified certain portions of his operation which he considers to be the most likely to result in airborne radioactivity. In a tour of the licensee's facilities, the Commission representatives selected points for independent measurement to include areas not identified by the licensee as "problem" areas, as well as those areas which the licensee considers to be the most likely to produce airborne activity. These areas are considered in more detail under the section of this report entitled "Facilities."
21. The licensee uses standard chemical processes, equipment, and techniques to convert and extract rare earth and thorium compounds from the monazite sand.

Organization

22. License No. R-234 provides for the operation of the West Chicago Plant of the American Potash and Chemical Corporation. The plant manager of the West Chicago plant is Mr. P. J. Bennett. Mr. Bennett reports to Mr. G. T. Deck, who is Director of Manufacturing (Eastern), whose office is in West Chicago. In the operational portion of the West Chicago plant, reporting to Mr. Bennett is Mr. Edward Vedder, who is the general plant foreman. Reporting to Mr. Vedder are the various area shift foremen and reporting to these foremen are the individual workers. The West Chicago plant also furnishes space and administrative support to the Research and Development Division; however, the Research and Development Division reports directly to the Vice President of the American Potash & Chemical Corporation.
23. Dr. Robert M. Healy has been appointed the Radiation Safety Officer. This appointment was made by Mr. C. R. Lindsay, III, a Vice President of the Corporation. Dr. Healy, who is a chemist, states that his position as Radiation Safety

23. Continued

Officer, is a part time position and utilizes approximately 20 - 25% of his time. His other position within this corporation is Head of Products and Processes Development Section within the Research & Development Division. Other than for the function of Radiation Safety Officer, Dr. Healy is not a member of the operational portion of the West Chicago plant. However, Dr. Healy states that with regard to his function as the Radiation Safety Officer, he does report to Mr. Bennett, who is the plant manager. Dr. Healy stated that he has been assigned and accepts full responsibility for the radiation safety of this operation. He has assisting him one full-time technician, Mr. Edward Maryniw. Dr. Healy emphasized that although the technician may perform collections and do the measurements of the samples taken, the entire responsibility for this program rests with Dr. Healy.

24. This licensee has no Radiation Safety Committee. Dr. R. S. Landauer, Sr., Radiological Physicist of Chicago, Illinois, is retained by the licensee on a consulting basis. Dr. Landauer does not currently take an active role in the routine radiation safety program of this licensee.

Administrative Control

25. Dr. Healy states that as the Radiological Safety Officer, the entire radiation safety program of this licensee is his responsibility. In discharging this responsibility, Dr. Healy states that he can require that operations be suspended. This would be accomplished by Dr. Healy going directly to Mr. B. J. Bennett, plant manager of the West Chicago plant. Dr. Healy stated, however, that the method of accomplishing radiation safety generally did not involve the closing down of processes. Rather, if an area appears to present a "problem," the method of operation in that particular area would be reviewed and then he would recommend changes in technique of operation within this area instead of closing down the area or requiring that equipment be changed. If the change of technique did not eliminate the problem, the next step would be change of process equipment. In reviewing such an area from the standpoint of eliminating any potential hazard which may exist, Dr. Healy stated that the area would be sampled in detail to determine the actual hazard present. The Commission representatives inquired as to whether in this detailed review of the particular area, consideration would be given to reducing time spent by employees within that area. Dr. Healy stated that this had not been done by the licensee. Rather, in most instances, a review of the area with regard to the operational technique has been sufficient to eliminate any potential hazard. However, in some areas, it had been necessary to stop the process and replace the existing process equipment so that air concentration levels could be reduced. Dr. Healy stated that it was not the intention of Lindsay Chemical to operate on a control time basis for employees. Rather it was the intention to have areas of operation to be less than the permissible limits for airborne concentrations established by the Federal Regulations.
26. With regard to procurement of thorium ore under license No. R-234, since there is no quantitative limit on the amount of material procured for production purposes, procurement control is not exercised as a function of the radiation safety officer. Rather, procurement control is exercised by the purchasing department and is an economic control function.
27. The Sales Department requires, prior to shipment of more than a generally licensed quantity, that the customer supply the number of the license authorizing possession. For generally licensed quantities, the customer is required to include with his order a description in general terms, of the use of the thorium so that it can be established that the use is included in the general license.

28. According to Dr. Healy, he constitutes a member of management of this licensee. With regard to review of his actions by higher management, he stated that there was no routine review of this action. Rather, if he arrived at a "problem" this problem was discussed with the plant manager, and some solution to this problem is determined by the plant manager, Mr. Bennett, and by Dr. Healy. He stated that he would consider that licensee management is quite concerned and enters directly into the control of the program from a radiation safety standpoint, as evidenced by the fact that radiation safety has been made a direct responsibility of a member of management.

