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UNITED STATES GOVERNMENT

Memorandum

TO : Files

DATE: MAR 5 1964

FROM : Robert L. Layfield
Source and Special Nuclear Materials Branch, DL&R

SUBJECT: UNITED NUCLEAR CORPORATION, WOOD RIVER JUNCTION, RHODE ISLAND
DOCKET NO. 70-820

DLR:RLL

I. Introduction

The subject corporation has applied for a license to receive, possess, use and transfer up to 2,000 kg of special nuclear material for the purpose of operating a scrap recovery plant for uranium enriched in U-235. They have also requested that the license cover source material for the purpose of checking out processes and equipment to be used for special nuclear material.

The recovery plant is located in the southern portion of Rhode Island in an area which is practically uninhabited. The nearest population group is in the town of Wood River Junction which is about one mile from the plant boundary.

The plant consists of a single principal building with office, general utilities and maintenance facilities to the front, and storage and processing facilities in the back. An eight (8) foot security fence surrounds the plant area with limited access through a locked gate.

The scrap material containing the uranium will be received in the form of metal and alloys, compounds, and solutions. The U-235 will be recovered, converted to U_3O_8 and returned to the Commission. The U-235 enrichment will vary from depleted to fully enriched. No plutonium or uranium-233 has been requested.

II. Personnel Qualifications

The educational requirements of technical supervisory personnel are a Bachelor of Science degree in Engineering or Chemistry from an accredited college or university. In addition, the plant superintendent will have at least ten (10) years experience in chemical plant operations, part of which was obtained in the nuclear industry, and shift supervisors must have experience in

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chemical plant operations.

The training and experience of other technical and staff personnel are as follows:

Chemist (Quality Control): B.S. in Chemistry plus industrial laboratory experience.

Supervisor, Nuclear Safety and Health Physics:
Mr. L. J. Swallow: Degree of Bachelor of Science, Mechanical Engineering, Washington University, St. Louis, Missouri, Degree of Master of Science, Mechanical Engineering, Washington University, St. Louis, Missouri, 1955. Special Training: ORNL Nuclear Safety Course, 1959. Experience: July, 1955, to December 1958, Project Engineer, Mallinckrodt Chemical Works, Uranium Division. Assigned to the UNC Hematite Plant since December, 1958. Since September 1959, responsibilities have included nuclear safety analysis for processing special nuclear materials. This includes preparation of special nuclear material license applications and AEC contract feasibility reports.

III. Process Description

All shipments of solid and liquid wastes containing special nuclear materials are received at a central receiving area within the confines of the security fence. The receiving clerk will perform an initial inspection of the containers to check the bill of laden against container identification, U-235 enrichment and gross weight. Damaged containers will be isolated until the contents can be removed to safe containers or otherwise segregated to assure nuclear safety.

Incoming shipments will normally be stored outside in the array as received on the transfer vehicle. Individual shipments will be isolated from each other by a safe distance or an eight inch solid concrete wall. In some cases the containers may be stored within the process building in approved storage areas.

The processing of solid scraps requires more extensive treatment than pickle liquors and other solutions containing SNM since the liquids are in an acceptable form for direct introduction to the extraction pulse columns. The solid scrap is generally subjected to disolution and filtration prior to entering the extraction columns in solution form.

Prior to disolution the solid scrap is subjected to various sampling and analyses then treated as necessary (e.g., crushing or ball, milling or solvent degreasing) for introduction to the dissolving and filtration processes. From the extraction columns the concentrated liquor is treated by precipitation or evaporation and filtered prior to final drying and calcining to U_3O_8.

During individual processes described in the abbreviated flow description presented in the preceding paragraphs, the product residues and recycle materials are subjected to laboratory analyses for quality control as well as nuclear safety.

The final product, usually U_3O_8, is then packaged and returned to the original shipper for reuse or sent directly to the Commission facilities.

IV. Radiological Safety Aspects

A. Airborne Radioactivity Surveys

Surveys for determination of concentrations of airborne radioactivity and personnel exposure will initially be obtained weekly until it is assured that the airborne radioactivity concentrations are less than the applicable limits specified in 10 CFR 20. In those areas where concentrations are greater than the appropriate Part 20 limit, corrective action such as installation or modification of ventilation equipment will be initiated.

Within ninety (90) days after the start up of each area, U.N.C. will submit the results of the weekly sampling program, and the proposed subsequent survey program to this Branch for approval.

