LRL:GPM
Docket No. 70-210

OCT 1 1959

Spencer Chemical Company
Dwight Building
Kansas City 5, Missouri

Attention: Mr. Harold Lambertus
General Manager

Gentlemen:

Enclosed is Special Nuclear Material License No. SNM-329.

Very truly yours,

J. C. Delaney
Chief, Nuclear Materials Section
Licensing Branch
Division of Licensing and Regulation

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Form AEC-318 (Rev. 9-53) U. S. GOVERNMENT PRINTING OFFICE 16—62761-8

Form AEC-401
(1-56)

UNITED STATES
ATOMIC ENERGY COMMISSION

SPECIAL NUCLEAR MATERIAL LICENSE

Pursuant to the Atomic Energy Act of 1954 and Title 10, Code of Federal Regulations, Chapter 1, Part 70, "Special Nuclear Material Regulations," a license is hereby issued authorizing the licensee to receive and possess the special nuclear material designated below; to use such special nuclear material for the purpose(s) and at the place(s) designated below; and to transfer such material to persons authorized to receive it in accordance with the regulations in said Part. This license shall be deemed to contain the conditions specified in Section 70.32(a) of said regulations, and is subject to all applicable rules, regulations, and orders of the Atomic Energy Commission now or hereafter in effect and to any conditions specified below.

Licensee

1. Name: Spencer Chemical Company

2. Address: Dwight Building
Kansas City 5, Missouri

3. License No.: SNM-329

4. Expiration Date: September 30, 1962

5. Docket No.: 70-310

6. Special Nuclear Material

Uranium enriched to 5% in the U-235 isotope.

7. Maximum quantity of special nuclear material which licensee may possess at any one time under this license

One thousand (1000) kgs U-235 contained in uranium enriched to 5% in the U-235 isotope.

8. Authorized use: For the chemical processing of uranium enriched up to 5% in the U-235 isotope in accordance with the procedures described in the licensee's applications of June 22 and July 28, 1959.

9. Quantity of special nuclear material allocated to licensee pursuant to Section 70.31(b) of said part

None

CONDITIONS

10. Unless otherwise specified, the authorized place of use is the licensee's address stated in Item 2 above.

This activity authorized in the licensee's Jayhawk Works located between Pittsburgh, Kansas and Joplin, Missouri

For the U. S. ATOMIC ENERGY COMMISSION

OCT 1 1959

Date of issuance

U.S. GOVERNMENT PRINTING OFFICE: 1956—O-305852

J. C. Delaney
Division of Licensing and Regulation

10/1/59

20-340
File Cy

SPENCER

Spencer Chemical Company

DWIGHT BUILDING

Kansas City 5, Missouri

June 22, 1959

Mr. J. C. Delaney
Division of Licensing and Regulation
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Mr. Delaney:

We are submitting herewith three copies of our license application covering a facility for handling uranium up to and including 5% enrichment in U-235. The system is designed to process either UF_6 or scrap to an oxide, nitrate or sulfate.

At the present time we are operating a similar but smaller facility under license No. SNM-154, and plan to continue its operation. The plant covered in this application also is to be located at our Jayhawk Works, but is physically located approximately one quarter mile from the smaller plant. Therefore, we are requesting a new license for the facility described in this application. The same laboratory facilities will serve both plants. Our current plant superintendent will have responsibility for both plants.

The new facility is under design and construction and we are planning to have it ready for operation by August 1, 1959. On that date depleted UF_6 will be used as feed for the startup operation. If there is any further information required, please contact us immediately by collect telegram or telephone in order to prevent any undue delay in the consideration of this application.

Yours very truly,

Nuclear Fuels Department

Harold Lambertus

Harold Lambertus
Manager

HL:el

Enclosures: ~~Four~~ Three copies of license application, as noted.

DOCKET NO. 70-340

File Cy.

SPENCER CHEMICAL COMPANY

NUCLEAR FUELS DEPARTMENT

APPLICATION FOR

SPECIAL NUCLEAR MATERIAL LICENSE

June 22, 1959

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I

INTRODUCTION AND APPLICATION

1. This application for a special nuclear material license is submitted by Spencer Chemical Company. The company is incorporated in the state of Missouri and has its principal office in the Dwight Building in Kansas City, Missouri. The principal officers of the Company are:

   K. A. Spencer - President

   C. Y. Thomas - General Vice President (Operations)

   J. P. Miller - General Vice President (Finance)

   J. E. Culpepper - General Vice President (Marketing)

   E. V. Friedrich - Vice President, Administration, and Assistant Secretary

   J. C. Denton - Vice President, Agricultural Chemical Division

   H. R. Dinges - Vice President, Industrial Chemicals Division

   F. L. Pyle - Vice President, Plastics Division

   N. C. Robertson - Vice President, Research and Development Division

   E. W. Morgan - Treasurer

   A. Mag - Secretary

2. All these officers have their offices in the Dwight Building except for Mr. Mag whose address is 9 West Tenth Street, Kansas City, Missouri. All are natural born citizens of the United States. The company is not controlled by any alien, foreign corporation or foreign government.

3. This license is requested for the processing of any enrichment of uranium up to and including 5%. The uranium in the form of UF_6 or scrap is to be converted to the oxide. The processing will be done at the Jayhawk Works of the Spencer Chemical Company located between Pittsburg, Kansas, and Joplin, Missouri, with a freight shipping designation of Military, Kansas.

4. The license is requested for ten years.

5. The product of the process normally will be finely divided UO_2 powder. Oxides other than UO_2 may also be produced as finely divided powders. Nitrates and sulphates may also be produced.

6. The uranium will be processed for other licensees. Plant start-up is scheduled for July 20, 1959. The maximum design processing rate is 300 pounds of uranium per day. The actual processing rate will depend upon the exact nature of the feed material and upon customer demand. Inventory of U-235 at the plant will not exceed 1,000 kilograms. Processing losses generally will be held to less

than one percent, but may exceed this for small lots.

7. The Spencer Chemical Company is currently engaged in the manufacture of ammonia, nitric acid, ammonium nitrate, polyethylene, nylon, urea, methanol and other similar products. Since December 1, 1957, Spencer has been operating a uranium oxide pilot plant (under license No. SNM-154) and has gained much valuable experience in the handling and processing of enriched uranium.

II

QUALIFICATIONS OF PERSONNEL

1. The processing of uranium is the direct responsibility of Harold Lambertus, Manager, Nuclear Fuels. Mr. Lambertus reports directly to H. R. Dinges, Vice President, Industrial Chemicals Division.

2. Mr. Dinges received a B. S. degree in chemistry from College of William and Mary in 1938, where he also served as instructor from 1939 to 1941. He was employed by E. I. duPont de Nemours and Company 1941-42, and Olin Mathieson Chemical Company 1942-47 before joing Spencer Chemical Company in February, 1947. Since February, 1957, Mr. Dinges has been Vice President, Industrial Chemicals Division.

3. Mr. Lambertus received his B. S. and M. S. degrees in Mechanical Engineering from Purdue University and California Institute of Technology respectively. He was employed in 1946 by the American Bearing Corporation where he received a background in engineering, sales and production. He was a vice president at American Bearing prior to his leaving there in 1958, and was responsible for the planning, building and staffing of a nuclear fuel element manufacturing facility. Just prior to joining Spencer Chemical Company as Manager of the Nuclear Fuels Department in April, 1959, Mr. Lambertus served as a consultant to several manufacturers of nuclear fuel elements.

4. The operation of the uranium processing plant is the responsibility of George E. Chenoweth, Plant Superintendent. Mr. Chenoweth received a B. S. degree in chemical engineering from the University of Missouri in 1951. He was employed by Phillips Petroleum Company from 1951 to 1952, and joined Spencer Chemical Company in 1952. He has been responsible for much of the process equipment design for the experimental uranium facilities and has been in charge of the operation of the uranium pilot plant facility since January 1, 1959.

5. Mr. Sinesio A. Zagnoli has been responsible for a major portion of the process design. Mr. Zagnoli received his B. S. in chemical engineering from Purdue University and his M. S. in chemical engineering and M. S. in gas technology from Illinois Institute of Technology. He had some three years of industrial experience with petroleum and natural gas industry before his entry into

atomic energy activities in 1952. He entered the atomic energy program with Nuclear Power Group in Chicago representing the Commonwealth Edison Company. He participated in several studies made by the Public Service Company of Northern Illinois and Commonwealth Edison Company before the latter joined Nuclear Power Group. With NPG Mr. Zagnoli's work was with heat transfer, fuels processing and fuel element metallurgy. He joined Spencer Chemical Company in October 1955, and has helped plan and design experimental programs and facilities, and has made economic analyses of various projects in the atomic energy field.

6. Dr. Russell A. Mesler of the University of Kansas is our consultant for criticality considerations. Dr. Mesler's background includes the Oak Ridge School of Reactor Technology 1951-52; Ph.D., University of Michigan 1955; Project Engineer for Ford Nuclear Reactor and Assistant Professor of Nuclear Engineering, University of Michigan, 1955-57. He is presently Associate Professor of Chemical Engineering at the University of Kansas.

III

PROCESSING AREA

1. The following equipment and facilities will be used to protect health and minimize danger to life and/or property.

2. The building used for uranium processing is constructed of a steel framework and covered with transite siding. The building measures 45' x 112' and is 30' high except for a 50' high bay in the center of the building.

3. The processing equipment will be located along the east half of the building only. Storage area has been provided in the west side of the building.

4. A fence encompasses the entire Jayhawk plant works and entrance into the plant area is controlled by a 24-hour guard force.

5. Tornadoes are a possibility in Kansas. Plant design is on the premise that a condition of criticality resulting from tornado damage would do negligible damage compared to that of a tornado.

6. The building site is 30 feet above any previous flood stage.

7. Loss of electrical power presents the hazards of loss of ventilation and an inoperative radiation alarm system.

8. In compliance with section 70.24 a radiation alarm system will be installed in the plant. Two detectors will be located in the plant, one on the ground level near the hydrolysis and scrap dissolution area and one on the first balcony at the panel board. These positions are indicated on the plot plan

(Drawing No. 1-2600-4). Outside alarm horns will also be connected to these alarms which will be clearly audible in the surrounding area.

9. The monitoring system to be installed is the Nuclear Measurements Corporation Gamma Alarm system (GA-2). This system consists of individual integral units containing the detector, power supply, meter, alarm bell, alarm lights and relays for connecting external warning devices.

10. These units will be set to give an alarm when the meter reads 6 mr/hr. or more. The time constant of this instrument is 2 seconds so that a 6 mr/hr reading would occur after the following delay times when the radiation level at the detector is instantaneously changed to a higher value:

50 mr/hr	0.236 sec.
100 mr/hr	0.118 sec.
500 mr/hr	0.024 sec.

Once the meter reads 6 mr/hr, the alarm would sound within 0.1 second. The response time will be verified by tests after the system is installed.

11. The detector will be activated by a low level source installed at the probe so that the meter reads at least 0.1 mr/hr under normal conditions. If failure of the instrument causes the meter to drop to 0.05 mr/hr, a light on the unit (normally on) will go out. Another light on the unit indicates the instrument is drawing current.

IV

PRECAUTIONS FOR SAFETY

1. The following procedures are proposed to protect health and minimize danger to life and/or property.

2. All personnel working with uranium are required to pass a complete medical examination including a chest x-ray before starting to work. Monthly urine samples will be analyzed for uranium. Chest x-rays will be required annually. No smoking or eating will be permitted in the uranium processing building.

3. Coveralls, safety shoes, safety glasses, acid goggles, dust masks, and rubber gloves are furnished for all personnel working in the plant. A change house and locker room are provided so clothing may be changed before entering the plant area. A washing machine is provided and coveralls must be washed daily after use. Individual film badges are provided and are checked monthly.

4. Good housekeeping will be exercised. Wet mopping will be performed in order to minimize air polution.

5. Any minor spills will be cleaned up immediately both to recover the uranium and to avoid spread of contamination. Clean-up solutions will be stored in safe containers awaiting return to the process. Major spills may necessitate orderly plant shutdown and reducing of the inventory of uranium in the spill area to allow more freedom of movement.

6. Portable Geiger counters will be available in the plant for surveying working areas for contamination. Building and exhaust air will be sampled to see that concentrations are below permissible limits of 5.0×10^{-11} and 1.7×10^{-12} microcuries per ml respectively.

7. Aqueous wastes will be discharged to the sewer which carries an average daily flow in excess of ten million gallons away from the plant. The quantity of waste released to the sewer will be limited to a quantity which, if diluted by the average daily flow of sewage, will result in an average concentration less than 2×10^{-4} microcuries per ml. These conditions are set by Title 10, Part 20, Code of Federal Regulations.

8. Only one uranium container may be in motion at any one time and no uranium container may be moved unless all other uranium containers are in approved locations.

9. The uranium processing building will be posted and uranium containers will be labelled according to Title 10, Part 20, Code of Federal Regulations. Outside shipping containers will be labelled according to ICC regulations.

10. Safe geometry storage is provided for all process streams. Before pumping any solution from safe waste storage tanks to the sewer, it is to be sampled to assure that the uranium concentration is below the permissible level.

11. While the building housing the plant is essentially fireproof, a fire in the processing area presents three problems. First, the organic phase for extraction is inflammable. Second, the reducing atmosphere in the furnace is both inflammable and explosive. Third, water used in fighting a fire could mix with uranium and create a criticality condition. CO_2 will be used to control any fire in the uranium building and the plant fire department is instructed not to use water unless requested to do so by the Plant Supervisor. Precautions have been taken to prevent explosions of the atmosphere in the furnace. In the event of a fire or explosion, the area will be surveyed for uranium contamination prior to re-entry.

12. The radiation alarm detectors will be checked hourly and the meter reading recorded on log sheets. The built-in low-level source provides a calibration check at one point. A portable source will be used to check the instrument at higher levels. The calibration will be checked once per week.

13. A training program will be initiated for all personnel who would be affected by a high radiation incident. Instructional meetings will be held for all people involved in the handling and processing of uranium to familiarize them with the alarm system and the proper procedures for evacuating the area in the event of a radiation incident. Unannounced practice evacuation drills will be held once a week the first month, another one a month later and then once every three months.

14. Criticality is avoided primarily by proper spacing of "always safe" geometry vessels. Concentration and mass control is exercised in handling dilute solutions. Mass and moderation control is exercised in handling dry UO_2 and in shipping and storing scrap uranium. A combination of mass, volume and moderation control is used in specifying containers for shipping and storing UO_2 product. All safe parameters are safe with a thick water reflector. The interaction between all vessels containing uranium in significant concentrations is within allowable limits.

15. A process description and equipment layout are presented in the appendix with a discussion of methods used for prevention of criticality.

V

FINANCIAL QUALIFICATIONS

1. A copy of the 1958 annual report of the Spencer Chemical Company is submitted with this application in support of the company's financial qualifications to handle enriched uranium.

VI

INSURANCE

1. Spencer Chemical Company carries a $5,000,000 liability policy to cover property damage or bodily injury to the public attributable to the uranium facilities. Spencer is also fully insured against loss of materials at the plant or in shipment. These two policies are issued by Nuclear Energy Liability Insurance Association and Nuclear Energy Property Insurance Association respectively.

APPENDIX

I. PROCESS DESCRIPTION

1. This process is designed to produce primarily UO_2 from either UF_6 or scrap. With UF_6 as a starting material, a cylinder is weighed and then vaporized using steam heat. A vacuum pump preceded by a cold trap and a chemical trap permits evacuation and leak testing of the UF_6 piping.