Radiological Safety Procedures

29. The licensee has no written radiological safety procedures for distribution to his employees. Rather, the licensee has a sheet drawing the employee's
X attention to the fact that he is working with radioactive materials and requiring the employee's signature. A copy of this sheet is attached as Exhibit B of this report.
30. Posted at the entrance to the production area is a sign stating "Film Badges: All Lindsay employees working in this area must wear film badges as part of the radiation monitoring programs."
31. According to Dr. Lindsay there is no formal training course provided for the employees other than an orientation at the time an employee begins work. All operating employees of this licensee, approximately 150, work with radioactive materials, either thorium as a major component or thorium as a contaminant in rare earths. Dr. Healy stated that the individual employee is informed of the hazards associated with radioactive materials and is required to read a statement and sign such statement (as shown in paragraph 29 above). (However, any specific instructions in handling techniques based on the radiation hazard involved is carried out verbally by the foreman of the area. These instructions are on a continuous basis.) These instructions are not written. The Commission representatives inquired as to when respiratory protection is required and how the employee knows that it is required. Dr. Healy stated that this had not been reduced to writing, but rather (the foreman informs the employee when respiratory protection is required,) and beyond that, the employee is permitted to wear the respiratory protection at any time that he sees fit, in addition to these required times.
32. In visiting the production areas of the plant, it was noted by the Commission representatives that no particular safeguards were employed by this licensee, other than respiratory protection and hooded equipment for certain operations. The licensee does not provide clothing other than shoes for his employees. The licensee does provide shower rooms and space for a change of clothing for the employees. However, it is not a company requirement that the employee take a shower or change his clothes prior to departing from work. Dr. Healy stated "most" workers change clothes and shower prior to leaving the facility at the conclusion of a work shift. The licensee does provide 5 minutes at noon and 15 minutes at closing time for "clean-up" by his employees.
33. The production techniques employed by the individual workers observed by the Commission representatives were those typical of bulk chemical processing plants. There appeared to be no special handling techniques employed by the licensee's employees because of the radioactive material being used. Rather, according to Dr. Healy, the licensee depends on revising his production procedures where necessary and in providing appropriate equipment where necessary so that no specific training or techniques because of the radioactivity are necessary to provide for the radiation safety of the employees.
34. It was noted that respirators have been provided by this licensee to his employees. It was noted further, with the exception of one instance, that these

34. Continued

respirators were being worn by the licensee's employees in any operation which would appear to generate dust. The one instance in which the Commission representatives noted that respirators were not being worn, involved repair of equipment in the sand roasting shed. Mr. Maryniw stated that respirators were required for this type work and he was certain that the workers had been informed to wear respirators. When this area was checked again by the Commission representatives approximately 30 minutes later, it was noted that respirators were being worn.

35. (The licensee does not survey for surface contamination nor provide equipment for his employees to monitor for body contamination.) The licensee depends on continuous clean up to provide control of contamination (See paragraph 68 of this report). Independent measurements for removable surface contamination show up to 6140 disintegrations per minute per 100 square centimeters Alpha on a funnel used for passing thorium compounds from one floor to that floor below. On the floor the maximum smearable contamination was 4140 disintegrations per minute per 100 square centimeters (See Exhibit C, Attachment 5).

Facilities (Sketches of facilities are attached to this report in Exhibit C)

36. The licensee's research and development facilities are located at West Washington and Wood Streets in West Chicago, Illinois. The licensee's production facilities are located at 258 Ann Street, West Chicago, Illinois.
37. At the research and development facilities, the licensee has research and development chemical laboratories and small scale pilot plant operations.
38. The production facility of the licensee covers an area approximately 300 yards by 100 yards in size. See Exhibit C, Attachment 1. Within this production area the licensee produces both thorium compounds and rare earth compounds. To a large extent, production facilities for the two classes of compounds produced are physically separated by being located within different areas and different rooms within the processing buildings. The thorium generally is handled during processing within four separate areas of the production facilities. These areas are arbitrarily designated facilities A through D for this report.

Facility A: Sand roasting shed.
Facility B: Four-story thorium building.
Facility C: Furnace Room (calcinating room) within Building 3.
Facility D: Thorium cascade room within Building 2.

39. Facility A, the sand roasting shed, is a separate building from the remainder of the processing building. The first processing of the monazite ore is accomplished here. The first stage of the chemical process which is carried out in facility B, the thorium building, is the initial separation of the ore into the thorium bearing component and the rare earth bearing component. Facility C, the furnace room, is a separate room located adjacent to a rare earth processing area. Facility D, the thorium cascade room, also is a separate room located in the rare earth processing area. At the time of this inspection, Facilities C and D were both inoperative and were in the process of having new equipment installed so that the technique of handling the material could be changed, in order to reduce airborne concentrations.
40. The sand roasting shed is a separate building which is equipped with externally gas fired rotary-type furnaces in which the original monazite sands are roasted. The exhausts from these furnaces pass through a duct work and through a bag-type dust collector on the roof of this building prior to discharge. In addition to this bag collector, according to the licensee, a caustic scrubber has been installed within this exhaust line. Within this sand roasting shed, the ore is received within a plastic lined burlap sack. The sack is ripped open

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40. Continued

in an open faced hood ("Loading hopper" Exhibit C, Attachment 6) by an operator. The bag is placed within the hood. The operator reaches into the hood and rips open the bag. For this operation the operator's arms and hands are within the hood. His head is outside the hood and above the horizontal plane of the top of the hood. The ore is transferred by a worm gear into the rotary kilns. For the opening of these bags, the operator wears both a respirator and gloves. The "empty" bags themselves are placed within a covered container and are transferred to an area known as "twelve acres" and, according to the licensee, are burned in an open pit at that site. See paragraph 83. After the ore has been roasted within this shed, the dry sand is dumped automatically from the kiln, after being cooled, into a "tote" which is a metal container without a lid approximately 3 feet high by 5 feet long by 4 feet wide. In these totes, the material is transferred from the sand roasting shed to the thorium building.

