UNITED STATES ATOMIC ENERGY COMMISSION

COMPLIANCE INSPECTION REPORT

Name and address of licensee	2. Date of inspection
Spencer Chemical Company Dwight Building Kansas City 5, Missouri	January 20, 1959
	3. Type of inspection Initial
Attention: Mr. L. H. Landrum, Director Nuclear Fuels	4. 10 CFR Part(s) applicable 20 and 40

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

License No.	Date	Expiration	Scope and Conditions
R-218	1-20-58	2-1-59	Scope: Up to 10 kilograms normal thorium oxide - uranium oxide mixture for use in the process research.

Inspection findings (and items of noncompliance)

The licensed program is being conducted in adequate facilities with acceptable radiological health and safety controls for the current program. Records are kept for accountability of licensed material. Records have been kept of waste disposals. Radiation surveys have been made and records kept of the survey findings. A record has been kept of R. S. Landauer's monthly film readings. Records are kept of monthly urinalysis results from Nuclear Science and Engineering Corporation. The Licensee's facilities were found to be posted in accordance with 10 CFR 20.

No items of noncompliance were observed or otherwise noted during the course of this inspection.

7. Date of last previous inspection	8. Is "Company Confidential" information contained in this report? Yes ☐ No ☒ (Specify page(s) and paragraph(s))
August 28, 1958 (Assist inspection by ALOO)	

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Division of Licensing & Regulation
Washington, D.C. (1)

William W. Peery
William W. Peery
(Inspector)

Approved by: Leo Dubinski
Oak Ridge Operations Office
(Operations office)

March 19, 1959
(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.

RECOMMENDATIONS SHOULD BE SET FORTH IN A SEPARATE COVERING MEMORANDUM

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DETAILS

I. GENERAL INFORMATION

9. On January 20, 1959, an initial inspection was made of the special nuclear and source material programs being conducted, under License Nos. SNM-154, C-3571 and R-218, by the Spencer Chemical Company in their Jayhawk Plant near Pittsburg, Kansas. Visits were made to the Spencer Chemical Company's offices in Kansas City, Missouri on January 19 and January 21 and the inspection of the Jayhawk Plant facilities was made on January 20, 1959. Spencer's Kansas City offices were initially visited to discuss administrative controls exercised by the Kansas City office over the licensed programs at the Jayhawk Plant. The second visit was made to the Kansas City office on January 21, to discuss the inspection findings at the Jayhawk Plant with the appropriate and responsible administrative personnel.

10. On August 28, 1958, the Licensee Inspection Division, Albuquerque Operations Office made an assist inspection of the activities being conducted under License Nos. C-3571, R-218 and SNM-154, in the Spencer Chemical Company's Jayhawk Plant at Pittsburg, Kansas. A copy of the Albuquerque covering memorandum and inspection report will be transmitted at the time this report is submitted to Washington headquarters.

11. Dr. Peter A. Morris, Division of Inspection, Headquarters, and Mr. J. T. Sutherland, Inspection Division, OROO, accompanied W. W. Peery, Inspection Division, OROO, on the visits of the 19th and 20th while only Mr. Sutherland accompanied Mr. Peery on the visit of the 21st. Dr. Morris' primary purpose in the visits was the evaluation of the criticality aspects of the programs being conducted under SNM-154 and his findings, observations and conclusions are included as an integral part of this report.

12. Licensee personnel interviewed at Spencer's Kansas City offices included Mr. H. R. Dinges, Vice President, Industrial Chemicals Division, Mr. L. H. Landrum, Manager of the Nuclear Fuels Department and Mr. Gordon Crowe of the same Department. Mr. Crowe reports to Mr. Landrum, who reports to Mr. Dinges. Persons contacted at the Jayhawk Plant included Mr. G. E. Chenoweth, Superintendent; Mr. R. Jopp, Assistant Superintendent in charge of the nuclear fuels plant operations and maintenance; Mr. E. G. Marhofer, Supervisor of the laboratory; Mr. F. L. Turbett, experimentalist; and Mr. J. E. Smith, Safety Director. Messrs. Jopp, Marhofer and Turbett report to Mr. Chenoweth who reports to Mr. Landrum.