2. The UF_6 is hydrolyzed by admitting the gas into a circulating stream of $AL(NO_3)_3$. Acid may also be added to adjust the acidity. The hydrolysis solution is transferred to rich acid storage.

3. With scrap UO_2 pellets, a weighed quantity of scrap is added to the empty dissolver and HNO_3 circulated through it and a rich acid storage tank until the desired concentration is reached. The dissolver vessel is jacketed to provide for heating or cooling.

4. Since "off-spec" product may be produced from time to time, provision is made for recycling it through the process. This scrap UO_2 powder is dissolved in a kettle using always mass safe batches, and then pumped to the rich acid storage tanks.

5. The rich acid is pumped to a countercurrent pulse extraction column. A solution of tri-butyl-phosphate in kerosene is used as the solvent. The rich organic phase from the extractor overflows to the scrub column. The raffinate flows to the waste storage tanks where it is sampled. From here it is either drained to the sewer or recycled to the system depending on the uranium concentration.

6. In the scrub column the rich organic is contacted with water. The water is recycled to the extraction column and the rich organic flows to the stripper where the uranium is stripped from it with water. The stripped organic phase overflows to a system which continuously cleans the solvent for reuse. The rich aqueous phase is fed to an evaporator to concentrate it and then precipitated with ammonia.

7. The ammonium diuranate precipitate is reduced to UO_2 in an electrically heated furnace. The UO_2 product is discharged through a mill to hoppers where it is sampled for moisture and other properties prior to being charged to the blender.

8. A dry atmosphere is maintained in the blender. Mass and moderation limits are used to determine the size of lots blended. After blending the UO_2 is discharged into approved shipping containers.

Appendix

II. PLANT LAYOUT AND EQUIPMENT DESCRIPTION

1. The building to house this facility is contained within the Jayhawk plant site. It is constructed of steel framework and covered with transite siding. All processing equipment is located along the east half of the building. High equipment such as the extraction columns is located in the 50' high bay in the center of the building. Layout of the equipment is shown on drawings 1-2600-4 and 1-2600-802.

2. The east wall behind the tanks and equipment is lined with stainless steel sheet to facilitate clean-up of spills and splashes. A stainless steel drip pan is provided along this wall under the equipment to contain leaks and spills. There are no floor drains to eliminate the possibility of a spill being lost to the sewer.

3. The UO_2 scrap pellet dissolver is 8.25" I.D. The dissolver for "off-spec" UO_2 powder is a kettle and will be used with mass safe batches. The cold trap is of 4" pipe and the evaporator is 8" Sch. 10 pipe. The pulse columns are 4" pipe with 8" pipe end section. All uranium-containing storage tanks are 10.25" maximum I.D.

4. The UF_6 cylinders are vaporized in a closed room. This room is provided with adequate forced ventilation. The exhaust air from the room is drawn through a scrubbing system to remove any UF_6 vapors. A fluorine detector is located in the duct carrying air from the room to detect any UF_6 leaks. The same fume scrubber system also is connected to a hood over the UO_2 powder dissolver to recover any uranium carry-over from the dissolutions.

5. Storage area is provided in the southwest quadrant of the processing building for feed materials and/or packaged product. Safe spacing will be maintained on all containers of uranium stored in this area. If more space is required, UF_6 cylinders may be stored outside in their bird cages on a concrete pad near the southwest corner of the building.

III. CRITICALITY CONSIDERATIONS

A. Criticality With UF_6 Feed

1. UF_6 in cylinders at enrichments no greater than 5% U-235 will be removed from storage or brought directly to the southwest corner of the processing area. Cylinders will be transported into the processing area on a monorail and placed in stations provided for the vaporization of the UF_6. With full UF_6 cylinders at all stations, the total U-235 inventory will be 66 kilograms. According to TID-7016, page 9, there are no mass limits on a non-hydrogenous chemical compound with a U-235/U-238 ratio of .05. The individual cylinders are spaced at distances of greater than 1 foot edge-to-edge according to K-1019 Rev. 4, page 25.

2. The UF_6 is reacted with water and the resulting solution is stored in vessels R-1, R-2, R-3, R-4, T-1, T-2, T-3, and T-4. The maximum concentration of uranium in these solutions is 100 grams per liter which corresponds to a maximum U-235 concentration of 5 grams per liter for 5% U-235 enrichments. According to K-1019 Rev. 4, page 20, 5.0 grams of U-235 per liter is an "always-safe" parameter. Further, according to page 24, interaction need not be considered for homogeneous solutions with a U-235 concentration no greater than 5 grams per liter. Vessels R-1, R-2, R-3, R-4, T-1, T-2, T-3 and T-4, are all 10-1/4 inch diameter vessels which is a "limited safe" parameter according to K-1019 Rev. 4, page 21, for 5% enrichment and below.

3. The UF_6 solution is pumped to the extraction columns where the uranium is extracted into an organic solution of TBP. The minimum ratio of H to U-235 in the organic phase is 6320. According to TID-7016, page 9, there are no restrictions for solutions if the atomic ratio of H/U-235 is greater than 2300. The maximum concentration of U-235 in the aqueous stream from the strip column (TA-3) is again 5 grams U-235 per liter for 5% U-235. In addition, the columns are 4 inches diameter with 8 inch separating sections. This stream flows to the neutralizer where the uranium concentration is slightly decreased. The neutralizer is a 10-1/4 inch diameter vessel as an extra precaution.

4. Out of the neutralizer the stream flows to E-3 on the first balcony. In E-3 the uranium concentration is increased to 450 grams per liter (22.5 grams U-235 per liter at 5% enrichment). E-3 is an 8 inch pipe with a 2 inch leg. By comparison to a "limited-safe" diameter of 10.25 inches, E-3 is considered safe. Interaction has been calculated between the evaporator and (1) the furnace, (2) vessel R-9, (3) the UO_2 hoppers, T-18 and T-19, (4) the blender M-5, (5) UO_2 packages on the first and second floors, and (6) vessels T-13 and T-14. The total solid angle viewed of these is less than 0.5 steradians.

5. The stream from E-3 is stored in two vessels, T-13 and T-14. These vessels are 10-1/4 inches I.D. x 8 feet tall, so that they are safe. Interaction must be considered between each other and the blender. The total interaction is .9 steradian which is less than the allowable 1.0 (K-1019 Rev. 4, page 24.)

6. From R-13 and R-14 the rich aqueous is pumped to R-9 on the second balcony. R-9 is a 10.25 inch diameter vessel. It sees even less than the neutralizer (R-8) which sees .50 steradians so that interaction is safe.

7. The product from R-9 is transferred to the furnace. The furnace proper is fitted with a 9 inch I.D. liner. The feed screw drops the uranium bearing material onto this furnace liner. There are three screws each operating in 2 inch pipe conveying the uranium. The furnace gases pass countercurrent to the uranium, and conceivably could carry light dried material into the breech where the gases leave the furnace. No significant carryover has ever been observed. The volume in the breech is .625 cubic foot compared to a safe volume of .95 cubic foot. The gas discharge line is steam traced to prevent condensation in the gas line before the condenser.

8. The furnace tube itself never operates more than one quarter full. It discharges into a breech of 1.465 cubic feet capacity. At a discharge rate of .25 cubic foot per hour, hourly inspection will prevent anything approaching an unsafe accumulation. Should the furnace exit gas temperature fall 50° below its normal value, the feed to the furnace will be shut off automatically. The furnace sees less than .9 steradians which is safe.

9. The furnace discharges into T-18 and T-19. The quantity of UO_2 allowed to accumulate in T-18 or T-19 will be kept below the safe amounts as limited by enrichment. (Table XVII, K-1019 Rev. 4). These vessels each have a k of .65 because they are mass safe (K-1019 Rev. 4, page 26). The allowable solid angle is 2.51 compared with an actual value of 1.28 steradians.

10. After a moisture analysis has been obtained on their contents, T-18 or T-19 can either be transferred to M-5 or to storage.

11. The entire inventory of UO_2 in M-5, SC-1 and at the bullion balance is limited to a safe mass quantity as limited by moderation. Table XIX of K-1019 Rev. 4 will be used to specify the safe mass to that corresponding to the highest H/U-235 ratio of any material added to the inventory. Table XIX is for UF_6, but since the density of UO_2 here is no greater than for UF_6, the table is applicable. The maximum solid angle of interaction at M-5, SC-1 or the bullion balance is .77 compared to a safe interaction of 1.0 steradians.

12. After filling the UO_2 containers, they are spaced at least one foot edge-to-edge from each other while they are weighed and transported to storage.

B. UO_2 Feed

1. General

a. The criticality conditions of the uranium process using UF_6 feed have already been described. Use of UO_2 feed alters the situation in the following respects:

(1) Dissolution of fired UO_2 represents a special problem because of the high density of fired UO_2.

(2) The solutions produced from UO_2 dissolution are more concentrated than those produced from UF_6.

b. The portion of the plant beyond the extraction columns operates the same regardless of the feed. However, there is more interaction which must be considered.

c. There are two types of UO_2 -- high density and low density. High density UO_2 is that which has been pressed and fired, while the low density material is characteristic of scrap generated in the process.

2. Low Density UO_2 Dissolution

a. Low density UO_2 (less than 3 grams per ml) is batch dissolved in R-5. The charge into R-5 is limited to the mass limits shown in Table XVII of K-1019 Rev. 4, page 22.

b. The UO_2 scrap is generated at T-18 and T-19. The scrap is drained from the hopper into a 5 gallon pail on the first balcony. After each pail is filled, it is carried down the north stairs to the first floor where it is weighed on SC-1. The pails will be marked with the weight and assay. From weighing, the pail is carried either to storage, or is carried to R-5. The route taken is to be over to the west side of the process line to the south stairs and up them to the UO_2 dissolver.

c. When dissolving a batch of low density UO_2, R-5 is first emptied. Then the safe mass or less is carried in 5 gallon pails to the dissolver. Never will the total quantity of uranium in the vicinity of R-5 or within R-5 exceed a safe mass. Before making up a batch, the supervisor is to certify that the quantity of uranium in pails is a safe batch.

d. When a batch is dissolved, it is pumped to storage. A check valve and a manually operated valve prevent solution in storage from increasing the uranium in R-5.

3. High Density UO_2 Dissolution

a. High density UO_2 is dissolved in R-13 which has safe dimensions. The UO_2 is hoisted to the first balcony on a monorail at the southwest corner of the process. The monorail carries the UO_2 to the north side of R-13. Only that amount of UO_2 which R-13 can accomodate at any one time is hoisted. The UO_2 is dumped into R-13. The total amount of UO_2 being added to R-13 is mass safe by moderation. R-13 must be emptied prior to recharging.

b. The safe diameter for R-13 was determined in the following fashion: Calculations in HW-57861, page 24, show the maximum buckling for 5% U-235 metallic uranium rod in water lattices to be 150×10^{-4} cm^{-2}. Values for other parameters, near this maximum buckling, are as follows:

$$k_{\infty} = 1.65$$

$$L^2 = 1.1 \text{ cm}^2$$

$$\tau = 32.5 \text{ cm}^2$$

For an 8.25 inch diameter vessel, K-1380, page I-13 to 15, shows $B_1^2 = .0344$, $B_2^2 = 0.049$. The value for k effective is:

$$k = \frac{k_{\infty} e^{-B_1^2 \tau}}{1 + L^2 B_2^2} = 0.513$$

A value of 10.25 for the radius gives k = .7, but the actual vessel radius of 8.25 is specified as an added factor of safety. Another safety factor is included because UO_2 with its lower density shows lower maximum buckling than does the metallic uranium as discussed in HW-57861, page 19.

c. The random placement of the rods when merely dumped into a vessel presents some uncertainty. Lattice values given above are for orderly spaced, uniform rods. Preliminary experiments mentioned in HW-56919, page 20, indicate the randomness tends to lower the buckling. This was assumed also in TID-7016, page 21.

d. Interaction between R-13 and its neighbors is less than 1.75 steradians compared to an allowable of 3.9 steradians (see Table I).

4. Allowable Interactions With UO_2 Feed

a. The interactions between all vessels which contain uranium at concentrations above 5 grams U-235/liter with UO_2 feed have been conservatively estimated by the methods given in TID-7016, page 14. These estimates are shown in Table I. Where the

Table I

Vessel	Diameter (Inches)	Contents	Interaction (Steradians)
E-3	8.25	b*	1.6
F-4	7.75	a*	2.8
F-5	7.75	a	2.5
KL-1	9.0	---	2.32
M-5	---	UO_2	1.15
R-1	10.25	a	1.56
R-2	10.25	a	1.91
R-3	10.25	a	1.65
R-4	10.25	a	1.97
R-5	22.0	a	.45
R-8	10.25	a	1.56
R-9	10.25	b	.93
R-13	8.25	---	1.73
SC-1	---	UO_2	2.05
T-1	10.25	a	1.92
T-2	10.25	a	1.98
T-3	10.25	a	2.22
T-4	10.25	a	1.83
T-13	10.25	b	.86
T-14	10.25	b	.86
T-18 & T-19	9.0	UO_2	2.28
TA-1	4 & 8	a	1.80
Bullion Bal.	---	UO_2	1.92

"a" and "b" are process solutions containing uranium

interaction is below one steradian, there is no limit on what may be placed in the vessels since each vessel is "always-safe". The basis for this is a statement in K-1019 Rev. 4, page 25, which states that if the vessels meet "always-safe" parameters the k value may be assumed equal to 0.8 for which the maximum solid angle is 1.0 steradian.

b. For those vessels where the interaction is greater than one steradian, a limit is placed on the maximum concentration or mass of U-235 which can be placed in these vessels.

c. Uranium in the process is contained in aqueous solutions in two different concentrations above 5 grams U-235 per liter. The more dilute of these two is designated solution "a" in Table I, while the more concentrated solution is designated "b".

d. The maximum permissible concentration for solution "a" is calculated as follows: Among the vessels containing solution "a" and excluding F-4 and F-5, the maximum interaction is encountered with vessel T-3 at 2.215 steradians. The next highest is T-2 at 1.982 steradians. The maximum k for an allowable 2 steradians is 0.713 (K-1019 Rev. 4, page 39). Now $k = \eta f \, U_f \, U_{th}$ (page I-9, K-1380).