41. After the material from the roasting kiln has been placed automatically within the totes, these uncovered totes are transported by fork lift truck from this sand roasting shed to the ground floor of the four-story thorium building. This is a distance of approximately 70 yards and involves movement within and outside of buildings. The totes are then dumped into a curtain faced hood ("sand loader," Exhibit C, Attachment 9), and the roasted ore is transmitted by worm lift to the fourth floor of the thorium building. On the fourth floor of the building within an enclosed hopper ("Monazite Sand Hopper" - Exhibit C, Attachment 12), the ore is transferred in one-ton batches to a removable hopper for the digestion pots.

42. The thorium building is equipped with a variety of typical chemical processing equipment for the conversion of the monazite ore into rare earth and thorium compounds. This equipment consists of acid digestion pots, bleaching, holding, treatment and evaporation tanks, centrifuge separators, filter presses, crystallization kettles, and weighing and packaging equipment. Within this thorium building, the transfer of the chemicals after the initial introduction of the dry roasted monazite sand into the acid digestion pots, is accomplished with the chemicals (either the rare earth-bearing or thorium-bearing component) in a liquid dissolved state or in a wet solid state with a consistency approaching mud. The liquids are transmitted by closed piping. The "mud" may be transmitted either by gravity feed within ducts from one floor to a lower floor, or by movement in uncovered totes by use of fork lift trucks.

43. The bulk of the final product from the thorium process of the licensee consists of thorium nitrate. The thorium nitrate is packaged in drums in a moist state, such that the airborne contamination problem is considerably reduced. However, for that portion of the licensee product which is sold as the oxide, it is necessary to convert thorium oxalate into thorium oxide by calcination. This calcination results in a dry powder which could cause airborne radioactivity. At the time of this inspection, the calcination room (also called the furnace room) was not in an operable condition due to the installation of new equipment, so that the handling techniques and process could be changed to reduce airborne radioactivity. Consequently, except for the handling of the dry ore and the handling of the oxide product, all of the material containing thorium (other than for the rare earths which contain thorium as a contaminant) are handled either in a liquid state or in a wet solid state by this licensee. In this manner the airborne radioactivity is less than would exist if handling of the material was done in a dry powdered state.

44. Within the sand roasting shed and within the thorium building, the handling of the monazite ore, once it has been removed from the plastic-lined bag in which received, is done in covered or open faced hoods for transfer

Continued -

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44. Continued

from one container to another. However, for transportation from one processing point (for example, the sand roasting shed) to another processing point (for example, the loading hopper for the thorium building) this transfer is accomplished within open top totes or within pipes and ducts. For those processes where air sampling has shown that an airborne radioactivity may exist, (Dr. Healy states that where the thorium compound may be handled in an open state, i. e. not within a closed process vessel) curtained-faced or open hoods are provided. Discharge of the air from these hoods is through bag-type dust collectors.

45. Located on the third floor of Building 9 (See Exhibit C, Attachment 11) are the D-7 Tanks. High airborne activity has been noted above these tanks. In utilizing these tanks, air is blown through the liquid contents of the tanks for agitation. The tanks are vacuum filtered for separation of liquid and solid components. For the air agitation, air lines are passed through open "man holes" (approximately 20" in diameter) and the agitation accomplished. It is during this agitation that high airborne activity has been detected. Dr. Healy stated considerable reduction in the activity has been accomplished by a reduction in rate of agitation. Although the tanks are vented, there is no forced air discharge from this area. The "man holes" remain open during this sampling. Employees wear respirators when working in the area on this agitation process.

46. Approximately one-third of a mile south of the processing area, the licensee maintains an enclosed area known as "twelve acres." Within "twelve acres" the licensee stores incoming ore shipments, semi-processed rare earth salts (pink salts) and gray mud waste from his thorium processes. In addition to this, a pond has been formed which is approximately 50 feet in diameter, and according to Dr. Healy - all the liquid process waste generated within this plant. Dr. Healy stated that the sides and bottom of this pond are not treated in any manner to provide for the retention of this liquid waste. However, it is expected that the waste resulting from this plant, will seep through the ground soil. The entire 12 acres is fenced with chain-link fence approximately 6 feet high topped by three strands of barbed wire.