II. ORGANIZATION

13. The individuals interviewed and their corresponding capacities reflect some changes in personnel and their assigned responsibility from that submitted in the Licensee's application dated September 15, 1957, and a part of the Licensee's application bearing the title "Health and Safety in Handling Uranium", dated February 19, 1958. Mr. L. G. Stevenson was previously responsible for many of Mr. Chenoweth's current duties including responsibility for over-all radiological health and

complete inventory of all licensed material. Mr. Jopp has assumed Mr. Stevenson's duties as supervisor of the pilot plant operation. The above personnel changes resulted from an organizational change about the beginning of 1959. Prior to this time, responsibility for the licensed program was assigned to the Research & Development Division which has as its director, Dr. N. C. Robertson. Personnel of the R & D Division conducted the program as described in the application. Responsibility for the program has now been assigned to the Nuclear Fuel Department which was created within the Industrial Chemicals Division. Only a part of the personnel previously associated with the licensed program were transferred to the new department. Mr. Landrum, Manager of the Department, has a small staff in the Kansas City office and Mr. Chenoweth, Superintendent of the Jayhawk Plant, licensed activities, has a staff of 12 to 18 operators of whom 6 to 8 are salaried. Mr. Jopp supervises the operation of the pilot plant and has four shift foremen and operators who report to him.

The Company relies on Dr. R. Mesler for technical evaluation of criticality aspects of their special nuclear material program. Dr. Mesler is a professor of Chemical Engineering at the University of Kansas, Lawrence, Kansas. Dr. Mesler's background includes the Oak Ridge School of Reactor Technology, 1951 - 1952, Ph.D., University of Michigan, 1955, Project Engineer for the Ford Nuclear Reactor and Assistant Professor of Nuclear Engineering, University of Michigan, 1955 - 1957.

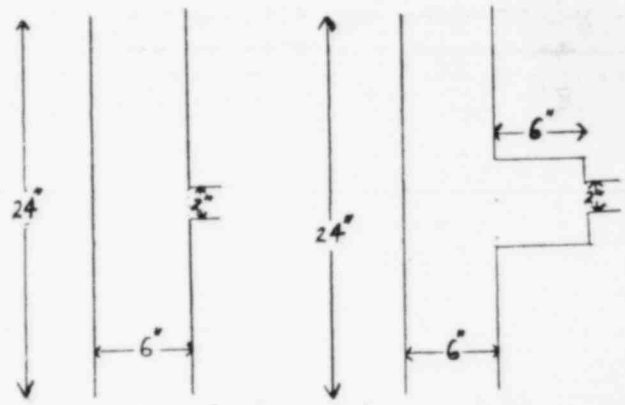
III. FACILITIES

14. The Spencer Chemical Company has general offices in Kansas City, Missouri with the Jayhawk Plant being one of six Company plants located in various sections of the country. The Jayhawk Plant is located in Kansas approximately 25 miles south of Pittsburg, Kansas and about 20 miles west of Joplin, Missouri. The facilities being used at the Jayhawk Plant for the licensed programs include the pilot plant process contained in Building 709, a separate analytical laboratory and a storage vault separately located in Building 703. Limited quality control work is being done in a building which has been designated as the facility in which the Licensee plans to install process equipment of essentially the same design as that currently in use in the pilot plant. Processing would be more on a production scale in the larger building. Facilities for conducting the quality control tests consist of a heliarc welding unit, a small nonflammable box in which samples are fused and a funneled duct and blower to exhaust fumes to the outside atmosphere. The area is posted and entry is somewhat restricted by placement of cabinets and other equipment to form a perimeter to the area. A facility separate from the pilot plant is provided for clothing changes prior to entering and after leaving the pilot plant. Coveralls are furnished to pilot plant personnel and laundry equipment is available in the building. A lunch room is also provided in the change room area.

15. The process equipment in Spencer's pilot plant largely conforms to that described in their application of May 16, 1958, with exceptions noted as follows:

    a. The separation sections at the top of the two pulse columns instead of being cylinders of 6 inch I.D. by 2 feet in length are actually 6 inch I.D. by 2 feet sections with tees of similar I.D. and approximately 6 inch length. (See diagram below)

(1) As indicated on application (2) Actual Installation



The 2" pipe leading away from the column does not tie directly into the 24" section but rather into the 6" tee on the side of the section.

b. Insulating material several inches thick is present around a 6 inch process vessel (evaporator EP-16), forming a reflector. From the back-up material there is no indication that insulating material is specified for the evaporator although this may be a type item generally understood where heat is involved.