Assume $U_{th} = 1$ (conservative estimate)

$B_1^2 = .0242$ for D = 10.25" (K-1380, page I-13)

$U_f = .596$ (K-1380, page I-14)

$$\eta f = \frac{k}{U_f} = \frac{.713}{.596} = 1.195$$

This is the maximum value for ηf. Assuming the solution contains nitrogen, hydrogen, U-238 and U-235, an ηf less than 1.195 requires the following quantity to be greater than 455.

$$\frac{1.88\ N}{U\text{-}235} + \frac{.33\ H}{U\text{-}235} > 455,$$

where N/U-235 is the ratio of nitrogen atoms to U-235 atoms and similarly for H/U-235. If T-3 is in the system, this must be greater than 510.

e. Returning to F-4 and F-5, these vessels have a diameter of 7-3/4 inches and have an allowable solid angle of 3.5 when $\eta f = 1.195$. The allowable solid angle for R-13 was discussed above.

f. The maximum concentration of solution "b" is such that the minimum H/U-235 is 920. Under these conditions the maximum ηf is 1.36. This concentration gives the maximum allowable interaction for E-3 of 2.26 compared to the actual 1.6. T-13, T-14 and R-9 all have interactions less than 1 steradian.

g. The furnace has an I.D. of 9 inches. However, it never runs more than 25% full. This gives it an equivalent diameter less than 5 inches. The safe interaction for a 5 inch pipe is 3.2 steradians (Table XX, K-1019 Rev. 4) compared to the actual value of 2.32.

h. The quantity of UO_2 allowed in either T-18 or T-19 is limited to the safe mass as limited by enrichment, (Table XVII, K-1019 Rev. 4). The k for these mass safe vessels is taken as 0.65 (K-1019 Rev. 4, page 26), so that the allowable solid angle is 2.51 compared to the actual value of 2.28.

i. After a moisture analysis has been obtained on their contents, T-18 or T-19 can either be transferred to M-5 or to storage.

j. The entire inventory of UO_2 in M-5, SC-1 and at the bullion balance is limited to a mass safe quantity as limited by moderation. Table XIX of K-1019 Rev. 4 will be used to specify the safe mass to that corresponding to the highest H/U-235 ratio of any material added to the inventory. Table XIX is for UF_6, but since the density of UO_2 here is no greater than the density of UF_6, the table is applicable.

k. The k value for this total mass is taken as 0.65. This is in accordance with K-1019 Rev. 4, page 26 for safe masses. Although this reference is not specifically justified in this instance, a value of .65 is considered conservative for two reasons. First the uranium is at most 5% enriched, while Table XIX is for any enrichment. Secondly, all the mass will not be accumulated in a configuration approaching an optimum arrangement. For a k of .65, the allowable interaction is 2.51 steradians. The maximum interaction from M-5, SC-1 or the bullion balance is 2.05 steradians.

l. Almost all piping which might conceivably carry uranium solution is 1/2 inch which presents no interaction problem (K-1019 Rev. 4, page 24). In the front of the process, sizes no greater than 3 inches are used sparingly. They are all spaced at least 2 feet from any vessel and enter the vessels either near the top or bottom so that they are safe.

m. Drip pans beneath process vessels overflow at 1/2 inch so that they are safe (K-1019 Rev., page 24).

n. All pumps and pulsers are located on the floor and are of safe volume, each having less than a gallon holdup. They are included in interaction calculations as extensions of the process vessels.

MAR 2 8 1962

L. Dubinski, Asst. Dir. for Materials
Division of Compliance

R. E. Cunningham, Chief, Enforcement Branch
Division of Licensing and Regulation

COMPLIANCE INSPECTION REPORT FOR SPENCER CHEMICAL COMPANY
DWIGHT BUILDING
KANSAS CITY, MISSOURI
INSPECTION CONDUCTED ON MAY 2 - 5, 1961

LICENSE NOS. C-4288 (DOCKET NO. 40-6673)
SNM-154 (DOCKET NO. 70-146)
SNM-329 (DOCKET NO. 70-340)

LR:CGW

Attached is a notice of violation to subject licensee for your concurrence.

We are not citing the licensee for exposing individuals in excess of the limits specified in Section 20.103(a), since there is not sufficient information provided in the report to establish that any individual has been exposed to average weekly concentrations of airborne radioactivity in excess of the MPC. We are citing the licensee under Section 20.201(b) for failure to conduct surveys sufficient to determine compliance with Section 20.103(a).

In addition, we are requesting that the licensee submit weighted exposure data on employees who work in areas with air concentrations in excess of the MPC.

SIGNED CONCURRENCE COPY IN DOCKET 70-146

OFFICE ▶	LR:EB	LR:EB				
	CGWelty:lrm	RECunningham				
SURNAME ▶						
DATE ▶	3-16-62					

Form AEC-318 (Rev. 9-53) U. S. GOVERNMENT PRINTING OFFICE 16—62761-2

LR:CGW
40-6673
70-146
70-340

1478

JUL 17 1962

Spencer Chemical Company
Bright Building
Kansas City 5, Missouri

Attention: Mr. Harold Lambertus
General Manager

Gentlemen:

Thank you for your letter of May 14, 1962 informing us that you have corrected those deficiencies in your AEC licensed program which we brought to your attention in our letter of April 17, 1962. These matters will be reviewed during the next inspection of your facilities.

Your cooperation with us is appreciated.

Very truly yours,

Eber R. Price
Assistant Director
Division of Licensing
and Regulation

bcc: Compliance Div., HQ)
Compliance Div., III) w/cpy ltr 5/14/62
Public Document Room

SIGNED CONCURRENCE COPY IN DOCKET 70-146

OFFICE ▶	LR:EB	LR				
SURNAME ▶	CGW:lrm:RGP	ERPrice				
DATE ▶	6-1-62					

Form AEC-318 (Rev. 9-53) U. S. GOVERNMENT PRINTING OFFICE 16—62761-2

APR 17 1962

LR:CCH
40-6073=1478
70-146
70-340

Spencer Chemical Company
Dwight Building
Kansas City, Missouri

Attention: Mr. Norman Greenlee

Gentlemen:

This refers to the inspection conducted on May 2 - 5, 1961, of activities at your Jayhawk Works, Pittsburg, Kansas, licensed under Source Material License No. C-4352 and Special Nuclear Material License Nos. SNM-154 and SNM-329.

It appears that certain of your activities were not conducted in full compliance with a condition of a license and the requirements of the AEC's "Standards for Protection Against Radiation," Part 20, Title 10, Code of Federal Regulations, in that:

1. Surveys conducted pursuant to Section 20.201(b), "Surveys," were insufficient as follows:

   a. Time occupancy studies and time weighted exposure evaluations had not been made to determine compliance with Section 20.103(a), "Exposure of individuals to concentrations of radioactive material in restricted areas."

   b. Environmental air surveys had not been conducted to determine compliance with Section 20.106(b), "Concentrations in effluents to unrestricted areas," with respect to airborne radioactivity.

2. Facilities and activities did not conform with statements in license applications, in violation of License Condition No. 8, "Authorized use," as follows:

OFFICE ▶	REGISTERED MAIL RETURN RECEIPT REQUESTED					
SURNAME ▶						
DATE ▶						

Form AEC-318 (Rev. 9-53) U. S. GOVERNMENT PRINTING OFFICE 16—62761-3

2. continued

a. The position of furnaces with respect to the location of hoods in "I" Room, Building No. 702, did not conform with Item 1, Page 3 of the license application dated January 4, 1960.

b. The furnace box was not loaded in the manner described in Item 5, Page 3 of the license application dated January 4, 1960.

c. Exhaust air from the hood in Room 16 of Building 702 was not filtered as described in Item 4, Paragraph A (Equipment) of the license application dated December 28, 1959.

d. Fused UO_2 is not stored in an inert atmosphere as described in paragraph 2(b) of the license application dated February 2, 1960.

Pursuant to the provisions of Section 2.201, "Notice of violation," of the AEC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, you are required to notify this office in writing within thirty days of your receipt of this notice, admitting or denying the alleged violations, the reasons for the violations if admitted, the corrective steps taken or to be instituted in achieving correction and preventing further violations, and the date when full compliance has been or will be achieved.

With respect to Item 1(a) above, you are requested to include in your reply the following information:

a. A detailed description of the air survey program you will follow in determining compliance with Section 20.103(a), and the date that such program was or will be put into effect.

b. A detailed description of the methods you will follow in determining average weekly airborne radioactivity exposures to those individuals who frequently or occasionally occupy areas with concentrations in excess of Appendix B, Table I, Column 1.

OFFICE ▶						
SURNAME ▶						
DATE ▶						

With respect to Item 1(b) we are enclosing a copy of our air survey guide entitled, "A Basis for Surveying to Determine Concentrations of Radioactive Material Discharged as Air Effluents from Uranium Mills," which may be useful to you in instituting an environmental air survey program to determine compliance with Section 20.106(b).

We note that concentrations of airborne radioactivity in some plant work areas are sufficiently high that it is possible that individuals have been exposed in excess of the limits specified in Section 20.103(a), "Exposure of individuals to concentrations of radioactive material in restricted areas." Therefore, you are requested to submit with your reply to this letter, the results of a weekly weighted exposure evaluation for each employee who is exposed to concentrations of airborne radioactivity in excess of the limits specified in Appendix B, Table I, Column 1.

Very truly yours,

Eber R. Price
Assistant Director
Division of Licensing
and Regulation

Enclosures:
1. 10 CFR 20
2. 10 CFR 2
3. Air Survey Guide

bcc: Compliance Division, HQ
Compliance Division, III
Public Document Room - to B. Jones for w/Rulemaking

SIGNED CONCURRENCE COPY IN DOCKET 70-146

OFFICE ▶	LR:EB	CO	LR			
SURNAME ▶	CGW:lrm:REC		ERPrice			
DATE ▶	3-16-62					

Form AEC-318 (Rev. 9-53) U. S. GOVERNMENT PRINTING OFFICE 16—62761-3

DLR:CGW
40-2136 40-1476
70-144 70-249

OCT 12 1960

Spencer Chemical Company
Dwight Building
Kansas City 5, Missouri

Attention: Mr. Harold Lambertus, General Manager,
Nuclear Fuels Department

Gentlemen:

This refers to the inspection conducted on March 30, 31, and April 1, 1960, of your activities authorized under AEC Source Material License Nos. C-4352 and R-218; and Special Nuclear Material License Nos. SNM-154 and SNM-329.

We note that containers in which licensed material was stored in the storage building adjacent to Plant No. 2, in the vault next to Engineering Building No. 703, and in Room 16 of the Research and Development Laboratory were not labeled as required by the AEC's "Standards for Protection Against Radiation," Part 20, Title 10, Code of Federal Regulations, Section 20.203(f)(1), (f)(2) and (f)(4), "Caution signs, labels and signals."

The labeling deficiencies were brought to your attention by the inspector and you stated that corrective action would be taken. Should you have any questions about this matter, please feel free to write us. Labeling will be reviewed during the next inspection of your facilities.

We appreciate the cooperation given the AEC representative.

Very truly yours,

Lyall Johnson,
Assistant Director for Facilities
and Materials Licensing
Division of Licensing and Regulation

Enclosure Signed Concurrence Cy in 40-2136

OFFICE ▶	DLR:RSB CGW:lrm:LRR	DLR:LB LJohnson			
SURNAME ▶					
DATE ▶	10-11-60				

Form AEC-318 (Rev. 9-53) U. S. GOVERNMENT PRINTING OFFICE 16—62761-2

LRL:CPM
Docket No. 70-340

JUl 2 9 1959

Spencer Chemical Company
Dwight Building
Kansas City 5, Missouri

Attention: Mr. Harold Lambertus
Manager

Gentlemen:

This refers to your June 22, 1959 application for a special nuclear material license to authorize the chemical conversion of enriched uranium at additional processing facilities.

In order that we may continue our review of your proposed activities, you should provide us with the following additional information:

1. The administrative procedures you will use to insure the proper application of the various criticality controls, particularly at those points in the process where the method of control changes.

2. The hydrogen content resulting from the presence of the moisture or other impurities in reactive material in process, particularly in UF_6 and UO_2 when used as feed materials.

3. When mass limits are used as a criticality control, the method of determining that the weight of the batch in process is within limits.

4. When concentration limits are used, the method of determining that the concentrations are within prescribed limits and of assuring that U-235 concentrations do not change due to evaporation or precipitation.

5. When moderation is used, your procedures for assuring that the H/X ratio is within the prescribed limits and of preventing this ratio from being increased due to the absorption of moisture from the air.

6. How the results of the monthly urinalysis required of employees will be interpreted regarding remedial action.

7. The method you will use to assure that the discharge of aqueous waste to the sewer is distributed in such a manner as to provide adequate dilution.

8. The provisions for including the residual reactive material in the dissolver, kettle and ancillary equipment in determining the safe mass for a new charge.

9. The coolant used in the dissolver jacket and the provisions you have made to check or prevent leakage of the coolant into the dissolver and any other jacketed vessels.

This information should be submitted in quadruplicate over the signature of a duly authorized corporate officer.

Very truly yours,

Charles P. McCallum, Jr.
Nuclear Materials Section
Licensing Branch
Division of Licensing and Regulation

DISTRIBUTION
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Doc. Rm.
Formal
Suppl.
L&R Reading
LRL Reading
C. P. McCallum, LRL

OFFICE ▶		LRL				
SURNAME ▶		CPMcCallum:rh				
DATE ▶		7/23/59				

Form AEC-318 (Rev. 9-53) U. S. GOVERNMENT PRINTING OFFICE 16—62761-3

DOCKET NO. 70-340

L&R File Copy

Spencer Chemical Company

Research Center
9009 WEST 67TH STREET
Merriam, Kansas

November 20, 1962

Mr. Donald A. Nussbaumer, Chief
Source and Special Nuclear Materials Branch
Division of Licensing and Regulation
U. S. Atomic Energy Commission
Washington 25, D.C.

Dear Mr. Nussbaumer:

This is in reply to your letter dated October 25, 1962, referring to our Special Nuclear Material License SNM-329 which expired on September 30, 1962.

Our Material Status Report (AEC-578) for the period ending December 31, 1961, showed that all special nuclear material had been transferred from SNM-329. No special nuclear material was transferred to SNM-329 after that date.

Licensees to which special nuclear material was transferred are shown on our Material Status Reports for periods before December 31, 1961.

Very truly yours,

N. A. Greenlee

N. A. Greenlee

NAG:fg

DOCKETED
USAEC
Division of
Licensing & Regulation
NOV 23 1962
asc
Docket Officer

RECEIVED
NOV 23 1962
U.S. Atomic Energy Commission
DIVISION OF
LICENSING & REGULATION

NOT adequate disposition

ACKNOWLEDGED

10703

DOCKET NO. 40-1478 70-146
70-340

KERR-McGEE OIL INDUSTRIES, INC.

Kerr-McGee Building • Oklahoma City 2, Oklahoma

L&R File Copy / suppl. only.

September 6, 1962

Mr. Lyall Johnson
Division of Licensing and Regulation
United States Atomic Energy Commission
Washington 25, D. C.

Dear Mr. Johnson:

Kerr-McGee Oil Industries, Inc. recently forwarded a request for a source material license in connection with the work being performed by the Department acquired from Spencer Chemical Company. It is anticipated that in the very near future we will also be forwarding a request for a special nuclear material license involved in the same area of work.

It would be appreciated if you would mark your records to indicate that all communications concerning these licenses should be directed to Kerr-McGee as follows:

Mr. Harold Lambertus, General Manager
Nuclear Products Department
Kerr-McGee Oil Industries, Inc.
Kerr-McGee Building
Oklahoma City 2, Oklahoma

Yours very truly,

KERR-McGEE OIL INDUSTRIES, INC.

George H. Cobb
Vice-President, Minerals

GHC:HL:go

SPENCER

Spencer Chemical Company

DWIGHT BUILDING

Kansas City 5, Missouri

DOCKET NO 70-340
70-146
40-1478

LDR File Copy

May 14, 1962

U. S. Atomic Energy Commission
Division of Licensing and Regulation
Washington 25, D. C.

Attention: Mr. Eber R. Price

Gentlemen:

This is in response to your letter of 17 April 1962 regarding the inspection conducted at our Jayhawk Works at Pittsburg, Kansas on May 2-5, 1961 under Source Material License C-4352 and Special Nuclear Material Licenses No. SNM-154 and SNM-329.