47. Posted at the entrances to the production facility and at the entrance to "twelve acres," are magenta on yellow signs displaying the conventional fan shaped symbol and the words "This entire plant is a radiation area - Caution - Airborne Radioactivity - Radioactive Materials. Containers, tanks, etc. in this area may contain radioactive material." Also posted at various areas within the plant itself are magenta on yellow signs displaying the conventional symbol and the words "Danger - Radiation Hazard." Posted by the time clock at the main entrance to the facility is a Form AEC-3. In addition, posted on the bulletin board at the entrance into the research and development facility is a Form AEC-3. Posted, in addition, at the main entrance to the processing plant is an informational bulletin with regard to the wearing of film badges. This is shown in Exhibit D to this report.

Storage of the ore and of the finished product of the licensee is accomplished in storage area within the main processing area and within warehouses within the "twelve acre" site. The unprocessed ore generally is stored within 50 pound bags of burlap lined with plastic. The finished product generally is stored within 55 gallon drums within a storage shed built on to the west wall of the main production building.

49. The "twelve acre" site is provided with padlocks for the gates and for the individual warehouses. The main production site, according to Dr. Healy, currently is operating on a 24-hour basis. All access into this production fa-

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49. Continued

cility is through locked doors for which it is necessary to ring for admission, or by a guard desk. A 6 foot chain-link fence or the exterior walls of buildings form the boundary of the licensee's facility.

Radiation Control Equipment

50. The licensee provides respirators for his employees. These are of two types: Mine Safety Appliance, Comfo type H-CR 76872 and American Optical Red Devil 5090 mask. These are half-face type respirators. The fitting of these respirators is accomplished under the supervision of the foreman of the production area to which the operator is assigned. The operator is instructed, according to Dr. Healy, in the method of determining whether he has a good fit on his mask. Dr. Healy stated that he has never made any checks to determine whether the masks were appropriately fitted. According to Dr. Healy, the face respirator is required for operations and work within the sand roasting shed and at the D-7 tanks, and for any other operation where dust may be generated. In addition, the individual employee is given the option of wearing the respirator at any time other than those for which it is required. The licensee's employee is expected to wear the respirator for required operations. Foremen of operational areas are depended upon to determine that respirators are worn when required. In determining the exposure of individuals to airborne activity, the licensee does not consider any protection afforded by the respirator.
51. The licensee provides no monitoring equipment other than film badges for his employees. No equipment is provided to determine the extent of body or clothing contamination prior to eating or prior to leaving the licensee's facilities at the conclusion of work.
52. For air sampling, the licensee possesses a locally constructed air sampler drawing 35 liters per minute. Sampling is accomplished using this portable air sampler and $1\frac{1}{2}$ inch Whatman 41 filter paper. For the counting of air samples, the licensee possesses two Tracerlab Model CE-13, two Pi alpha scintillation counters, using a rubber hydrochloride window. These detectors feed into two Tracerlab 1,000 scalars. In addition, the licensee possesses a Tracerlab spectrometer and ratemeter with a two inch gamma scintillation detector. This is within a $2\frac{1}{2}$ " lead shield. The licensee possesses also a thin end-window Geiger detector, which feeds into a Tracerlab 1,000 scalar. For portable instrumentation, the licensee has a Precision Radiation Instrument, Los Angeles, California Model 1111 gamma scintillation portable meter showing a meter range of 0 to 5 mr/hr. This instrument was inoperable at the time of the inspection due to lack of batteries. The licensee has Nuclear-Chicago Model 2111 "PeeWee" Proportional Alpha Counter. This was inoperable. The licensee has a Zeus Alpha Beta Gamma Meter Model C 100. This was operable. The licensee possesses an Anton Electric V 700 GM Survey Meter. The licensee possesses also a Nuclear-Chicago Model 2612 GM survey meter using a GM detector of approximately 30 milligram per square centimeter window thickness.

Personnel Monitoring and Exposure Determination

53. According to Dr. Healy, personnel monitoring and exposure determination is accomplished by the use of film badges for exposure to external sources of radiation. The licensee subscribes to film badges on a calendar month basis from R. S. Landauer, Jr., Matteson, Illinois. Badge exchange is accomplished on the 15th of each month. Dr. Healy stated that all operating personnel, employed by the West Chicago plant, wear film badges with the exception of the foremen in the rare earth plant, whose normal place of work is not within an area showing radiation. The badge is worn by an employee only during the time that he is within the plant at work. A rack is provided at the time clock alley

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53. Continued

at the entrance to the production plant for the storage of film badges at times other than normal hours of work. Film badge results are received directly by Dr. Healy who, according to Dr. Healy, reviews the results immediately upon their receipt. Dr. Healy stated that if a badge is high, action is taken to determine the reason for this high reading and to determine corrective action which may be appropriate. Dr. Healy stated that he considered a 13-week total of 1,000 mrem to constitute a "high" badge.