B. Surface Contamination Surveys

Surface contamination will be determined via the smear paper technique. Surveys will be performed at least weekly in process areas when in operation. Non-process areas will be surveyed weekly or monthly depending upon the proximity of the area to the process area (i.e., clean area locker room and approach hallways will be surveyed weekly, offices monthly).

C. Contamination Control

The processing area is physically separed from the non-process areas by the locker/change room. Workers enter the process area via this room. Street clothes are left in lockers in the clean area. Pursuant to a "Step-on" - "Step-off" procedure workers cross to the restricted area where work clothes are donned. This procedure in reverse is observed when leaving the restricted area. All personnel leaving the restricted area are required to wash hands and face. Showers are available if required. Gloves are worn by operating personnel when handling radioactive materials.

D. Ventilation System

All processing areas and equipment where airborne radioactivity might be generated are enclosed by hoods or glove boxes. In case of the open-faced hoods, a minimum face velocity of 150 LFM is maintained. This velocity is usually satisfactory for controlling airborne radioactivity.

The effluent from each hood and glove box is exhausted through an MSA absolute filter to an exhaust stack on the roof. The effluent from the stacks will be initially evaluated by taking three separate samples from each stack during operations to determine that the concentration of airborne radioactivity being released is less than Part 20 limits. Thereafter, the exhaust stacks will be sampled whenever the routine air sampling program indicates that airborne radioactivity concentrations in non-process areas are greater than 50% of the Part 20 limit but each stack will be sampled no less frequently than once per quarter.

In the event of process and/or system changes including filter changes the effluent from the exhaust stacks thus affected will be sampled at least three times to re-establish the effectiveness of the filtering system.

A weekly inspection of all process exhaust systems will be made. This will include intake velocity measurements and inspection of the degree of filter loading. Velocity measurements will be made with a velometer and filter loading will be determined by pressure drop readings.

E. Liquid Waste Disposal

All liquid wastes which contain radioactive materials are discharged to a large lagoon within the fenced-in area of the plant. The lagoon is lined with polyethlene to control seepage into subterranean water tables. Liquids containing acids are neutralized prior to discharge to the lagoon.

The concentration of radioactive materials in the liquid waste effluent is measured at the lagoon discharge. A continuous aliquot sample of the waste liquid is collected and stored in a bucket size container. The total liquid discharge is measured by a flow meter. These composite samples will be collected and analyzed initially at a frequency of at least once per week. Corrective action will be taken if the analyses indicate radioactivity concentrations in excess of Part 20 limits. Within ninety (90) days after the start up of this system, U.N.C. will submit the results of these weekly surveys and the proposed subsequent sampling program to this Branch for approval.

In addition, samples will be taken from the Pawcatuch River below the liquid waste discharge point at least once per month and analyzed for radioactivity and pH. Also, samples of the water from the well on U.N.C. property will be taken monthly and analyzed for radioactivity and pH.

F. Shipment

Shipment of special nuclear materials in from this plant will be made in the shipping containers approved for U.N.C. at Hematite, Missouri. The SNM will be limited to uranium compounds with uranium density less than 3.2 grams/cubic centimeter and full density metal.

Shipments will either be by exclusive use of the vehicle or certification from the carrier that the SNM shipments will not be commingled with other special nuclear material. Transhipment or intermediate unloading of the SNM will not be authorized.

G. Nuclear Alarm System

The nuclear alarm system consists of six gamma detectors (Nuclear Measurement Corp Model GA-2) situated throughout the plant so that the maximum distance from the detector to any SNM storage or process area within the building is less than 70 feet and the maximum distance to outside storage areas is less than 100 feet; Part 70 requires that this distance be no greater than 120 feet. Attenuation of gamma radiation by walls, etc., has been considered in the placement of these detectors. These detectors are tied into a central console in the guard station. Also, sirens are distributed over the plant area to give an audible alarm in the event of a criticality incident. In the event of primary power failure, the alarm system is provided with an emergency power generator which will automatically provide power to the alarm system. These detectors are so designed that malfunction of the detector will provide audible and visual alarms. The monitor alarm system and the emergency power generator are checked weekly to assure proper operation.

H. Emergency Control Plan

UNC has presented a emergency plan which provides for immediate evacuation and assembly at a designated point 500 feet from the main building. Procedures are provided for selecting an alternate assembly point in the event that it becomes desirable to vacate the primary assembly area.