Replying to your items as listed in your letter, we submit the following information for your consideration:

I. Time-occupancy studies have been made in the area where high air-borne dust samples were observed.

A. Incidents Involving Thorium

Six incidents have been noted involving thorium, natural isotopic assay. The counts of the air samples in these six samples are as follows:

Microcuries per ml of Air
3×10^{-10}
4×10^{-10}
2×10^{-10}
2×10^{-10}
2×10^{-10}
5×10^{-11}

In all cases, these were 30-minute air samples taken at a position between the man and the hooded operation where the material was being utilized. The air samples therefore represent the absolute maximum that the man could have achieved. Time studies on the operation have indicated that the man is in the operating

position less than 25 minutes during an 8-hour normal shift of operation. During the rest of the time the man would be in other parts of the room or hallways or the building where the air has consistently been 10^{-12} microcuries per ml or less. Therefore, the overall daily exposure would be less than the limits of Part 20.

B. Normal Uranium

Seven instances were observed where the air-borne concentration of normal uranium was in excess of the Part 20 limit. These were as follows:

Microcuries per ml of Air
1.3×10^{-10}
9×10^{-11}
1×10^{-10}
1×10^{-10}
2×10^{-10}
1×10^{-10}
9×10^{-11}

These instances all occurred at the fusion operation, samples being taken for a 30-minute period at a position approximately head high between the man and the hood where the material was being utilized. Again it was determined that the man was in this operating position less than 25 minutes during an 8-hour shift. At other times he would be in air-borne concentrations ranging from 10^{-12} to 10^{-14}, so that his overall daily exposure was less than prescribed limits.

C. 93% Enriched Uranium

Instances involving 93% enriched uranium have revolved around two pieces of equipment. One was a dry sample splitter where the samples had to be taken between the machine and the man. These were as follows:

Microcuries per ml of Air
4×10^{-8}
4×10^{-8}
4×10^{-8}
8×10^{-9}
2×10^{-9}
8×10^{-10}
1×10^{-9}
4×10^{-9}

The other was a green salt unloading hood where the air samples encountered were as follows:

Microcuries per ml of Air
5×10^{-9}
3×10^{-9}
8×10^{-10}
1×10^{-9}
7×10^{-10}
1×10^{-9}
1×10^{-9}
3×10^{-9}
5×10^{-9}
8×10^{-9}

These samples were half-hour samples taken at a position between the man and the hood where the operations were taking place. Therefore this also represents maximum possible exposure to the man.

The operator was in position at the sample splitter once during an 8-hour shift for not more than five minutes during the loading and unloading of the sample splitter. Since the dust samples were on the average of less than 100 times the limit for 93% uranium, and since the man's occupancy is approximately 1/100 of the 8-hour working day, the rest of the time being exposed to air samples of less than 10^{-12}, the daily exposure to any of the operators handling this equipment would not exceed the limits.

At the green salt unloading operation, the exposure is less than 10 times that of the upper limit of Part 20. The unloading operation during which the dust is generated requires approximately 15 minutes during every 8-hour shift. The rest of the time the man would be in air of the room at 10^{-12} or less microcuries per ml of air. Therefore, his overall daily exposure would not exceed Part 20 limits. Operation of the sample splitter and green salt unloading was not carried out by the same operator during a single shift.

The corrective measures which have been taken to eliminate the high air-borne dust around this equipment are as follows:

A. Thorium Operations. Additional lucite sliding baffles have been installed in these hoods to increase the air flow across the working opening. This has effectively trebled the air velocity and since their installation no high thorium air-borne dust readings have been observed.

B. Normal Uranium Operation. The hoods where the high dust samples were observed have also been equipped with additional lucite baffles to increase the air flow into the hood at the operator's position. Since the installation of these lucite baffles, no high normal uranium air samples have been observed.

C. Fully Enriched Uranium Operation. In the green salt unloading station a permanent lucite baffle with slotted arm holes has been installed to greatly increase the linear velocity of air into the hood at the operating position. Since the installation of this lucite baffle, no high readings have been observed at this station.

The sample splitter has been completely overhauled to insure dust tightness. Since the correction of this equipment, there have been no observed instances of high uranium concentrations around this equipment.

1-b. Concentration in Effluents to Unrestricted Area. During the inspection of May 1961, one effluent air sample on a stack indicated a discharge of 1 gram of normal uranium to the exterior air around the plant site. At the time the air-flow through this stack was so low that one gram over a 24-hour period exceeded the limits of Part 20. Two corrections have been made to this stack:

(1) A filter has been installed downstream from the exhaust fan, and

(2) The effluent air has been increased by enlargement of the exhaust fan. No high samples have been observed at this point since this corrective measure.

Since the inspection of May 1961, a systematic study of the stack effluents from all operations have been periodically conducted, and no high samples have been observed to date.

II. A. Position of the furnaces with respect to the hood in the T-room, Building 702: During the actual installation of this equipment, it was determined that the position described in the application would not lend itself to convenient installation of the ventilation exhaust for the furnaces. Therefore, the actual installation position was modified so that the exhaust stacks could be properly positioned. The spacing between the furnaces was still maintained as described in the license application, and the distance from the furnace to the hood was greater than two feet, which also maintained an adequate safety factor from criticality control. We did not feel that such a minor change was properly a subject for license modification.

B. The loading of the furnace boxes is being conducted in accordance with the license application. Operators and supervisors have been carefully instructed to follow exactly the provisions of the license application.

C. The hood in Room 16 of Building 702 has been equipped with a filter in accordance with the license application.

D. The term "inert atmosphere" is a relative description. In the case of fused uranium dioxide, it has been determined that air, CO_2 and/or argon are in fact inert to crystalline UO_2 at room temperature. We feel therefore that free substitution of any of these three gaseous atmospheres is in full compliance with the license.

In answer to your further requests, we are attaching as Appendix I the air survey program which was initiated in October 1961, and has been followed since that time.

If further information is desired, please advise.

Yours very truly,

Nuclear Fuels Department

Harold Lambertus

Harold Lambertus
General Manager

WML:el

Attach: Appendix I.

APPENDIX I

PROCEDURE USED TO SET UP SAMPLING PROGRAM FOR AIR AND SMEAR TESTS

I. Introduction

In order to set up a program which is not entirely subjective, it is necessary that sampling be carried out on a random basis. To accomplish this, the building plot plan was divided into areas and marked off in rectangles, approximately 3½' x 3', with each square carrying a letter and number such as B16 to identify it.

From this plot plan the sampling points were taken. Primary stress was placed on the processing areas and the lunch room since these are the areas of greater concern.

II. Selection of Sampling Points

A. The 30-minute air samples and smear samples.

The number of sample points in each zone and area are as follows:

Zone 1		Zone 2		Zone 3		Zone 4	
Area	No.	Area	No.	Area	No.	Area	No.
Offices	4	T-House	25	Room 9	4	Room 14-	
Lunch Room	11	Ex.& Pur. Area	7	Rooms 10 & 11	8	Storage	5
Change Area	7	Hallway	2	Room 12	5	Unit	2
Misc.	4			Rooms 16-19	12		
				Misc.	4		
Total	26		34		33		7

B. The 24-Hour Air Samples

Various sample points in various rooms were selected for the 24-hour samples. A total of 13 points were selected for taking these samples.

III. Sequence of Sampling

A. The 30-minute air samples and smear samples

In Table I is given a table of 100 random numbers used to set up the sequence of sampling. In Table II is given the sampling points by areas and the sample number assigned. The thirty-minute numbers started with

the first column of random numbers from Table I. The smear sample numbers started with the second column of numbers. The numbers were assigned in order of zones 1 through 4. The numbers assigned by zone are given in Table II. In Table III is the rearrangement of the sampling sequence in the order that they will be taken. The day and shift will be filled in on a weekly or monthly basis. The frequency of the samples will depend upon the amount of activity in the building.

B. The 24-hour air samples

A total of thirteen sample points were picked out to obtain 24 samples. These were arranged in a random sequence. The location of these points are given on Table II. It is expected that one 24-hour sample will be taken every day. More or fewer samples will be taken in the future, depending upon the amount of activity.

IV. Coding of Samples

The air samples will be submitted much as a regular analytical sample. An AVI book will be supplied with the clip board used in recording samples. The following information is to be supplied on the AVI:

(1) Date
(2) Time
(3) Sample No.
(4) Zone (1, 2, 3, or 4)
(5) 30-minute samples, the CFM readings at 0, 10, 20, and 30 minutes.
(6) 24-hour samples, liters/minute at 4-hour intervals.

The sample number includes the sample point designation and the height at which the sample was taken. For example, a sample taken at point E37 and four feet off the floor should be coded E37-4.

V. Records

The AVI will serve as a request for the analysis of a particular sample. The laboratory will return this AVI with the result. They will keep the record showing all the calculations. The AVI result will be recorded according to zone and type along with the sample number and date taken. Once a month the health and safety information will be combined into one health and safety report covering all phases of the health and safety program.

TABLE I

Table of One Hundred Random Numbers

1	2	3	4
90	39	36	83
61	43	24	50
33	79	19	29
67	62	05	32
11	75	14	65
38	71	80	78
82	91	92	84
52	68	02	49
09	98	97	60
54	74	85	58
47	34	44	72
56	42	10	26
95	06	86	66
57	64	53	51
16	13	37	76
77	89	40	41
08	88	81	30
03	99	18	
04	94	59	73
48	70	63	69
17	01	35	
45	25	87	
22	20	07	
27	96	21	
28	93	55	
12	23	46	
31	100	15	

TABLE II

Assignment of Sampling Sequence by Area and Number

Zone No. 1 Sample Point	Air Samples	Smear Samples
B6 - DER office	90	39
K4 - Room 2 office	61	43
K-8 - G.S. office	33	79
A12)	67	62
A13)	11	75
A14)	38	71
B11))))))) Lunch Room	82	91
B14)	52	68
C11)	09	98
C14)	54	74
D11)	47	34
D12)	56	42
D13)	95	06
D14)	57	64
G8 - Center hall office	16	13
C37)	77	89
D38) Dirty Change area	08	88
E37)	03	99
A42))	04	94
E42)) Center Hall storage	48	70
J27 - Met. lab	17	01
J32)	45	25
J34) Clean Change area	22	20
L32)	27	96
K39 - Men's Room	28	93
K42 - Center hallway south	12	23

Total - 26

Table II (continued)

Zone No. 2
Part a T-House

	Air Samples	Smear Samples
A21	31	100
B18	39	36
B34	43	24
C17	79	19
C19	62	05
C21	75	14
C23	71	80
C25	91	92
C27	68	02
C29	98	97
C31	74	85
C33	34	44
D18	42	10
D19	06	86
D20	64	53
D21	13	37
G21 - Hall	89	40
D23	88	81
D24	99	18
D25	94	59
D26	70	63
D27	01	35
D29	25	87
G31 - Hall	20	07
D31	96	21
D32	93	55
D34	23	46

Part b - Extraction and Purification Area

J20	100	15
J24	36	83
J30	24	50
K22	19	29
K27	05	32
L20	14	65
L24	80	78

Total 34

Table II (continued)

Zone 3
Fusion Area

Area	Sample Point	Air Samples	Smear Samples
Room 9	A47	92	84
	B45	02	49
	D45	97	60
	D47	85	58
Room 10	B49	44	72
	C51	10	26
	D49	86	66
	E51	53	51
Room 11	B56	37	76
	C55	40	41
	D56	81	30
	E55	18	73
Room 12	B60	59	69
	C59	63	90
	C61	35	61
	E59	87	33
	E61	07	67
Room 13	C66	21	11
Hall	G47	55	38
Hall	G61	46	82
Room 15	J-64	15	52
Room 16	I57	83	09
	J59	50	54
	K56	29	47
	L59	32	56
Room 17	I54	65	95
	K54	78	57
Room 18	J50	84	16
	L50	49	77
Room 19	J45	60	08
	J47	58	03
	J46	72	04
	L48	26	48

Total 33

Zone No. 4
Room 14

C70	66	17
C83	51	45
D76	76	22
G70	41	27
G76	30	28
K70	73	12
K83	69	31

TABLE III

Sequence of Air and Smear Samples

Air Samples - 30 Minutes						Smear Samples		
No.	Zone	Sample No.	Location	Date	Shift	Zone	Sample	Location
1	2	D27	T-House			1	J27	Met. Lab
2	3	B45	Room 9			2	C27	T-House
3	1	E37	Dirty Chg. Area			3	J47	Room 19
4	1	A42	Center Hall, N			3	L46	Room 19
5	2	K27	Ex and Pur. Area			2	C19	T-House
6	2	D19	T-House			1	D13	Lunch Room
7	3	E61	Room 12			2	G31	Hall
8	1	D38	Dirty Chg. Area			3	J45	Room 19
9	1	C11	Lunch Room			3	I57	Room 16
10	3	C51	Room 10			2	D18	T-House
11	1	A13	Lunch Room			3	C66	Room 13
12	1	K42	Center Hall, S			4	K70	Room 14
13	2	D21	T-House			1	G8	Center Hall Office
14	2	L20	Ex. and Pur. Area			2	C21	T-House
15	3	J64	Room 15			2	J20	Ex. and Pur. Area
16	1	G8	Center Hall, office			3	J50	Room 18
17	1	J27	Met. lab			4	C70	Room 14
18	3	E55	Room 11			2	D24	T-House
19	2	K22	Ex. and Pur. Area			2	C17	T-House
20	2	G31	Hall			1	J34	Clean Change Area
21	3	C66	Room 13			2	D31	T-House
22	1	J34	Clean Change Room			4	D76	Room 14
23	2	D34	T-House			1	K42	Center Hall, South
24	2	J30	Ex. and Pur. Area			2	B34	T-House
25	2	D29	T-House			1	J32	Clean Change Area
26	3	L48	Room 19			3	C51	Room 10
27	1	L32	Clean Change Area			4	G70	Room 14
28	1	K39	Men's room			4	G76	Room 14
29	3	K56	Room 16			2	K22	Ex. and Pur. Area
30	4	G76	Room 14			3	D56	Room 11
31	2	A21	T-House			4	K83	Room 14
32	3	L59	Room 16			2	K27	Ex. and Pur. Area
33	1	K8	G.S. Office			3	E59	Room 12
34	2	G33	T-House			1	D11	Lunch Room
35	3	C61	Room 12			2	D27	T-House
36	2	J24	Ex. and Pur. Area			2	B18	T-House
37	3	B56	Room 11			2	D21	T-House
38	1	A14	Lunch Room			3	G47	Hall
40	3	C55	Room 11			2	G21	Hall
41	4	G70	Room 14			3	C55	Room 11
42	2	D18	T-House			1	D12	Lunch Room
43	2	B34	T-House			1	K4	Room 2 office
44	3	B49	Room 10			2	C33	T-House
45	1	J32	Clean Change Area			4	C83	Room 14
46	3	G61	Hall			2	D34	T-House
47	1	D11	Lunch Room			3	K56	Room 16
48	1	E42	Center Hall, N			3	L48	Room 19
49	3	I50	Room 18			3	B45	Room 9
50	3	J59	Room 16			2	J30	Ex. and Pur. Area