54. Film badge records, as reported by the licensee, have shown exposures of individuals in excess of 1.25 rem per quarter, the limit utilized by this licensee. These results are shown in Exhibit E. Consequently, the licensee is in noncompliance with 10 CFR 20.101(a) in that he permitted individuals in a restricted area to receive in any period of one calendar quarter in excess of 1.25 rem of whole body exposure.
55. A 9-week survey using badges has been accomplished for nonoperating personnel to demonstrate that film badge coverage is not required according to the Federal Regulations.
56. The licensee does not employ the use of pocket dosimeters or chambers.
57. The licensee performs no bioassays of individuals to determine uptake of radioactive materials. According to Dr. Healy, he feels that such bioassay for thorium exposure is valueless.
58. The licensee has performed some direct reading surveys in his operational areas. See Exhibit F. However, these have been in the form of informational surveys to inform Dr. Healy of the general radiation level within an operational area. No estimate or determination of exposures received, based on these direct reading surveys and calculations, have been made, nor are any used by the licensee.
59. In determining the total exposure of an individual, the licensee considers exposures to external sources of radiation and the exposure by inhalation as two separate quantities. The licensee does not consider these two exposures to be additive in the determination of personnel exposures.
60. For the licensee's method of determining overexposure to airborne radioactivity, see Exhibit G and paragraph 70. By letter of 1/29/62, the licensee reported three employees to be overexposed to airborne radioactivity (See Exhibit G). The licensee hence is in noncompliance with 10 CFR 20.103(a) for permitting three individuals to be exposed to concentrations of radioactive material in excess of the limits specified in Appendix B, Table I.

Radiation Surveys and/or Evaluations

61. The licensee has performed, on occasion, direct reading instrument surveys at his operational area and his storage area. Results of such surveys are shown as Exhibit F to this report. The licensee states that in general these surveys once performed have established the general radiation level within a given area. Consequently, direct reading surveys are not performed on a routine or established frequency. Mr. Maryniw does perform such surveys occasionally; however, after the initial surveys no record has been made of such surveys.
62. The licensee survey record of about March 25, 1962 (See Exhibit F) shows up to 1.95 mr/hr exterior to the fence surrounding the "twelve acre" storage area. Access to the area exterior to the fence is not controlled by the licensee. Storage at this site is accomplished for periods in excess of seven consecutive days. Independent measurement showed radiation levels of up to 1.9 mr/hr

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62. Continued

at the fence line. (See Exhibit C, Attachment 2). On a railroad right-of-way approximately 40 feet from this fence, a radiation level of 0.7 mr/hr was detected. The licensee hence is in noncompliance with 10 CFR 20.105(b)(2) for permitting radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 100 millirems in any seven consecutive days. The radiation is emanating from a pile of grey "mud" thorium waste. The licensee has applied to the AEC for exemption from 10 CFR 20.105 for this storage.

63. The licensee has experienced overexposure of his workers in the calendar quarters January - April, 1962 and April - July, 1962. (See Exhibit E) The overexposures to external radiation have resulted, according to the licensee, due to excess radiation in a storage area and excess time at one process operation. In addition, licensee workers have been exposed to concentrations of airborne radioactivity in excess of permitted values (See Exhibit G). These overexposures demonstrate that the licensee did not perform a complete and adequate evaluation of the radiation hazards present within his facilities. Consequently, the licensee is in noncompliance with 10 CFR 20.201(b) for failure to adequately evaluate the radiation hazards resulting from his use of radioactive materials.
64. The licensee states he has no waste streams as such, leaving his plant site. Rather, solid waste is stored for reprocessing. Liquid waste is discharged into the pond at "twelve acres." The licensee states he has done a "little" sampling of this liquid discharge. However, such sampling is not routine. The licensee states that he believes such sampling to be of little value due to the location of his discharge line and waste pond within the confines of his own facility. The licensee had the results of one such sample. This sample had been filtered by the licensee and a counting sample prepared from the filtrate. It showed 1×10^{-6} uc/ml. Two independent samples taken by the Commission representatives showed 2×10^{-6} uc/ml soluble and 6×10^{-6} uc/ml insoluble at the point of discharge from the waste line into the pond and 1×10^{-6} uc/ml soluble at the side of the pond opposite from the point at which the waste entered the pond. These values are less than those established for thorium for release into the sanitary sewerage system per 10 CFR 20.303(b)(1) and on the same order as those values permitted for release into unrestricted areas 10 CFR 20.106(b).
65. The licensee does not routinely sample his stack effluents, but does routinely take environmental samples for airborne activity. The environmental samples are located at specific locations off and on his plant site.
66. As shown in the compilation of the licensee's air monitoring program results (Exhibit H) from the period June 1961 through April 1962, two sets of samples were taken at three environmental locations on two occasions (8/14/61 and 10/20/61). All results were within limits. In addition, samples from building roofs were taken on 11/17/61 and 11/27/61. These also were within limits. Due to the infrequency of sampling, the licensee is in noncompliance with 10 CFR 20.201(b) for failure to make an adequate evaluation of airborne radioactive materials discharged from his facility. The licensee stated he has not independently evaluated his air exhaust dust collection system, but has accepted the manufacturer's specifications.
67. For environmental sampling, the licensee proposes to take one sample per week at a place known as Ball's Greenhouse, which is located one-half mile west of the plant, and a second sample each week at Vedder's house, one-half mile east of the plant. In addition, one will be taken at the plant itself. Once per month, the licensee proposes to take six samples from the roofs of the buildings within the plant. He proposes also to take six samples at the fence