15. Radiation survey instrumentation consists of the following:

3 Sears Roebuck "Tower", model 6159 GM survey meters.

1 Nuclear-Chicago model 2612 GM survey meter.

Two of the "Tower" survey meters were randomly tested for reaction to a radiation source and found to be responsive. These instruments are not suitable for surveying for α radiation.

17. Storage facilities consist of a concrete vault, approximately 14 x 20 ft., which is equipped with a steel combination lock door. The section of Building 703 in which the vault is located is empty at the present time. The vault is provided with a floor drain, exhaust fan, and has a steam radiator mounted on one wall. No provisions for physical separation of SNM containers other than bird cages (such as shelves, racks or cupboards) are available in the vault.

18. Spencer Chemical Company has submitted plans of its proposed radiation alarm system to the Division of Licensing and Regulation for approval as required by 10 CFR 70.24. The application was dated December 19, 1958, and requested that all of the plans be considered Company Confidential. The Division of Licensing and Regulation requested in a letter to the Licensee, dated January 19, 1959, that Spencer withdraw or re-phrase

their request so that parts of the proposal would not be unnecessarily classified Company Confidential. It is noted that the Licensee's application was not submitted within the 30 day period stipulated in 10 CFR 70.24.

IV. PROCESS DESCRIPTION AND PURPOSE

19. The purpose of the Licensee's pilot plant is to process several types of starting uranium bearing materials for use in the fuel cycle of nuclear energy. The purified uranium compounds from the process may be used in research and development and/or actual core material for nuclear reactors. Purification is done principally by solvent extraction and the process is designed to produce primarily UO_2 from UF_6 or scrap. Further compounding of Spencer's purified materials by the ultimate consumer may be necessary since it is the policy of Spencer not to compete with their customers in manufacturing uranium containing products for specialized uses. The pilot plant was originally designed to process uranium of any enrichment in accordance with the license approval received for their application dated September 15, 1957. The current program at Jayhawk is being conducted in process equipment modified in accordance with licensed approval received for their application dated May 16, 1958. This last approval was granted for processing only materials containing up to 5% enrichment. The process equipment must be physically modified for enrichments up to 10% and further modified so that the equipment originally approved in the September 15, 1957, application is used for enrichments > 10%.

20. Changes in the enrichment of materials being processed are said to require approval of the department manager, before execution. The differences noted in process equipment from that approved under the license were brought to the attention of Messrs. Landrum and Chenoweth. They were informed that the Division of Inspection would probably recommend to the Division of Licensing and Regulation that an amendment be required to SNM-154 before operations are permitted with highly enriched material. It was explained that an amendment to the license approving the equipment that differs from that presently approved should particularly be sought. Messrs. Landrum and Chenoweth were also advised that the Licensee should always consult the Division of Licensing and Regulation when there is any doubt whether an amendment to their license is required or whether changes in equipment or procedures should be reported, before such changes are made. Both men concurred with these proposals and indicated that such a procedure would be followed in the future.

21. At the time of the visit the plant was in operation, processing natural uranium, according to procedures described in the license application, to produce UO_2 powder. The Licensee had on-hand scrap UO_2 pellets, enriched to 1.5% of U-235 which are scheduled to be processed within about one week. There are no plans to process material with enrichments greater than 5% in the near future, however, it is planned that material of higher enrichment will be processed at some time in the future and the process equipment presumably will be modified to conform with that approved in the license. Mr. Chenoweth indicated that it is expected that the present processing facility will be moved to the larger building by about mid-summer of 1959, at which time a larger inventory of special nuclear material will be desired. It is planned that all licensed

material will be confined to this building. This arrangement is desirable because it increases the control of the licensed material in the Jayhawk Plant which is also engaged in the production of agricultural chemicals.