Table III (continued)
Sequence of Air and Smear Samples

Air Samples - 30 minutes						Smear Samples		
No.	Zone	Sample No.	Location	Date	Shift	Zone	Sample	Location
51	4	C83	Room 14			3	E51	Room 10
52	1	B14	Lunch Room			3	J64	Room 15
53	3	E51	Room 10			2	D20	T-House
54	1	C14	Lunch Room			3	J59	Room 16
55	3	G47	Hall			2	D32	T-House
56	1	D12	Lunch Room			3	L59	Room 16
57	1	D14	Lunch Room			3	K54	Room 17
58	3	J47	Room 19			3	D47	Room 9
59	3	B60	Room 12			2	D25	T-House
60	3	J45	Room 19			3	D45	Room 9
61	1	K4	Room 2 office			3	C61	Room 12
62	2	C19	T-House			1	A12	Lunch Room
63	3	C59	Room 12			2	D26	T-House
64	2	D20	T-House			1	D14	Lunch Room
65	3	I54	Room 17			2	L20	Ex. and Pur. Area
66	4	C70	Room 14			3	D49	Room 10
67	1	A12	Lunch Room			3	E61	Room 12
68	2	C27	T-House			1	B14	Lunch Room
69	4	K83	Room 14			3	B60	Room 12
70	2	D26	T-House			1	H42	Center Hall, N
71	2	C23	T-House			1	A14	Lunch Room
72	3	L46	Room 19			3	B49	Room 10
73	4	K70	Room 14			3	E55	Room 11
74	2	C31	T-House			1	C14	Lunch Room
75	2	C21	T-House			1	A13	Lunch Room
76	4	D76	Room 14			3	B56	Room 11
77	1	C37	Dirty Change Area			3	L50	Room 18
78	3	K54	Room 17			2	L24	Ex. and Pur. Area
79	2	C17	T-House			1	K8	G.S. Office
80	2	L24	Ex. and Pur. Area			2	C23	T-House
81	3	D56	Room 11			2	D23	T-House
82	1	B11	Lunch Room			3	G61	Hall
83	3	I57	Room 16			2	J24	Ex. and Pur. Area
84	3	J50	Room 18			3	A47	Room 9
85	3	D47	Room 9			2	C31	T-House
86	3	D49	Room 10			2	D19	T-House
87	3	E59	Room 12			2	D29	T-House
88	2	D23	T-House			1	D38	Dirty Change Area
89	2	G21	Hall			1	D37	Dirty Change Area
90	1	B6	DER Office			3	C59	Room 12
91	2	C25	T-House			1	B11	Lunch Room
92	3	A47	Room 9			2	C25	T-House
93	2	D32	T-House			1	K39	Men's Room
94	2	D25	T-House			1	A42	Center Hall, North
95	1	D13	Lunch Room			3	I54	Room 17
96	2	D31	T-House			1	L32	Clean Change Area
97	3	D45	Room 9			2	C29	T-House
98	2	C29	T-House			1	C11	Lunch Room
99	2	D24	T-House			1	E37	Dirty Change Area
100	2	J20	Ex. and Pur. Area			2	A21	T-House

TABLE IV

Sequence of Twenty-Four-Hour Air Samples

Number	Zone	Sample No.	Location	Date	Shift
1	3	B49	Room 10		
2	3	B60	Room 12		
3	2	C21	T-House		
4	2	L17	Ex. and Pur. Area		
5	3	C55	Room 11		
6	2	J13	Ex. and Pur. Area		
7	3	I54	Room 17		
8	4	D76	Room 14		
9	1	D38	Dirty Change Area		
10	3	L46	Room 19		
11	1	D11	Lunch Room		
12	2	C31	T-House		
13	3	D47	Room 9		

DOCKET NO. 70-340
File Cy

SPENCER

Spencer Chemical Company

DWIGHT BUILDING

Kansas City 5, Missouri

July 28, 1959

Mr. Charles P. McCallum, Jr.
Nuclear Materials Section
Licensing Branch
Division of Licensing and Regulation
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Mr. McCallum:

This is in answer to your letter of July 23 (LRL:CPM, Docket No. 70-~~430~~ 340) requesting more information on our June 22, 1959, application for a special nuclear material license.

The answers are given below in the order that the questions were set forth in your letter:

1. Procedures to Insure Criticalty Control

(a) Movement of UF_6 cylinders into the melt room is accomplished with a monorail hoist which maintains the proper spacing between other cylinders in the room. Only one UF_6 cylinder may be in motion at any one time, and the movement of any cylinder must have the approval of the supervisor.

(b) The movements of scrap UO_2 pellets or powder, and of product containers, also are governed by the rule that only one container may be in motion, and again any movement must have the supervisor's approval.

(c) The volumes and weights of the materials used in hydrolysis or dissolution will be stated in written instructions and will have a safety factor to allow for errors. Any deviation from the normal procedures in these areas must be with the supervisor's express approval.

(d) Since solutions resulting from scrap dissolution may have a higher concentration than those from hydrolyses, the interaction of T-3 may not permit its use when using scrap as a feed material. Only one feed system will be in use at any one time and piping modifications will isolate T-3 from the rest of the system during scrap dissolutions when the interaction criterion precludes

its being in the system. The piping modifications will be inspected and approved by the supervisor to be absolutely sure that T-3 is completely isolated before any dissolutions are made.

(e) Any transfer of UO_2 product from the hoppers to the blender or from the blender to packaging containers will be with the supervisor's approval. A continuous inventory will be maintained to show clearly the total quantity of UO_2 in the blender, at the scales and at the bullion balance.

2. Hydrogen Content

The hydrogen content of UF_6 and UO_2 feed materials will be known from the suppliers of these materials and from samples taken when there is any doubt about the hydrogen content. In the case of UF_6 from the Commission, the Operation Criteria of the Oak Ridge Gaseous Diffusion Plant will be used. This states that "In the absence of wet air inleakage, all condensations are considered to be essentially unmoderated, a maximum hydrogen to uranium ratio of 0.1 being used in determining equipment safety." (K-1019, Rev. 4, page 30.) Wet air inleakage is assumed absent since any inleakage of air during the filling of the cylinder would cause trouble in filling. (K-1323, page 21.)

3. Safety Limits - Mass

(a) The amount of UO_2 pellets or powder charged to a dissolution vessel will be carefully weighed. The dissolution vessel will be emptied upon completion of a dissolution and inspected before the next charge.

(b) The amount of material allowed to accumulate in the furnace discharge hoppers will be below the safe mass. Records will be kept on the amount of material charged to the blender and no more than the allowable safe mass, depending on enrichment and moderation, will be charged to it.

4. Safety Limits - Concentration

(a) The concentration of the solution resulting from hydrolysis of UF_6 will be limited to a maximum of 100 grams of uranium per liter. A specified volume of liquid will be measured in the hydrolysis tanks and the weight of the UF_6 cylinder recorded at frequent intervals until the required mass of UF_6 for one batch has been hydrolyzed. The solution will be continuously circulating during hydrolysis to assure adequate mixing. Also, an analysis will be obtained on the solution for uranium concentration immediately after hydrolysis.

(b) In scrap dissolution, the acid will be circulated through the pellets until the required specific gravity, which has been correlated with uranium concentration, is reached. Chemical analyses of the solution will be obtained also to verify the concentration.

(c) When dissolving UO_2 powder, a mass safe quantity of powder and the required amount of acid are added to the kettle. After dissolution, the solution is adjusted to the required concentration and a check analysis obtained.

(d) The streams leaving the pulse columns are periodically analyzed for uranium concentration. Since feed rates are controlled, no sudden change in concentration in these streams would be expected.

(e) Storage tanks containing uranium solutions will be covered to prevent concentration due to evaporation. Since all of the feed solutions will be acidic and at concentration well below the saturation point, no precipitation of uranium should occur.

5. Safety Limits - Moderation

(a) Moderation control is used for feed materials and in product handling. Methods of assuring that the H/U ratio is within prescribed limits with feed material was described in the answer to question 2.

(b) The UO_2 product discharges into one of two hoppers where it is held until a moisture analysis is obtained. If the moisture is below the permissible level, and if the inventory of uranium in the blender permits, the product is discharged into the blender. If the moisture is above the allowable amount, the product will be discharged into a separate container and stored for further processing. A dry atmosphere is maintained in the blender to prevent the adsorption of moisture.

Closed system continued

6. Interpretation of Analyses

(a) If the monthly urinalysis of any employee is above the recommended value, he will be assigned other duties outside the uranium processing facility and another sample will be submitted immediately for urinalysis. The employee will not be permitted to return to the uranium plant until his uranium analysis is below the recommended value. If there is any indication that a high urinalysis was caused by a condition in the plant, such as inadequate ventilation or dust control, immediate steps will be taken to remedy the situation.

(b) Continuous air samples are taken at points in the system where dust might escape from containers. If the concentration of uranium in the air should be above the limits specified in 10 CFR 20, immediate remedial action will be taken.

7. Aqueous Waste

(a) All waste streams from this plant will be held in storage tanks, thoroughly mixed, checked for an acid pH, and analyzed for uranium concentration. Before any waste storage tank may be dumped to the sewer, the transfer must have the supervisor's approval.

(b) Normally, waste solutions discharged from the tanks will contain less than 0.05 grams of uranium per liter which is below the maximum permissible concentration of waste streams to sewer (restricted area) for 5% enrichments.

(c) If the concentration of the waste solution is above 0.05 grams of uranium per liter, several factors will be considered in determining whether it is dumped to the sewer or returned to the process. For higher enrichments, economics will set a limit on the amount of material which may be dumped. Waste solutions leaving the plant also receive additional dilution from the discharge of cooling water from condensers and vessel jackets. The sewer from the plant discharges to a pond where it mixes with effluent water from the rest of the Jayhawk Works. The average daily flow of water through this pond to the river is in excess of ten million gallons. The concentration of uranium in the discharge from the pond will thus be kept below the maximum permissible level.

8. Precautions Regarding Residue

Before charging uranium to the dissolver or kettle, the vessel must be inspected by the supervisor for residual uranium from previous dissolutions. If any residue is present, it will be taken into account in calculating the safe mass for a new charge.

9. Jacketing

The dissolver jacket is provided with steam for heating and water for cooling. When either steam or water are being used, the pressure in the jacket will be higher than in the vessel, and any leakage will be from the jacket into the vessel. This

Mr. Charles P. McCallum, Jr.
USAEC

will result only in dilution of the vessel contents, and will involve no criticality problems. If neither steam nor water is in service, a drain at the bottom of the jacket will be open so that any leakage from the vessel to the jacket cannot occupy an unsafe diameter.

Yours very truly,

Nuclear Fuels Department

Harold Lambertus

Harold Lambertus
General Manager

HL:el

~~CONFIDENTIAL~~

C. K. Beck, Chief
Hazards Evaluation Branch

September 24, 1957

Lyall Johnson, Chief
Licensing Branch

SEE Rpts for Application

SPENCER CHEMICAL COMPANY APPLICATION FOR SPECIAL NUCLEAR MATERIAL LICENSE, DOCKET NO. 70-1146

SYMBOL: CAL:JCD

Transmitted herewith is a copy of an application for special nuclear material license dated September 15, 1957 and submitted by Spencer Chemical Company, Kansas City, Missouri.

Please review the application with respect to the adequacy of the applicant's proposed procedures to protect health and minimize danger to life or property, especially those procedures related to the prevention of conditions of accidental criticality.

The application should be returned with your comments.

Enclosure:
Supp. 70-1146

~~RESTRICTED DATA~~

This document contains restricted data as defined in the Atomic Energy Act of 1954. Its transmittal or the disclosure of its contents in any manner to an unauthorized person is prohibited.

When separated from enclosures, handle this document as Unclassified
(Insert proper classification)

~~CONFIDENTIAL~~

OFFICE ▶	CAL	CAL				
SURNAME ▶	DeLaney/cw	LJohnson				
DATE ▶	9-23-57	9-23-57				

Form AEC-318 (Rev. 9-53)

U. S. GOVERNMENT PRINTING OFFICE 16—69761-3

DOCKET NO. 70-146

SPENCER CHEMICAL COMPANY

PROCESS DEVELOPMENT DEPARTMENT

APPLICATION FOR

SPECIAL NUCLEAR MATERIAL LICENSE

September 15, 1957

UNCLASSIFIED

Enclosure to
Ltr dtd 9-15-57

TABLE OF CONTENTS

NOTE: The Appendix comprises a separate document, parts A and B of which are considered by Spencer Chemical Company to be Confidential between Spencer and the Atomic Energy Commission, and part C of which is considered to be AEC classified as Confidential, Restricted Data.

I
INTRODUCTION AND APPLICATION

This application for a special nuclear material license is submitted by Spencer Chemical Company. The company is incorporated in the state of Missouri and has its principal office in the Dwight Building in Kansas City, Missouri. The principal officers of the Company are:

K. A. Spencer - President

C. Y. Thomas - General Vice President (Operations)

J. P. Miller - General Vice President (Finance)

J. E. Culpepper - General Vice President (Marketing)

E. V. Friedrich - Vice President, Administration, and Assistant Secretary

J. R. Brown, Jr. - Vice President, Research and Development Division

J. C. Denton - Vice President, Agricultural Chemical Division

H. R. Dinges - Vice President, Industrial Chemical Division

F. L. Pyle - Vice President, Plastics Division

E. W. Morgan - Treasurer

A. Mag - Secretary

W. L. Elleman - Administrative Assistant

All these officers have their offices in the Dwight Building except for Mr. Mag whose address is 9 West Tenth Street, Kansas City, Missouri. All are natural born citizens of the United States. The company is not controlled by any alien, foreign corporation or foreign government.

This license is requested for the processing of any enrichment of uranium up to highly enriched. The uranium in the form of UF_6 or scrap is to be converted to the nitrate or an oxide. The processing will be done at the Jayhawk Works of the Spencer Chemical Company located between Pittsburg, Kansas, and Joplin, Missouri, with a freight shipping designation of Military, Kansas.

The license is requested for 10 years.

Any enrichment of uranium up to highly enriched is to be processed. The uranium to be processed may be UF_6, a compound of uranium or a mixture of uranium and some metal such as might be generated in the fabrication of fuel elements. The product of the process will normally be finely divided UO_2 powder or pellets. When the nitrate is produced it will be in solution form. Oxides other than UO_2 may also be produced as finely divided powders or pellets.

The uranium will be processed for other licensees. Production is scheduled to begin December 1, 1957. The maximum design processing rate is 30 pounds of uranium per day. The actual processing rate will depend upon the exact nature of the feed material and upon customer demand. Inventory of U^{235} at the plant will not exceed 100 kg. Processing losses generally will be held to less than 1%, but may exceed this for small batches.

The Spencer Chemical Company is currently engaged in the manufacture of ammonia, nitric acid, N^{15}, polyethylene, nylon, urea, methanol and other similar products. It is accustomed to handling highly valuable materials on a commercial scale as exemplified by its current handling of a $200,000 inventory of platinum used as a catalyst. Also, the company has extensive experience in handling hydrogen and unstable compounds.

II
QUALIFICATIONS OF PERSONNEL

The processing of enriched uranium is the direct responsibility of L. H. Landrum, Director, Process Development. Mr. Landrum reports directly to Dr. John R. Brown, Jr., Vice President in charge of Research and Development for Spencer Chemical Company.

Dr. Brown holds a B.S. degree in chemistry from Oberlin College, an M.S. degree in chemistry from Ohio State and a Ph.D. degree in chemical engineering from Massachusetts Institute of Technology. From 1938 to 1946 Dr. Brown was employed by Esso Laboratories in Elizabeth, New Jersey, serving as assistant Director of the Chemical Division from 1941 through 1946. In 1946 he was made Director of Research for the Pro-phy-lac-tic Brush Company, a division of the Lambert Company in Florence, Massachusetts, and in 1949 transferred to the Lambert Pharmacal Company, a division of the Lambert Company, as Director of Research. In 1953 he became Vice President - Director of Research. Dr. Brown joined Spencer Chemical Company in August, 1953, as General Manager - Research and Development, and in February, 1957, became Vice President - Research and Development.