- continued -

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67. Continued

- line of his plant four times per year. Environmental samples are sixty minute samples at a rate of 35 liters per minute. The licensee states that the prevailing winds at the location of the plant are in a westerly direction.
68. The licensee has established no limits for removable contamination within his process area or other areas of his facilities. In addition, the licensee has established no limit for personnel contamination of his employees. The licensee has performed no survey to determine the extent of removable contamination, or the presence of radioactive material as contamination to the persons of his employees. The licensee provides no instrumentation to his employees for the purpose of personnel monitoring for contamination. Dr. Healy stated that the licensee depends on continuous clean up to control contamination. It was observed during the course of this inspection that the licensee keeps the fourth and third floors of the thorium building damp, and that he has a mechanical scrubber for clean up of floor areas. Dr. Healy stated he did not consider surface contamination as controlled by the licensee to constitute any problem. For independent measurements of removable surface contamination see Exhibit C, Attachment 5.
69. The licensee states that the only routine monitoring or surveys which are performed by him consists of the film badges worn by individuals and in-plant and environmental air sampling.
70. As shown in the compilation of the licensee's air monitoring program results (Exhibit H) for the period June 1961 through April 2, 1962, air samples were taken within the processing facility on 29 occasions for a total of 334 samples. Of these 29 occasions, 9 showed results in excess of those set forth in 10 CFR 20. The compilation of Exhibit H, Attachment 1, shows the areas sampled and frequency of sampling.
71. For "in-plant" sampling, the licensee states that over a period of one year, the entire area of operations will be sampled. For "in-plant" sampling other than those areas which the licensee has designated as "critical," the licensee proposes to take random areas samples on a frequency such that each year the entire plant will have been sampled at least once. He estimates that this will require 100 samples, perhaps less.
72. For those areas which the licensee has designated as critical, the licensee proposes to take sufficient samples so that the entire critical area is sampled each two weeks. The licensee states that he defines a critical area as an area where he suspects that there may be airborne activity. These areas have been defined by him as the following areas:
- A. The furnace room (or calcination room)
 - B. The sand roasting shed
 - C. The D-7 tanks
 - D. The pot baking area
 - E. The thorium nitrate evaporator
 - F. The thorium cascade room
- The locations at which samples will be taken are shown as black dots or circles on the sketches of the various facilities shown in Exhibit C.
73. The licensee states that for critical areas a weighted time study will be or has been performed. In the performance of this weighted time study, the foreman and the operator involved have timed or estimated the elapsed time for an operation in a given area. The time study is based on a given number of hours per day in a given area. According to Dr. Healy, actual timing was accomplished

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73. Continued

at the cascade facility, but the weighted time study for other areas is based on estimates by the foreman and operator. In conjunction with these times, air sampling was performed both as area sampling and breathing zone sampling within these areas. Dr. Healy stated that the breathing zone samples involved taking the sample at the face height of a man working in the area. Sometimes this is accomplished with the man present and performing the operation and the sampler moved as the man moves, but usually the sampler is placed stationary at face height during the conduct of such operation. Based on this weighted time study exposure rates, exposure concentrations are established for a specific job within a specific area. According to the Radiation Safety Officer, no one operator is assigned to operations within two critical areas.

74. According to Dr. Healy, the maximum permissible concentration serves as the base line for operations within the plant. If an area is above this base line, the techniques are reviewed and corrections made. If this does not reduce the airborne concentration, then equipment will be replaced and/or operating techniques revised. If air sampling indicates that an area is below this base line regardless of the absolute value of this air sampling, no action is taken to reduce the airborne concentration.
75. According to Dr. Healy, at the present time all areas are below the maximum permissible concentration values except at the monasite sand hopper. A compilation of air sample results is shown as Exhibit H. Dr. Healy stated that at the monasite sand hopper, air samples will show above permissible limits for a brief period. However, if averaged out over a 40-hour work week, the concentrations are below those of the Federal Regulations except as has been reported to the AEC by him.
76. Dr. Healy stated that not every operation within the production facility has been subjected to a weighted time study. In fact no operations within the rare earth processing has been so studied. The Commission representative inquired as to what would cause a given portion of the production operation to be time studied. Dr. Healy stated that if any area, by knowledge of the process, would appear capable of producing an airborne concentration in excess of permissible limits, then a time study is conducted within this area. In addition, if an air sample indicates concentrations above permissible limits, then the operation within the area in which this high concentration was noted is time studied. It should be noted that the utilization of time studies by this licensee is solely for the purpose of determining whether an operation, based on a 40-hour work week, will exceed the permissible limits. The licensee does not use a time study as a basis for limiting the amount of time which any employee spends within a given area within the plant. Rather, based on the time study the licensee arrives at the length of time that a worker in his normal course of work is exposed to a given concentration. Based on this length of time and the measured concentration, if the licensee's employees would be exposed for any given operation to a concentration in excess of that permitted by the Federal Regulations for a 40-hour work week, then the licensee corrects this situation to reduce the airborne concentration of radioactive material. Dr. Healy stated that it is not the intention nor is it the practice of this licensee, to control exposures to airborne concentrations of radioactive materials by limiting the time spent within such concentrations.
77. With the exception of the critical areas which have been time studied, the licensee assumes, according to Dr. Healy, that throughout the remainder of the plant for a determination of employee exposure that the licensee's employees are subjected to no airborne radioactive material resulting from licensed material. With the exception of the critical areas, any time study conducted