V. CRITICALITY CONTROL PROCEDURES

22. General procedures and operating rules to insure criticality safety are used, as described in the license. Check list procedures are not in use, however, log book and data sheets are used for control of the process. Samples are taken and analyzed routinely each shift as a control measure. Non-routine samples are also taken when it is deemed necessary. Generally, criticality control is obtained by maintaining "ever-safe" geometry and mass limitations. The analytical samples are used in part to determine mass by establishing solution concentration before transfer to a vessel whose geometry is not "ever-safe". Safe geometry is frequently dependent on administrative control. Isotopic assay of materials received and shipped is not currently done at the Jayhawk Plant. Information on assay of highly enriched material in the past has been obtained from the shipper, however, they are considering plans for doing isotopic analysis of highly enriched material to be done at the Jayhawk Plant. Stainless steel catch pans are provided under practically all vessels in the process and criticality safe catch pans are provided under all vessels that present potential spills of unsafe volumes of up to highly enriched materials. Spills would probably be observed soon after they occur since operating personnel are present on a 24-hour basis. The Licensee's process equipment contains the inherent possibility of leakage from vessel to jacket and vice-versa thus creating a possible criticality hazard. Control of this hazard is the responsibility of the operators diligent observance of pressure differential changes and visual changes in volumes of associated vessels. Some of the tanks in the process are not criticality safe, these are primarily storage tanks and the valves leading to these tanks are said to be controlled by supervision and analysts who are responsible for determining that U-235 concentrations are below approved amounts before transfer of the solutions to the unsafe tanks. Overflow of solution from the evaporator (EP-16) to water storage tanks (T-11) could result in a criticality hazard. An overflow container has been installed to prevent this, however, this control is dependent on an operator's visual check of the container at 30 minute intervals. Control of mass safe limits in process furnaces is dependent on visual determination by operators that 15% of furnace tube capacity is not exceeded and that no greater than accepted amounts of uranium throughput exists. The control of all the foregoing possible criticality hazards are largely dependent on the diligence of direct plant supervision and operators.

23. Administrative personnel are responsible for modifying the process equipment to meet the licensed approved specifications for materials of a particular enrichment. Administrative personnel are also responsible for assuring that only material of single isotopic analysis will be used in the system at one time. It was noted that the Licensee's nuclear material storage vault is also used for storing Company documents in filing cabinets, and is, therefore, accessible to personnel outside the Nuclear Fuels Department. It was pointed out to Mr. Chenoweth that the Division of Licensing and Regulation would probably expect that access to the vault be limited to personnel in the Nuclear Fuels Department who are responsible for the material stored there and also desire that there be limited access to the vault before approving an increased SNM inventory in an expanded program.

VI. QUALITY CONTROL AND PROCESS CONTROL SAMPLE ANALYSIS

24. The fusing of UO_2 samples is done to determine the sintering qualities of this product. Small samples of approximately one gram are fused with heat from a heliarc unit. The samples are placed in graphite crucibles and fired with the heliarc inside a small non-flammable box. Shaded glass is used by the technician to view the process through a small opening in the top of the box.

25. Colorimetric analysis of samples are made in the laboratory to determine uranium content. Mr. Marhofer is responsible for control of these samples in the laboratory. Samples from various points in the process are analyzed in this laboratory as an integral part of process control both from the standpoint of quality and criticality considerations.

26. The license requires that blending of material be done in a dry atmosphere. In the past this was done by purging the blends with nitrogen before each blending. The material from the dry box to blender is conveyed in closed containers. Since the inspection we have been informed that the blender now has a direct connection with the dry box to utilize the same dry gas for control of moisture. Mr. Chenoweth stated that a moisture analysis is made daily on the oxide powders and the results have consistently indicated a moisture content of 0.1 to 0.2% by weight.

27. Spectrographic analysis of samples from the Licensee's program is being made at Rockhurst College, Kansas City, Missouri under SNM-257 issued to the College on October 21, 1958. This program was inspected on January 22, 1959, and the inspection findings are contained in a separate report dated February 5, 1959. This report contained one item of non-compliance with 10 CFR 20.401(c) in that the Licensee had not maintained records of surveys as required by this section of the regulations. The issuance of SNM-257 corrected one item of noncompliance cited in Item 6 of Form AEC-417 submitted with ALOO report dated 7-11-58 and included as attachment A of this report.