Procedures for accounting for all personnel and re-entry are provided. Also, there are provisions for emergency instruments and equipment.

Each person who enters the plant is issued film badge. The film is sensitive to beta and gamma radiation. A strip of indium foil is attached to each badge for determination of neutron exposure in the event of a criticality incident. At the assembly point the film badges will be collected and the indium foil monitored for activation with a log level beta-gamma instrument.

Coordination with local fire, medical and police personnel has been accomplished. These extraneous personnel will be taken through the plant to familiarize them with the type of emergencies which might be encountered.

In the event of a suspected false alarm, the emergency coordinator will cautiously approach the building with a survey meter. In the absence of any abnormal radiation levels and the alarm continues to sound, he will proceed to silence the alarm and personnel will be allowed to re-enter the building. No work will be performed in any area not covered by an operable detector.

V. Nuclear Safety

The basic controls against accidental criticality are safe batch or safe geometry. In some cases where nuclear safety depends upon administrative controls, the addition of fixed neutron poisons in the form of Boron Raschig rings have been employed as secondary controls to assure nuclear safety. In some specific cases, nuclear safety of a piece of equipment or process is based on actual published criticality data.

The Criticality Evaluation Branch has thoroughly reviewed the applicant's submissions. Particular attention has been given to the identification of possible drainage or accidental introduction of concentrated special nuclear materials into unsafe containers and neutron interaction between associated process equipment. Meticulous review of the process flow sheets and equipment designs by the CEB has resulted in uncovering design errors where modification has been mutually accepted.

VI. Hazards Analysis

The applicant has evaluated the probability and effects of an accidental nuclear excursion based primarily on the Convair Research and Development Report NYO-2980. The maximum excursion in the order of 10^{20} fissions would result from an unmoderated metal system. This type of excursion would be terminated almost instantaneously by physically blowing itself apart. However, probability of this type excursion has been considered quite unlikely, since the metallic scrap will be in the form of small pieces of metal alloy with relatively low U-235 enrichment.

The maximum excursion from a moderated assembly would be in the order of 10^{18} fissions in the initial burst with a total yield in the order of 10^{19} fissions. The shutdown mechanism in a aqueous solution excursion would result from the boiling of the solution, resulting in dispersion or evaporation of the moderated material. The probability of this type excursion has been designed against by nuclear safety controls such as safe geometry and/or safe batch processing, moderation control and nuclear poisons.

In the case of a metal excursion, the lethal radius from direct radiation would extend to approximately 100 meters. Harmful but not lethal radiation exposure could extend to approximately 450 meters. An aqueous excursion would cause a lethal exposure to direct radiation upto a radius of approximately 50 meters. Harmful, but not lethal exposure from the aqueous excursion could extend to 100 meters.

At the U. N. C. plant, the nearest fence to a potential source of excursion is about 20 meters. Therefore, anyone close to the fence could receive a lethal exposure. However, the plant is in a relatively remote location and the land surrounding the plant is farmland owned by U.N.C., but leased to potato farmers. Accordingly, it appears unlikely that more than two non-U.N.C. persons would be close enough to the plant to receive any direct radiation exposure, let alone a lethal dose.

A lethal dose from direct radiation emanating from a fission cloud would probably extend to a distance of about 300 meters. Less than fatal exposures could be expected up to 1800 meters. The number of non-U.N.C. Persons receiving a lethal exposure should again be less than three. Assuming the cloud reached Wood River Junction (1100 meters), about 500 persons could be affected. Howver, this type exposure could be controlled by immediate evacuation. Ground contamination could be limited to about 250 meters. There are no residences within this radius and the land is owned by U.N.C.

In summary, it appears that relatively few non-U.N.C. personnel would be affected by a nuclear excursion at this plant.

VII. Conclusion

Based on the information submitted by U.N.C. it appears that adequate design and technical experience have been provided in the planning and construction of this scrap recovery facility. Sufficient surveys, controls, and inspections are provided to allow reasonable assurance that U.N.C. would be cognizant of any significat and/or abnormal changes which might occur. In view of the foregoing and in consideration of the information submitted by the applicant and personal observations made by members of this Branch and the Criticality Evaluation Branch during a pre-licensing visit to the plant on January 13, 1964, I recommend that a special nuclear material license be issued to the United Nuclear Corporation at their Scrap Recovery Plant in Wood River Junction, Rhode Island.