Mr. Landrum received his B.S. and M.S. degrees in Chemical Engineering from Missouri University and Washington University respectively. Before entering the atomic energy program, he had some ten years of industrial experience in process and engineering development with Carbide and Carbon Chemicals Corporation in South Charleston, West Virginia, and with Titanium Division of National Lead Company in St. Louis and Sayreville, New Jersey. He entered the atomic energy program in July, 1951, when American Cyanamid sent him to Oak Ridge as part of that company's contract with the Atomic Energy Commission to operate the Idaho Chemical Processing Plant. At Oak Ridge he was associated with the pilot plant at the X-10 laboratory and participated in the design of some special recovery facilities. He was transferred to Idaho Falls in December, 1951, and was placed in charge of Cyanamid's process engineering section. His efforts were directed toward design of facilities for recovering uranium from spent fuel used in the submarine reactors, and in studies connected with the main chemical processing plant.

Mr. Landrum joined Nuclear Power Group in Chicago in 1953. Nuclear Power Group consisted of representatives of four utilities and a construction company, and Mr. Landrum represented Union Electric of Missouri. Studies made by NPG were directed toward industrial utilization of atomic energy. Since joining Spencer Chemical Company in July, 1955, Mr. Landrum has been Director of Process Development. As such, he has been in charge of Spencer's pilot plant activities. A portion of this has been in studies toward developing background for this license application.

Under Mr. Landrum's supervision are 21 other engineers and scientists, some of whom have been associated with the design of the uranium process. The process has been demonstrated in the laboratory with the use of depleted uranium obtained under source material license No. C-3571.

Mr. D. A. Young has been responsible for a major portion of the process design. Among the people who have participated in the design and who have applied previous experience to the design are Sinesio A. Zagnoli and R. B. Mesler. Two of the people who have participated in the laboratory demonstration of the process are L. G. Stevenson and David Rankin.

Mr. Young obtained a B.S. degree in Chemical Engineering from Pennsylvania State University in 1942. He spent 5 years with the Sun Oil Company at Marcus Hook, Pennsylvania, and then a year with the Warwick Wax Company at Chanute, Kansas. He has been with Spencer Chemical Company since 1947 and has been a group leader since 1954. He has been associated with many of the process development projects which have been responsible for Spencer's growth. Among these have been ammonia and methanol gas reforming, formaldehyde, polyethylene, nylon 6 and others.

Mr. Zagnoli received his B.S. in Chemical Engineering from Purdue University, and his M.S. in Chemical Engineering and M.S. in Gas Technology from Illinois Institute of Technology. He had some three years of industrial experience with petroleum and natural gas industry before his entry into atomic energy activities in 1952. He entered the atomic energy program with Nuclear Power Group and represented the Commonwealth Edison Company. He participated in several studies made by the Public Service Company of Northern Illinois and Commonwealth Edison Company before the latter joined Nuclear Power Group. With NPG, Mr. Zagnoli's work was with heat transfer, fuels processing and fuel element metallurgy. Mr. Zagnoli joined Spencer Chemical Company in October, 1955, and is a senior staff member in the Process Development Department, being assigned directly to Mr. Landrum. He is charged with planning experimental programs and designing experimental facilities, and with making economic analyses of various projects in the atomic energy field.

Mr. Stevenson was an Air Force officer during World War II, having completed the Air Force training program at the University of New Mexico and the California Institute of Technology. He was graduated with high honor from Kansas State College in 1947 with a B.S. in Chemical Engineering. After graduation, Mr. Stevenson was employed in the research and development laboratories of the Linde Air Products Company. In 1951 he joined the Spencer Chemical Company for process development work. He has been active in the nuclear fuel program since midsummer of 1956.

Dr. Rankin graduated from Monmouth College in 1936 with a B.S. degree and a major in chemistry. He completed his M.S. and Ph.D. work at Purdue University in 1942 with a major in chemistry. He was employed at Penick and Ford, Ltd., Inc., as a research chemist during the years 1942-1943, and again in 1946-1947. In 1944-1945 he was naval officer in training activity. Dr. Rankin was employed as a research chemist and later as chief chemist of Lucidol Division, Wallace and Tiernan, Inc., whose principal products were peroxide catalysts and bleaching compounds. He joined Spencer Chemical Company in June, 1956, and was assigned to Process Development Department work on uranium scrap recovery and uranium dioxide production for the nuclear fuel cycles.

Dr. Mesler of the University of Kansas was consulted for criticality considerations. Dr. Mesler's background includes the Oak Ridge School of Reactor Technology, 1951-52, Ph.D., University of Michigan, 1955, Project Engineer for the Ford Nuclear Reactor and Assistant Professor of Nuclear Engineering, University of Michigan, 1955-1957. He is presently Associate Professor of Chemical Engineering at the University of Kansas.

III
PROCESSING AREA

The following equipment and facilities will be used to protect health and minimize danger to life and/or property.

The building used for uranium processing is a building formerly used as a high pressure laboratory. It is of frame construction containing 4 cells. These cells have a concrete roof and concrete walls on 3 sides, all a foot or more thick. One cell has been converted to a vault by adding a fourth concrete block wall. Another cell is used for the location of several storage vessels and a third cell for dissolving operations. The walls of these cells effectively isolate the contents criticalitywise, from anything outside.

The east end of the building has a partial second level. There is enough head room in the east end to accomodate the extraction columns and some other pieces of equipment. Lockers are provided at one end of the building for changing clothes. Film badges are provided for all personnel and ring film monitors are provided for those using the dry boxes. A Geiger counter survey meter with a range from 0.2 to 20 mr per hour is available for monitoring against contamination. Air sampling equipment and dust masks are available for monitoring building air. Film monitors will be mounted around the building to detect the occurrence of any spread of radioactivity.

A fence encompasses the entire Jayhawk plant works and entrance into the plant area is controlled by 24 hour guard force.

The concrete vault in the building is provided for storage of both raw materials and finished product. Another vault in a nearby building may also be used. Raw material will arrive in "always safe" geometry containers, packed in bird cages to maintain the necessary spacing between other containers. Watertight containers of "always safe" geometry along with their bird cages are provided for shipping out finished product.

IV
PRECAUTIONS FOR SAFETY

The following procedures are proposed to protect health and minimize danger to life and/or property.

All personnel working with uranium are required to pass a complete medical examination including chest x-ray before starting to work. Quarterly, or more frequently if justified, urine samples will be analyzed for uranium. Chest x-rays will be required annually. No smoking or eating will be allowed within the uranium processing building.

Good housekeeping will be exercised. Wet mopping will be performed in order to minimize air pollution.

Any minor spills (less than 20 grams) will be cleaned up immediately, both to recover the uranium and to avoid spread of contamination. Clean-up will be performed with rubber gloves and dust mask. Wash water will be collected and stored in safe containers awaiting return to process for recovery. Detergent may be useful for decontamination.

Major spills may necessitate orderly plant shutdown and reducing the inventory of uranium in the spill area to allow more freedom of movement. In handling cleanup solutions 1 liter graduates are to be used to transfer solution to safe storage, or transfer may be accomplished with small diameter tubing running to safe storage.

Clothing is to be monitored when leaving the building to prevent spread of contamination. The working areas will be continually surveyed for uranium on the floor and elsewhere.

Building and building exhaust air will be sampled to see that concentrations are below permissible limits of 5.0×10^{-11} and 1.7×10^{-12} microcuries per ml respectively.

Aqueous wastes will be discharged to the sanitary sewer which carries an average daily flow in excess of a million gallons away from the plant. The quantity of waste released to the sewer will be limited to that quantity which, if diluted by the average daily flow of sewage, will result in an average concentration less than 2×10^{-4} microcuries per ml. These conditions are set by Title 10, Part 20, Code of Federal Regulations.

Only one uranium container may be in motion at any one time and no uranium container may be moved unless all other uranium containers are in approved locations. No uranium container may enter the storage tank cell, the area behind the cells, or the main processing area. Chain guards prevent the movement of UF_6 cylinders, scrap containers, or finished material into these areas. A UF_6 cylinder and scrap may be safely moved by the processing area on the sidewalk outside the building.

Uranium containers are always to be in bird cages or in place in process except when removed and replaced one at a time.

Uranium shipments are to be shipped by Railway Express, Protective Signature. Shipment is to be made in bird cages with instructions to the carrier not to stack containers, but to secure them while in transit. No other enriched uranium shipment is to be handled in the same car. In the case of UF_6 cylinders, special additional instructions to the carrier will be as follows:

1. Avoid mechanical damage to container.

2. Protect from fire or excessive heat.

3. In case of leak as evidenced by a white fume, avoid exposure and notify shipper. Protect the public by prohibiting access to the general area.

The uranium processing building will be posted and uranium containers will be labeled according to Title 10, Part 20, Code of Federal Regulations. Outside shipping containers will be labeled according to ICC regulation.

Safe geometry storage is provided for all process streams. Before pumping any solution from safe storage to unsafe storage, it is to be sampled to assure that the uranium concentration is below 1 gram/liter. Unsafe vessels are to be inspected frequently for accumulation of uranium.

As much of the uranium inventory as possible will be kept in the vault where it is secure in the event of an emergency.

Fire in the frame constructed building presents three problems. First, the organic phase for extraction is inflammable. Second, the hydrogen is both inflammable and explosive. Third, water used in fighting a fire could mix with uranium and create a criticality condition. This is particularly true of the uranium in the dry box and furnaces. CO_2 will be used to control any fire in the uranium building and the plant fire department is instructed not to use water unless requested to do so by the uranium building supervisor. Care will be taken in handling UO_2 as it has been reported to burn. Explosion could occur as a result of the hydrogen, although precautions have been taken to prevent this. In the event of an explosion, the area will be surveyed for uranium containation.

Tornadoes are a possibility in Kansas. Material in the vault and in the vessel storage cell should be undisturbed by a tornado. Plant design is on the premise that a condition of criticality resulting from tornado damage would do negligible damage compared to that of the tornado.

The building site is 30 feet above any previous flood stage.

Loss of electrical power does not present any hazard except for loss of ventilation. Pumps, furnaces, vacuum system and dry box would be inoperative.

Criticality is avoided primarily by proper spacing of "always safe" geometry vessels. Concentration and mass control is exercised in handling dilute solutions. Mass and moderation control is exercised in handling dry UO_2 in the dry box, and in storing and shipping scrap uranium. A combination of mass, volume, and moderation control is used in specifying containers for shipping and storing UO_2 product. All safe parameters used are safe with a thick water reflector.

Process vessels are located so as to minimize interaction between vessels. In many instances advantage has been taken of the isolating effect of concrete walls thicker than 8". In other instances, spacing is used to minimize interaction.

A detailed process description, flow sheet and layout are presented in the Appendix with a discussion of the methods used for prevention of criticality.

V
INSURANCE COVERAGE

The company is negotiating for insurance to cover any possible loss of enriched uranium both while in process and in transit. Details of coverage will be supplied to the AEC when they are obtained.

VI
FINANCIAL QUALIFICATIONS

A copy of the 1957 annual report of the Spencer Chemical Company is submitted with this application in support of the company's financial qualifications to undertake the processing of enriched uranium.

DOCKET NO. 70-946

SPENCER CHEMICAL COMPANY

PROCESS DEVELOPMENT DEPARTMENT

Rec'd w/memo dtd 9/24/57

APPLICATION FOR

SPECIAL NUCLEAR MATERIAL LICENSE

September 15, 1957

APPENDIX II

~~(This section is all confidential to the Spencer Chemical Company and should not be revealed to the general public.)~~

TABLE OF CONTENTS

A. PROCESS DESCRIPTION

This process is designed to produce primarily UO_2 from either UF_6 or scrap. The steps in the process are uranium dissolution, extraction, precipitation, filtration, drying, calcining, reducing, screening and grinding. These steps are shown graphically on the flow sheet, Drawing 48-7. In turn, a material balance, showing expected flows of materials, is attached as Table I to this Appendix.

Starting with UF_6, a cylinder is first weighed and then placed in a heating chamber (EP-3) to liquify the UF_6. The chamber is steam heated and the temperature is controlled at 160° F. A vacuum pump preceded by a cold trap and a chemical trap permits evacuation and leak testing of the UF_6 piping.

A batch of UF_6 for hydrolysis is prepared by filling a small vessel (V-2) which holds 7 pounds of UF_6. Nitrogen is used to force UF_6 out of the UF_6 cylinder into V-2 and then to force UF_6 from V-2 into the hydrolyzer.

Before transferring UF_6 to the hydrolyzer, the hydrolyzer is first charged with an aqueous solution of $Al(NO_3)_3$ prepared in V-6. Nitric acid may also be added to adjust the acidity.

The product of the hydrolyzer is transferred to one of two rich acid storage tanks (T-1 and T-2) again with nitrogen pressure.

Starting with metallic scrap, a weighed quantity of the scrap is added to the empty dissolver. Acid is then added. The dissolver is fitted with a reflux condenser and with a jacket for heating and cooling the dissolver. After solution is developed, it is tranferred to one of the rich acid storage tanks using nitrogen pressure. This may result in a residue of solids in the dissolver which, for convenience, may be cleaned out periodically by prolonged dissolution treatment. Modification to the procedure may involve periodic addition of scrap and continuous addition of dissolving agents. In any event, the solution developed is tranferred to one of the rich acid storage tanks either by the pressure on the system maintained continuously or intermittently, or by a pump.

Only one of these two operations, hydrolysis of UF_6 or dissolution of scrap, will be in operation at any time.

Rich acid is pumped to the countercurrent extractor column (C-1) using metering pump (P-1). A solution TBP in kerosene is the solvent. The top part of the extractor serves as a scrub section in which acid is used to scrub the organic extract.

The flows of rich acid and solvent to the extractor are 1-1/2 gallons per hour. Scrub acid flows at about one-tenth this rate. Some variation in these stream ratios may be needed to accommodate other processes involving scrap recovery. The rich organic phase overflows from the extractor column into an intermediate storage tank. From this tank the rich organic is pumped to the stripper column. Raffinate from the extractor column exits through a jack leg to one of two lean acid storage tanks (T-3 and T-4). Here the lean acid is sampled and if the concentration of uranium is less than 1 gram/liter, it is then pumped to either the aqueous recycle tank (T-9) or the remote aqueous waste tank (T-14).

Water flowing at 1-1/2 gph is the solvent in the stripper column. The stripped organic phase overflows to a system which continually cleans the solvent for reuse. The rich aqueous phase exits through a jack leg to the rich aqueous storage tank (T-5).

Rich aqueous is pumped continuously to the precipitator where ammonia is also added continuously. Slurry from the precipitator overflows to one of two filters. The filters remove water to produce a more concentrated slurry.

Concentrated slurry from the filter overflows to a furnace where the precipitate is dried and calcined. Out of this furnace the material falls into the reducing furnace where reduction with hydrogen to UO_2 occurs. The reduced UO_2 from the second furnace is transferred to a dry box with a screw conveyor.

An inert helium atmosphere is maintained in the dry box so that the UO_2 can be screened and ground without oxidation.