VII. ACCOUNTABILITY

28. Complete and systematic records are kept of materials received and transferred in the Licensee's program. Mr. Chenoweth is responsible for keeping such records. A separate record is kept of each shipment of material from receipt, during processing and through transfer of Spencer's finished product. Special nuclear materials inventory from July 30, 1958, to December 31, 1958, reflects the following:

	Uranium Compounds	U-235 Content
Total Receipts	644,695 grams	14,083 grams
Shipments	448,865	11,601
	195,820	2,482
Losses	2,734	116
On Hand	193,096	2,366
Previous Inventory	3,458	594
Total On-Hand	196, 554	2,960

Of the total on-hand SNM, 196,069 grams are scrap UO_2 pellets of 1.5% enrichment from the Commonwealth Edison Company. Only small amounts of normal material to 2268 grams have been transferred under License No. R-218. Small amounts of material remaining on-hand from receipts under C-3571 are said to be covered now under License No. C-4352 and future orders of similar materials will be made under the new license. License No. C-3571 expired September 1, 1958, and R-218 expired February 1, 1959. The approaching expiration of R-218 was called to the attention of Mr. Chenoweth. The Inspection Division, ORDO, did not receive a copy of License No. C-4352 and back-up material until February 19, 1959. In a letter, dated September 8, 1958, the Division of Licensing and Regulation authorized receipt by the Licensee, prior to June 30, 1959, of 227 kg of normal uranium as UF_6 for use under License No. C-3571. The date of the authorization letter and the final authorized delivery date in the letter are both after the expiration date of the license. A complete audit of the Licensee's material receipts and transfer records was not made, however, the manner in which such records are being kept indicates that an accurate accounting can be made at any time. The Licensee establishes eligibility to receive before transfers of licensed material are made to the recipient.

VIII. WASTE DISPOSALS

29. The uranium content of waste tanks is determined before the tank is discharged to the settling basin and/or the effluent stream from the plant which flows into an unrestricted stream adjacent to the Spencer Jayhawk Plant property. The settling basin has a water flow of about 950,000 gallons/hr. which gives a considerable dilution factor. A record is kept of the analytical results of samples taken of wastes discharged to the settling basin and thence to the Jayhawk waste treatment plant. The record of waste tank analysis shows a discharge of uranium to the settling basin of solutions containing to .6 grams/liter and other sample results indicate that discharge to the settling basin has averaged approximately .05 grams/liter. During the month of November 1958, a representative total of 767 grams of uranium was discharged to the settling basin at the above rate of approximately .05 grams/liter. With the above amounts of material diluted by the settling basin water flow and the over-all plant effluent results in a concentration of less than 7×10^{-6} µc/ml (specified in 10 CFR 20.103 as the MPC). The g/liter units used above are operational procedure limits, but sufficient records in µc/ml units are kept to meet the requirements of Part 20. Records were not available of results of analysis of samples taken at the point of discharge of waste stream from the uranium facility to the unrestricted area but any measurements at this point should be even less than discussed above because of additional dilution. However, Mr. Chenoweth and Mr. Smith, Safety Director, stated that the State of Kansas Health Department has counted such samples for them and reported no radioactivity greater than permissible levels of 10 CFR 20. The Kansas Health Department informed them that a study of the natural radioactive content of the stream adjacent to and up-stream from the Jayhawk Plant should be made for more accurate determinations of the activity being contributed to the stream by the Jayhawk Plant. These were random "grab" samples, and no routine, constant sampling method is in use at this point in the plant effluent. Messrs. Smith and Chenoweth indicated that any

available past sample results and future results on such samples will be kept. A record of the sample counts on settling basin water and silt from 11-5-58 to 12-9-58 shows gross beta and gamma levels of .6 x 10^{-9} to 13 x 10^{-9} μc/ml. Mr. Smith stated that these samples were also counted by the Kansas State Health Department. These are also "grab" type samples. This present method of sampling is adequate since samples taken of wastes prior to discharge to the pond have not shown levels greater than MPC for discharge to unrestricted areas, for the processing currently being done. However, if an increase is seen in the uranium content of waste tank samples, constant sampling of the effluent would be necessary for adequate evaluation of waste disposals to unrestricted areas.

IX. RADIOLOGICAL SAFETY PROCEDURES

30. Written radiological health and safety procedures were submitted as a part of the application, however, these are mostly explanations and descriptions of material and not specific detailed safety rules for the program. Pilot plant personnel are verbally instructed to laundry coveralls daily, however, no routine monitoring of clothing has been ordered by written procedure. The plant operating procedures could more nearly be considered safety procedures, however, neither has been distributed or discussed with personnel to assure complete familiarity and no periodic sessions are held to impress, remind, or instruct personnel in radiological health and safety or to re-emphasize the importance of adherence to established procedures designed to control criticality hazards. Mr. Chenoweth stated that to his knowledge personnel have not been expressly given an explanation of the nature of an accidental criticality excursion and the scope of the potential hazard.