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77. Continued

as a result of a "high" air sample is an after-the-fact time study. With the exception of the critical areas, the licensee cannot assign to any employee within his facility a given value based on a time study to show the concentration of radioactive material to which the employee was exposed for the conduct of his work. Dr. Healy states that based on samples within the areas within the facility, he can show whether an employee worked within an area which has shown in excess of permissible limits or which has not shown in excess of permissible limits. However, he cannot place a quantitative value on the airborne concentration to which the individual was exposed within these areas other than those critical areas which have been the subject of a time study.

78. In order to determine whether an employee has been subjected to airborne concentrations in excess of permissible limits, Dr. Healy stated that the following is the sequence of events. An air sample will be taken which will show in excess of permissible limits. The licensee will verify this high air sample with additional samples to establish that the high air sample is valid. Upon a determination that the high sample is a valid measurement, the licensee then performs a weight time study of the operations within the area showing the high airborne concentration. If, as a result of this study, it is determined that employees, based on a 40-hour work week, will be exposed to greater than the concentration permitted by the Federal Regulations, then the licensee considers these employees to have been so exposed.

79. As stated in paragraph 50 above, licensee's employees wear respirators in those areas where it is considered that an airborne concentration in excess of limits may exist. Dr. Healy stated that in determining exposures to airborne concentrations, he gives no credit to the fact that the employee may have been wearing a respirator. He has made application to the AEC for permission to consider the protection provided by the respirator.

80. For "in-plant" air samples, a 5-minute sample is taken using a 35 liter per minute sampler. As mentioned in paragraph 72 above, the frequency of sampling in the critical areas is such that the area is sampled once each two weeks.

81. Exhibit I to this report shows the licensee's technique for analysis and measurement of air samples.

Posting and Labeling

82. Posting and labeling is considered under that section of this report which deals with facilities. It should be noted that insofar as the licensee is concerned, he states that he considers the entire production area of his plant to constitute a restricted area under his control for radiation protection purposes. Consequently, he considers the posting of the sign as described in paragraph 47 above to be adequate area posting from the standpoint of satisfying the Federal Regulations. With the exception of the containers holding finished product, no container or vessel was noted to be posted so as to display the conventional symbol and the words "Caution - Radioactive Material," the material contained, the quantity, and the date of measurement of quantity. License No. R-234 provides an exemption to labeling of containers of natural thorium material used in factory processing operation.

Waste Disposal

83. The licensee states that the radioactive wastes generated by this program consists of normal process wastes from the chemical processes. Dr. Healy states that he has no waste streams as such leaving the plant site. Solid wastes are stored for reprocessing. Liquid wastes are discharged into the pond at "twelve

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83. Continued

acres," and airborne radioactive material is discharged through bag-type dust collectors from the stacks for the processing building. The solid waste stored for reprocessing is in the form of a mud and is placed in a large pile at "twelve acres." Dr. Healy states that the licensee maintains no records to show quantities of waste discharged since none is discharged. The plastic lined burlap sacks in which the ore is received, after being opened for roasting of the ore, are placed inside a hopper and these are transported to "twelve acres" and burned. A smear taken within one of these sacks showed 586 disintegrations per minute alpha. (See Exhibit C, Attachment 5) The licensee hence is in noncompliance with 10 CFR 20.305 for treatment of licensed material by incineration without the approval of the Commission.

84. The licensee contends he releases no waste. Solid waste is stored on his property. Liquid waste is discharged into a pond on his property. Air effluents pass through dust collectors.
85. With regard to liquid waste, Dr. Healy states that all thorium discharged into the pond is in insoluble form such that the extent of thorium in the liquid component of this discharge is within the limits established by the Federal Regulations. In the act of leaching from this pond which has no exit, the solid component (insoluble) will be retained by the soil through which the liquid leaches. Consequently, once the liquid has passed through sufficient soil to leave the restricted area and property of the licensee, it has been leached sufficiently to remove the thorium such that the concentration is within the limits of the Federal Regulations.
86. A sample taken by the licensee from the pond and filtered shows 1×10^{-6} uo/ml on the filtrate. Dr. Healy states leaching through the soil provides the filtering action. The results of samples taken by the Commission representatives are shown in Exhibit C, Attachment 3. Also, see paragraph 64 above.
87. The licensee is disposing of liquid process waste containing thorium by discharge into an enclosed open pond located on licensee property. The licensee hence is in noncompliance with 10 CFR 20.301 for disposing of radioactive material in a manner not authorized by the Federal Regulations and not approved pursuant to 10 CFR 20.302.