TABLE I

MATERIAL BALANCE FOR URANIUM PROCESSING SYSTEM

HYDROLYZER

	1 Lb. UF_6		7.2 Lb. UF_6		30 Lb. U/Day		
	Pounds	Ft^3	Pounds	Ft^3	Pounds	Ft^3	Gal/Day
Inputs							
UF_6	1.0	0.00447	7.2	0.0321	43.2	0.192	1.44
$Al(NO_3)_3$	3.73	---	26.9	---	161.0	---	---
H_2O	7.03	0.113	50.5	0.812	304.0	4.87	36.4
Total	11.8		84.7		508		
Outputs							
$UO_2(NO_3)_2$	1.15	---	8.28	---	49.7	---	---
H_2O	6.90	0.110	49.7	0.797	298	4.77	35.6
HNO_3	0.736	---	5.29	---	31.7	---	---
Al_2F_6 complex	0.487	---	3.5	---	21.0	---	---
$Al(NO_3)_3$	2.49	---	17.9	---	107.0	---	---
Total	11.8		84.6		508		

TABLE I

MATERIAL BALANCE FOR URANIUM PROCESSING SYSTEM
(Continued)

EXTRACTOR	Lbs./Hour	Ft^3/Hour	Gal./Day
Inputs			
Organic Phase			
TBP	2.94	0.0497	8.9
Kerosene	7.21	0.149	26.7
	10.15	0.199	35.6
Aqueous Phase			
$UO_2(NO_3)_2$	2.07	---	---
H_2O	12.40	0.199	35.6
HNO_3	1.32	---	---
Al_2F_6 complex	0.875	---	---
$Al(NO_3)_3$	4.47	---	---
	21.13		
Total	31.3		
Outputs			
Organic Phase			
TBP	2.94		
Kerosene	7.21		
$UO_2(NO_3)_2$	2.07		
	12.2		
Aqueous Phase			
H_2O	12.4		
HNO_3	1.32		
Al_2F_6 complex	0.875		
$Al(NO_3)_3$	4.47		
	19.06		
Total	31.3		

TABLE I

MATERIAL BALANCE FOR URANIUM PROCESSING SYSTEM
(Continued)

STRIPPER

		Lbs./Hour	Ft^3/Hour	Gal./Day
Inputs				
Organic Phase				
TBP		2.94		
Kerosene		7.21		
$UO_2(NO_3)_2$		2.07		
		12.22		
Aqueous Phase				
H_2O		12.4		
	Total	24.6		
Outputs				
Organic Phase				
TBP		2.94	0.0414	8.9
Kerosene		7.21	0.148	26.7
		10.15	0.189	35.6
Aqueous Phase				
H_2O		12.4		
$UO_2(NO_3)_2$		2.07		
		14.47		
	Total	24.6		

TABLE I

MATERIAL BALANCE FOR URANIUM PROCESSING SYSTEM
(Continued)

PRECIPITATOR

	Basis - Continuous	
	Lbs./Hour	Ft^3/Hour
Inputs		
Aqueous		
H_2O	12.4	0.196
$UO_2(NO_3)_2$	2.07	---
	14.47	
NH_3 Solution		
H_2O	0.76	0.0122
NH_4OH	0.76	
	1.52	
Total	15.99	
Outputs		
Solid		
$(NH_4)_2U_2O_7$	1.64	
Aqueous		
H_2O	13.3	0.213
NH_4OH	0.231	
NH_4NO_3	0.80	
	15.97	

TABLE I

MATERIAL BALANCE FOR URANIUM PROCESSING SYSTEM
(Continued)

FILTER

	Basis - Continuous	
	Lbs./Hour	Ft^3/Hour
Inputs		
Aqueous Solution		
H_2O	13.3	0.213
NH_4OH	0.231	---
NH_4NO_3	0.80	---
	14.30	
Solid		
$(NH_4)_2U_2O_7$	1.64	
Total	16.0	
Outputs		
Aqueous Solution		
H_2O*	7.2	0.115
NH_4OH	0.12	---
NH_4NO_3	0.434	---
	7.75	
Cake		
H_2O*	6.1	0.0978
NH_4OH	0.106	---
$(NH_4)_2U_2O_7$	1.64	
NH_4NO_3	0.366	---
	8.21	
Total	16.0	

*Assumed 80% solution, 20% solids by weight in filter cake. No wash used.

TABLE I

MATERIAL BALANCE FOR URANIUM PROCESSING SYSTEM
(Continued)

DRYING AND DECOMPOSITION REACTION

	Basis - Continuous	
	Lbs./Hour	Ft^3/Hour
Inputs		
Cake		
H_2O	6.1	0.0978
NH_4OH	0.106	----
$(NH_4)_2U_2O_7$	1.64	
NH_4NO_3	0.366	
	8.21	
Air*	5.80	72 (STP)
Total	14.0	
Output		
Exit Gas		
N_2	4.59	58.8 (STP)
O_2	0.352	3.95 "
H_2O	6.59	131.0 "
NO_2	0.750	5.85 "
	12.28	200 "
Solid		
U_3O_8	1.48	----
	13.8	

* Assumed 25% excess air.

TABLE I

MATERIAL BALANCE FOR URANIUM PROCESSING SYSTEM
(Continued)

REDUCER

		Basis - Continuous	
		Lbs./Hour	Ft^3/Hour
Inputs			
U_3O_8		1.47	
H_2 *		0.014	2.51 (STP)
	Total	1.48	
Outputs			
UO_2		1.42	0.0061 (Solid)
H_2O		0.063	12.6 (STP)
H_2		0.007	1.25 "
	Total	1.49	

* Assumed 100% excess H_2.

B. PLANT LAYOUT AND EQUIPMENT DESCRIPTION

The building to house this facility is contained within the Jayhawk plant site. It is a two-level building with high equipment, pulse columns, furnaces, precipitator and filters in the two-story section; the dry box, wash room and storage vault are in the one-story section. It is constructed of steel framework and covered by wooden siding. It contains four concrete cells originally built for conducting high pressure research work. Attached Drawings 48-9, -12 and -13 show plot plans at two levels and an elevation view of the ground floor. Feed and product are stored in a vault in caged, safe containers. The flow of material is across a balance, around the building to the UF_6 heating chamber. Thence the uranium compounds flow through pipes and vessels as shown on flow sheet, Drawing No. 48-7. Movement of materials in other directions is hindered by chain guards.

Uranium scrap follows much the same path from the vault into the concrete cell containing the dissolver. Critically safe storage vessels (T-1, -2, -3, -4, -5, -6, -7 and V-16 and -20) are all located within another concrete cell.

Concrete trenches, lined with an acid-resistant coating are under these vessels. Accidental discharge of contents of any one of these vessels will be contained within trenches. The complete contents of more than 1 vessel would overflow into the cell. There is no connection to the sewer from this room. Similarly the pulse columns, precipitator and filters are equipped with such trenches.

Various storage tanks for chemical feed solutions are on the north side. They are conveniently placed for the process and will contain no uranium. All feed to the aqueous recycle and remote aqueous waste tanks will have been analyzed and be at a low uranium level before storage.

The second level of the building at 11' covers approximately one quarter of the building and is shown in Drawing 48-12. The floor consists of the tops of the concrete bays and access is obtained by stairway and walkway. Extending into this area are the pulse columns, precipitator, filters and furnaces.

Drawing 48-13 is an elevation view of the processing equipment as seen from the south. It shows the relative height and arrangement of important processing equipment. Both the hydrolyzer and critical storage vessels are enclosed within the concrete cells and do not appear on this drawing.

Important aspects of major items of equipment are described as follows:

1. <u>UF_6 Heating Chamber (EP-3)</u>

   This is a steam heated jacket, a completely safe enclosure for handling the UF_6 cylinders. It consists of an 18" flanged steel pipe 5' long, equipped with steam jackets and internal piping.

2. <u>Hydrolyzer (V-3)</u>

   A stainless steel vessel, 5" ID, by 8' long, equipped with agitator, NH_4OH vent trap, various inlets, and bottom discharge.

3. Dissolver

A 5" diameter x 6' high, Carpenter 20 vessel. Flanged top and full-length jacket for heating or cooling. Connected to a reflux condenser. Gases produced will be vented outside building.

4. "Safe" Storage Vessels (T-1, -2, -3, -4, -5, -6, -7 and V-16 and -20)

5" ID x 6 to 7' height, constructed of stainless steel. T-1 and -2 equipped with agitator and cooling coil. All are open-topped except T-6 and T-7 which will be under vacuum.

5. Pulse Columns

Pyrex glass construction, 17' long. The main body is 1" tubing, while settling zones are 3" tubing. Equipped with stainless steel sieve plates spaced on 2" center. Pulser consists of mechanically flexed diaphragm.

6. Precipitator (V-10)

5" ID x 2' long stainless steel, agitated vessel, open at the top. Product overflows to filters. Two incoming liquid streams converge at the suction of the impeller. Agitation prevents settling of di-uranate cake.

7. Filters (V-11 and V-12)

5" ID x 12" long, stainless steel, agitated filters. Equipped with porous stainless steel filter media. Bottom outlet for filtrate, side outlet for thickened di-uranate slurry.

8. Furnace System

F-1. 5" ID x 7-1/2' long furnace, with sections devoted to feeding, heating in a zone that has external gas firing, and cooling. The furnace has no internal restrictions that would cause buildup. Furnace converts a slurry feed to a dry powder.

F-2. 6-1/2" ID x 7-1/2' long furnace, very similar to F-1. Converts powdered oxide feed to fully reduced UO_2.

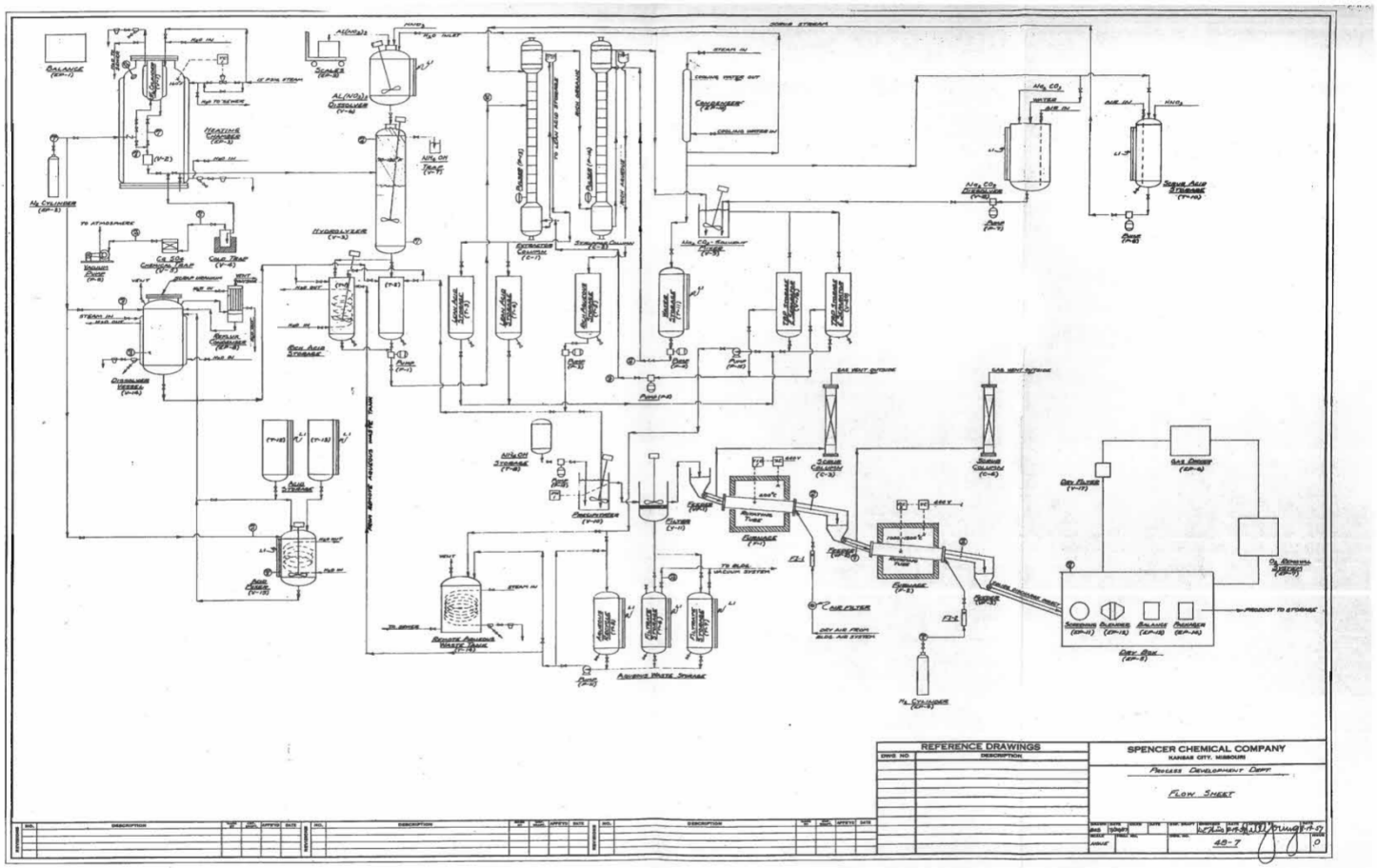
Feeder (VF-1). 2" vertical hopper joined to a 2" horizontal stem. Horizontal section equipped with a screw driven at variable speed. Feeds slurry to furnace.

Feeders (VF-2 and -3). Similar to VF-1 except that they feed a dry powder and furnish a gas seal.

Scrub Columns (C-3 and -4). 3" ID x 2' high, stainless steel vessels. Will contain dilute nitric and scrub process gases exit the furnaces to remove uranium dust.