X. RADIATION SURVEYS AND PERSONNEL MONITORING

31. Records kept of radiation survey findings indicate relatively low alpha and beta contamination. Levels of the order of 300 - 400 d/m alpha activity and readings on smears with GMSM of .02 to .09 mr/hr. beta have been detected. A record has been kept of routine readings taken in the plant area with GMSM w/thin window tube. These readings range from natural background to 4 mr/hr. with most readings between background and .5 mr/hr. Mr. Smith stated that corrective action is requested for any readings observed to be as much as 1 mr/hr. Establishment of the above survey records may be considered corrective action for the survey record deficiency reported as an item of noncompliance in ALOO report of 9-11-58 and included as Attachment A of this report.

32. Available sample results covering the period from 9-4-58 to 12-1-58 show levels of air activity for alpha and beta ranging from 1.01 x 10^{-13} to 2.2 x 10^{-13} μc/ml. These air samples are randomly taken with a portable sampler of the filter paper disc type with a calibrated air flow. Samples have been taken at some points in system where airborne radioactivity is likely to occur, however, Mr. Chenoweth stated that samples had not been taken at the blender or at least he knew of no sample results from that location. Mr. Chenoweth agreed that air samples at the blender location, during blending, appeared desirable and that such sampling would be done. It was pointed out to Mr. Chenoweth that additional and routine air sampling procedures would make a more complete evaluation of the air contamination status of the Jayhawk processing plant possible. Air sampling of the sintering process was also discussed.

Mr. Chenoweth agreed that such sampling was needed and would be initiated.

33. Personnel in the Licensee's program are monitored with a monthly film badge service furnished by R. S. Landauer Company, Park Forest, Illinois. Records are kept of the Landauer reports as well as a cumulative record of each individual's radiation dose. Records from August 1958, to December 1958, show no monthly exposures >45 mrem gamma or 115 mrem beta except for one individual. The Landauer report of October 1958, indicated that J. D. Rogers received a dose of 35 mrem gamma and 880 beta. The monthly Landauer report for December 1958, showed that Rogers received a dose of 475 mrem gamma and 7450 beta. Mr. Chenoweth stated that it is the consensus of the responsible Spencer personnel that Rogers received the above doses as a result of work with the heliarc unit which is used for fusing the uranium oxide samples to test the sintering qualities of the material. Rogers received the higher film readings on each occasion after working with the sintering process. Spencer supervision theorize that the exposures were possibly caused by low energy rays from the heliarc welder (presumably low energy x-rays). It appears doubtful that these are true beta readings. However, similar readings were not seen on the film of another man who directly assisted Rogers in the sintering tests. This difference may be due to the position of the two film badges relative to the source of low energy rays. Procedure dictates that film badges will not be taken out of the plant area. Mr. Chenoweth stated that potential non-occupational causes of the film readings, such as medical x-ray, are being investigated. Controlled film monitoring of the heliarc is planned with assistance from Landauer in evaluating the results. Mr. Chenoweth was informed that the incident was reportable under 10 CFR 20.403(c). Mr. Chenoweth stated that the incident would be reported as required but that it is planned to include in the report as much information as the investigation of the incident reveals, within the 30 day reporting limit. Mr. Chenoweth further stated that shielding will be placed around the sintering process if the need is indicated by the controlled film monitoring.

34. The Licensee is provided with a monthly urinalysis service from the Nuclear Science and Engineering Corporation, Pittsburg, Pennsylvania. The results reported since the inspection of the program by ALOO were not found to be significantly different with an average of approximately .006 mg/l reported.

XI. POSTING

35. The Licensee's facilities were found to be posted in accordance with the requirements of 10 CFR 20.203(e)(1) & (2), and (f)(1) & (2). The analytical laboratory was not posted, however, at the time of this visit posting was not required for this area. Posting requirements for the laboratory were discussed with Mr. Chenoweth as an aid in meeting future posting needs in this facility. The above posting findings may be considered as constituting adequate corrective action for the items of non-compliance with 10 CFR 20.203 as reported in Item 6, Form AEC-417 of the ALOO report dated 9-11-58.