Reports of Overexposures and Excess Levels in Concentrations

88. Film badge records show overexposure of 6 individuals. Reports of these overexposures were made by the licensee. Copies of reports appear as Exhibit E.
89. The licensee has notified the individuals of the exposures received. In the licensee's report of May 9, 1962 two of the quarterly totals indicating overexposure include the exposures shown on badges reported by the supplier to be contaminated. These quarterly totals amounted to 1400 mrem and 1380 mrem. Due to the contaminated badges, these totals do not represent the actual exposure received by the individuals to whom the badges are assigned. The same applies to one total of the report of August 1, 1962.
90. Three of the quarterly totals indicating overexposure appear valid. Dr. Healy stated that his investigation disclosed that the overexposures resulted from the storage in a working area of an excess number of drums containing thorium nitrate and of excess time spent by an operator during a filtering operation. In order to prevent any recurrence of these exposures, the number of drums containing thorium nitrate which may be stored within the working area has been reduced from several dozen to six. Operators for the filtering process are being rotated. In addition, the licensee is studying the feasibility of

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Independent Measurements

99. Independent measurements were performed by the AEC representatives throughout the licensee's facility. The results of these surveys and measurements are shown in Exhibit C.

Management Discussion

100. In the absence of Mr. C. T. Deck, Director of Manufacturing (Eastern) and Mr. P. J. Bennett, Plant Manager, the results of this inspection were discussed with Dr. R. M. Healy, licensee Radiation Safety Officer and Head of Products and Processes Development Section. Dr. Healy stated it was the full intent of the licensee to operate in full compliance with the requirements of the Federal Regulations.
101. Dr. Healy stated that practices already in force should prevent overexposures of individuals either to external radiation or to concentrations of airborne activity. Air sampling has been increased and systemized in accordance with the procedures already submitted to the Commission in support of his pending application. Waste disposal into the licensee's waste pond has been described to the Commission. Dr. Healy stated he had no reason to believe that such disposal will be denied. He stated he did not consider the burning of the bags to constitute treatment of the licensed material since the bags were empty. If he is cited for this, he intends to request an exemption to 10 CFR 20.305.

Enclosures:

Exhibits A through K, with attachments

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90. Continued

providing lead shielding at the filtering operation site. Also, Dr. Healy is now furnishing the foreman of each plant area a list of names of operators who show more than 417 area during the first month of the quarter, and 700 area total for the first two months of the quarter. On this list, also, is shown the exposure allowed for the remainder of the quarter so that the foreman may appropriately assign their operators.

91. Before this system could be fully initiated, two additional overexposures occurred for the quarter 4/15/62 - 7/15/62. The report shows one of these exposures (1280 area) included two contaminated badge results. Due to this contamination, this exposure does not represent a true exposure. The second exposure reported (1260 area for) appears valid.
92. The licensee hence is in noncompliance with 10 CFR 20.101(a) for permitting to receive 1390 area whole body exposure and to receive 1160 area whole body exposure for the quarter 1/15/62 to 4/15/62, and for permitting to receive 1260 area whole body exposure for the quarter 4/15/62 to 7/15/62. These exposures are in excess of the 1-1/4 rem exposure specified in 10 CFR 20.101(a). (See also paragraph 84 above and Exhibit E).

Records

93. Receipt of Materials: The licensee's purchasing department maintains records of all receipt of materials. These records show date of receipt, and quantities received. The source material license under which the licensee operates has no possession limit specified for thorium ores for production of thorium components.
94. Transfer of Materials: The licensee's purchasing department maintains a record showing transfer of materials. The licensee does determine the license number of his customers.
95. Surveys: The licensee maintains records of surveys. The licensee routinely performs air sampling surveys and these records are maintained. A compilation of survey results is shown in Exhibit H to this report. Exhibit J discusses the content of these records. In addition to records of airborne surveys, the licensee maintains records of direct reading surveys. A compilation of these results is shown in Exhibit F. The licensee performs no surveys for removable contamination and maintains no records of such.
96. Personnel Exposure Records: (External Sources) Personnel exposure is determined by use of film badges. Film badges are obtained on a monthly basis from the Landauer Company. All operating personnel are badged with the exception of the foreman in the rare earth plant. Film badges are worn on the basis of the calendar month with exchange occurring on the 15th of each month. The licensee does not maintain a Form AEC-4, but does maintain film badge records on equivalents of Form AEC-5. The licensee's maximum permissible limit is 1.25 rem per calendar quarter. These film badge records consist of a Landex file and a supplier's report. Film badges are reviewed for the period January 15, 1961 through April 15, 1962. A review of film badge records showed overexposures as shown in Exhibit E. See paragraph 86 above. A compilation of film badge records is shown in Exhibit E.
97. Personnel Exposure Records (Airborne): A discussion of records of exposure to airborne radioactivity appears as Exhibit E.
98. Waste Disposal Records: The licensee maintains no records of waste disposal. See paragraph 83 with regard to licensee's contention that he disposes of no radioactive waste.

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