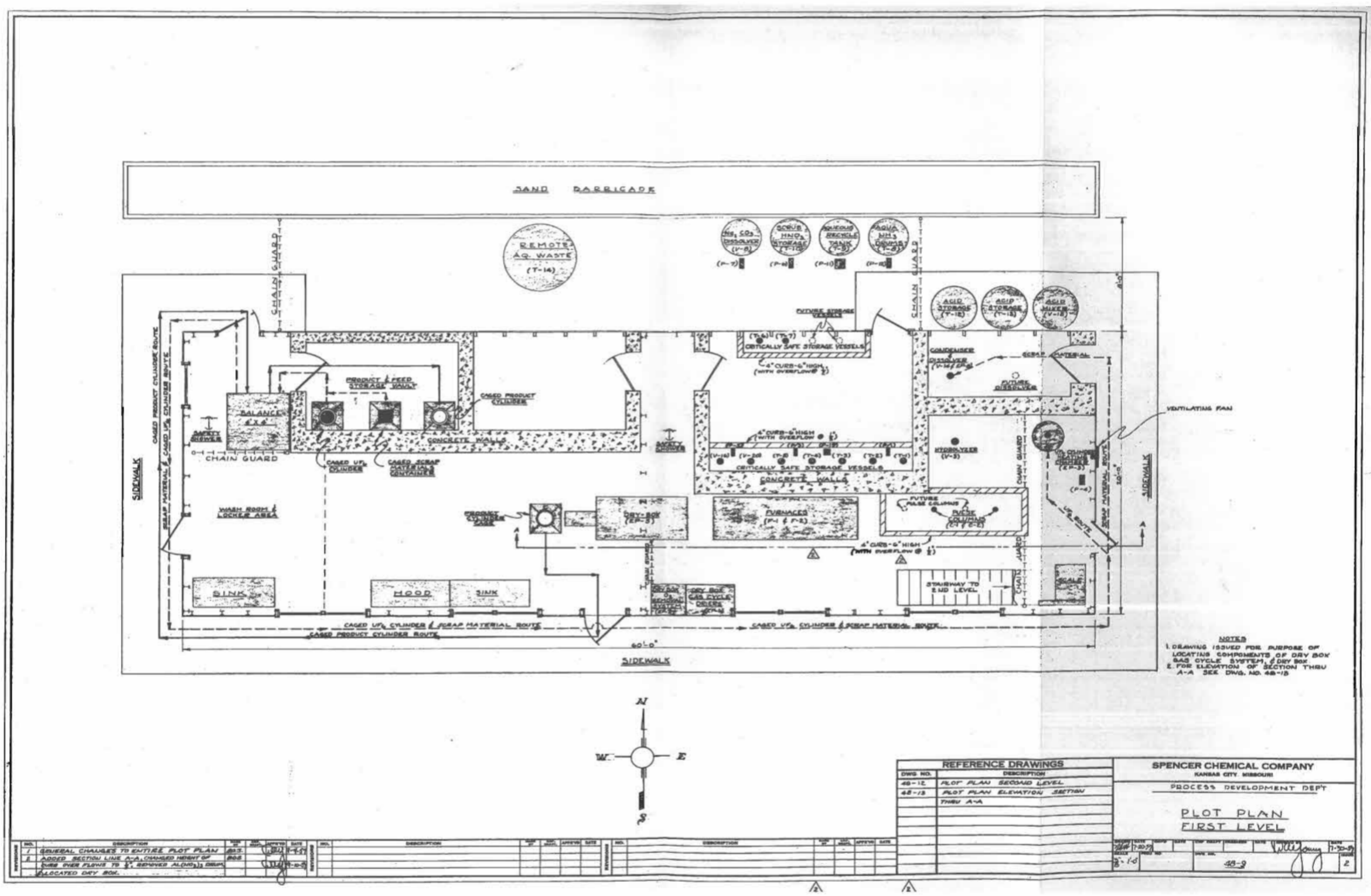
9. Na_2CO_3-Solvent Mixer

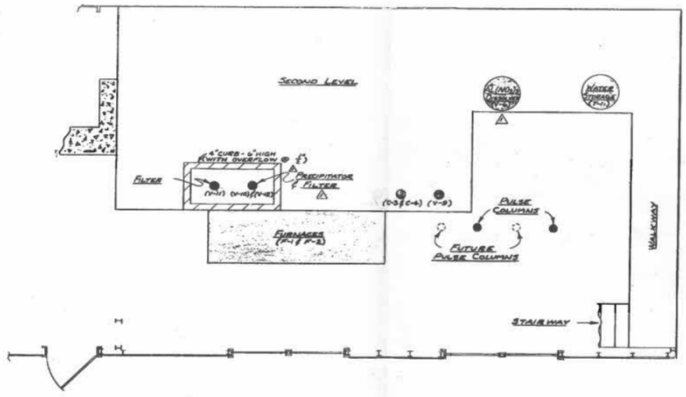
5" ID x 2' high, stainless steel mixing chamber, equipped with stirrer. Performs 1-stage mixing for the purpose of cleaning up the extracting solvent.



REFERENCE DRAWINGS	
DWG NO.	DESCRIPTION

SPENCER CHEMICAL COMPANY
KANSAS CITY, MISSOURI
PROCESS DEVELOPMENT DEPT.
FLOW SHEET
49-7


SAND BARRICADE
REMOTE AQ. WASTE (T-14)
CHAIN GUARD
ACID STORAGE
ACID MIXER
CONDENSER
DISSOLVER
SCRAP MATERIAL
FUTURE DISSOLVER
VENTILATING FAN
BALANCE
SAFETY SHOWER
PRODUCT & FEED STORAGE SCALE
CAGED PRODUCT CYLINDER
CONCRETE WALLS
CAGED UF6 CYLINDER
CAGED SCRAP MATERIAL CONTAINER
CRITICALLY SAFE STORAGE VESSELS
FUTURE STORAGE VESSELS
HYDROLYZER (V-3)
WASH ROOM & LOCKER AREA
DRY BOX
FURNACES (F-1 & F-2)
FUTURE PULSE COLUMNS
PULSE COLUMNS
STAIRWAY TO 2ND LEVEL
SINK
HOOD
SIDEWALK
CAGED UF6 CYLINDER & SCRAP MATERIAL ROUTE
CAGED PRODUCT CYLINDER ROUTE
60'-0"
N
W
E
S
NOTES
1. DRAWING ISSUED FOR PURPOSE OF LOCATING COMPONENTS OF DRY BOX GAS CYCLE SYSTEM, & DRY BOX
2. FOR ELEVATION OF SECTION THRU A-A SEE DWG. NO. 48-13
REFERENCE DRAWINGS
DWG. NO. | DESCRIPTION
48-12 | PLOT PLAN SECOND LEVEL
48-13 | PLOT PLAN ELEVATION SECTION THRU A-A
SPENCER CHEMICAL COMPANY
KANSAS CITY, MISSOURI
PROCESS DEVELOPMENT DEP'T
PLOT PLAN
FIRST LEVEL
7-20-59
7-30-59
48-9
2
1 GENERAL CHANGES TO ENTIRE PLOT PLAN
2 ADDED SECTION LINE A-A, CHANGED HEIGHT OF CURB OVER FLOWS TO 1/2", REMOVED ALONG DRUM, RELOCATED DRY BOX.



REVISIONS NO.	DESCRIPTION	DRWN BY	CHK. ENGR.	APPR'VD	DATE
1	ADDED $AL(NO_3)_3$ DISSOLVER, CHANGED HEIGHT OF CURB, OVERFLOWS TO 4", CHANGED POSITION OF FILTER (V-18)	BDS			12/19-6-57

REVISIONS NO.	DESCRIPTION	DRWN BY	CHK. ENGR.	APPR'VD	DATE

REFERENCE DRAWINGS

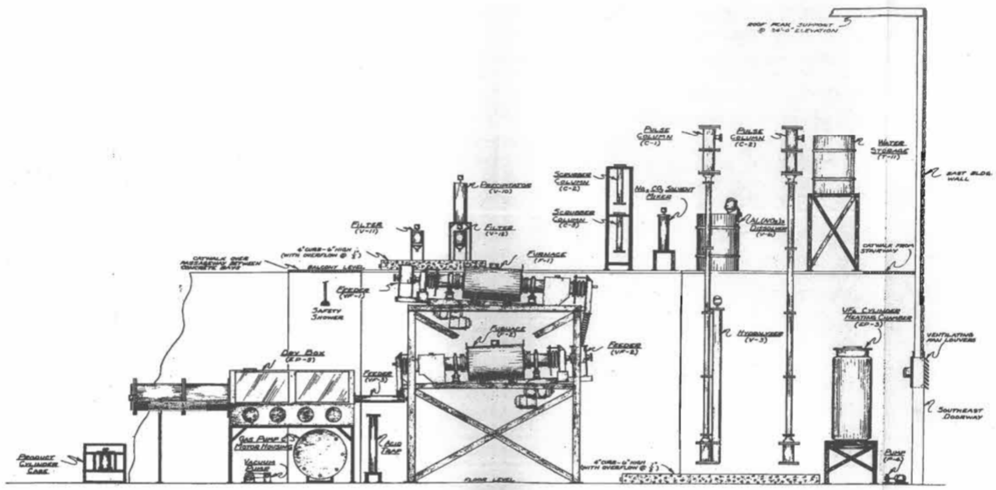
DWG. NO.	DESCRIPTION
48-9	PLOT PLAN FIRST LEVEL
48-13	PLOT PLAN ELEVATION SECTION THRU A-A

SPENCER CHEMICAL COMPANY
KANSAS CITY, MISSOURI

PROCESS DEVELOPMENT DEPT

PLOT PLAN
SECOND LEVEL @ 11'

DRAWN	DATE	TRACED	DATE	CHK. GROUP	ENGINEER	DATE	APPROVED BY	DATE
BDS	9/8/57						JAL	9-4-57
SCALE 1" = 1'		DRWG. NO.					DRWG. NO. 48-12	ISSUED 1



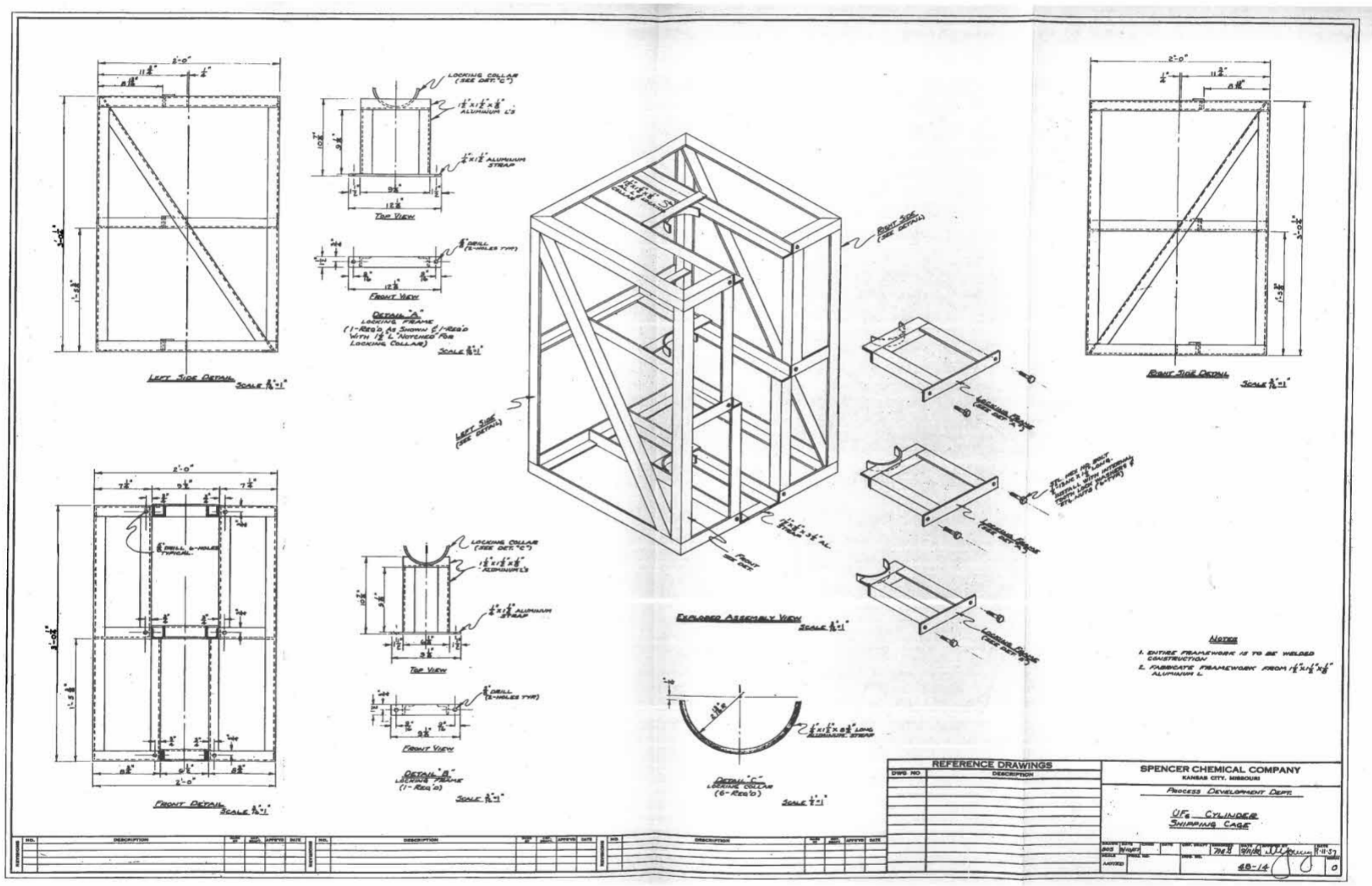
REFERENCE DRAWINGS	
DWG. NO.	DESCRIPTION
48-9	PLOT PLAN FIRST LEVEL
48-12	PLOT PLAN SECOND LEVEL

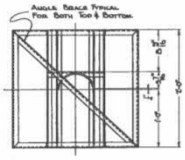
SPENCER CHEMICAL COMPANY
KANSAS CITY, MISSOURI

PROCESS DEVELOPMENT DEPT.

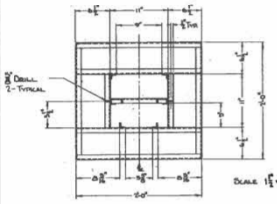
PLOT PLAN ELEVATION
SECTION THRU A-A

Drawn: BGS 9/4/57
Scale: 1/8" = 1'
Dwg. No.: 48-13
Date: 9-10-57
Issue: 0


Left Side Detail Scale 1/8"=1"
Right Side Detail Scale 1/8"=1"
Front Detail Scale 1/8"=1"
Detail "A" Locking Frame (1-Req'd As Shown & 1-Req'd With 1 1/2" L Notched For Locking Collar) Scale 1/8"=1"
Detail "B" Locking Frame (1-Req'd)
Top View
Front View
Locking Collar (See Det. "C")
Exploded Assembly View Scale 1/8"=1"
Detail "C" Locking Collar (6-Req'd) Scale 1/4"=1"
Notes
1. Entire framework is to be welded construction
2. Fabricate framework from 1 1/2"x1 1/2"x1/8" aluminum L
REFERENCE DRAWINGS
DWG NO
DESCRIPTION
SPENCER CHEMICAL COMPANY
KANSAS CITY, MISSOURI
Process Development Dept.
UF6 Cylinder Shipping Cage
48-14
0

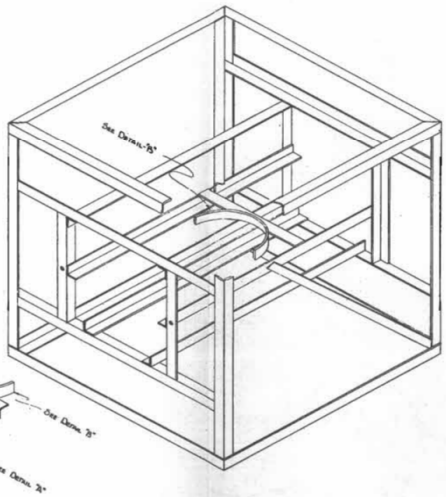


Top View

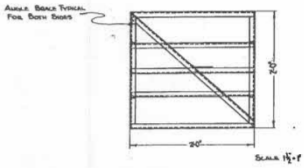


Front View

Scale 1½"=1'



Assembly View

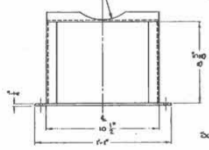


Right Side View

Scale 1½"=1'

Drill
2- Typical

Notch L On A



Detail "A"
Bending Clamp
(1- Required)

Scale 3"=1'

Detail "B"
Locking Collar
(2- Required)

Scale 8"=1'

Notes

1. All Angles Are 1"×1"×⅛" Al.
2. All Welded Construction.

REFERENCE DRAWINGS	
DWG. NO.	DESCRIPTION

SPENCER CHEMICAL COMPANY
KANSAS CITY, MISSOURI

Process Development Department

Product Contained Shipping Cage

DRAWN	CHECKED	DATE	SCALE	DATE
CM Hoot		2-28	1"=1'	3-11-15
TRACED	CHECKED	DATE	DWG. NO.	REV.
			48-15	0