13 pgs

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

PUBLIC HEALTH SERVICE — WASHINGTON 25, D. C.

BUREAU OF STATE SERVICES

Refer to: DRH:TOB

JUL 1 1963

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

Dear Mr. Lowenstein:

For your information, I am enclosing a draft of notes made at a meeting on May 22, 1963 which was held at the request of the Rhode Island State Department of Health with representatives of the H. K. Ferguson Company and the Public Health Service. The purpose of the meeting was to review the H. K. Ferguson Company plans for a nuclear fuel scrap recovery facility, proposed to be operated by the United Nuclear Corporation at Wood River Junction, Rhode Island, and to discuss the provisions being made to control waste disposal and other potential health or environmental contamination hazards.

Attached also is a draft of a report, "Environmental Hazards Associated with Fuel Fabrication Facilities", which was given to the Rhode Island State Department of Health as a basis for the discussions.

Sincerely yours,

James G. Terrill, Jr.
Deputy Chief
Division of Radiological Health

Enclosures

Acknowledged 7-12-63 -LPRH
Copies sent to S+SNM Br. 7-15-63

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Draft

May 27, 1963

MEETING AT STATE DEPARTMENT OF HEALTH
PROVIDENCE, R. I. on MAY 22, 1963.

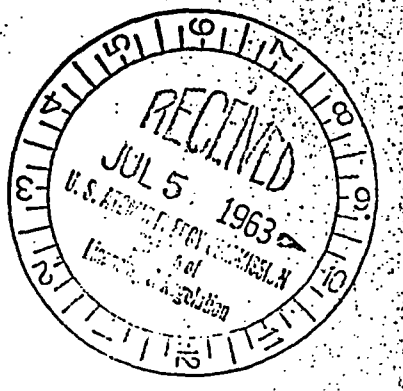
TOPIC: Proposed Scrap Recovery Facility of United Nuclear Corp.

SECTION ATTENDANCE REQUESTED BY:
R. I. State Department of Health to Mr. F. Tetzlaff, Associate Regional Health Director for EHS Region I; request to Section via Mr. S. Harris, Radiological Health Consultant.

ATTENDEES:

For State of R. I. Department of Health:

Mr. W. Shea, Assistant Director
Dr. J. P. Deery, Deputy Director
Mr. J. Wuraftic, Div. of Ind. Hygiene
Mr. C. A. Maine, Div. of Water Pollution Control
Mr. Delety, Chemist



For H. K. Ferguson Co.:

Mr. A. H. Gerber, Vice President, Engineering
Mr. C. M. Cantrell, Engineer

For U. S. Public Health Service:

Mr. S. Harris, Regional Radiological Health Consultant, Region II
Mr. J. J. Sabo, Chief-Nuclear Facilities Environmental Analysis Section, DRH
Dr. D. Shearer, Radiological Water Pollution Activities Unit, DWS & PC

The following documents were transmitted to Mr. Maine by Mr. Sabo:

1. A review of the Environmental Hazards Associated with Fuel Fabrication Facilities.
2. 10 CFR 20
3. 10 CFR 70
4. Proposed amended 10 CFR 70

GENERAL:

The representatives of H. K. Ferguson Co. had submitted "Specification for Scrap Recovery Facility - United Nuclear Corp. - Wood River Junction, R. I."; W. O. No. 2296-C dated May 17, 1963, and several blue prints which presented overall building size, utility lines, foundations, etc. but did not give any process flow data, thru-put, equipment description or size or any information of the process size. Mr. Gerber requested immediate approval of this facility (which he stated would employ 20

E-4821

to 30 people) since the ground breaking ceremony was scheduled for May 27, 1963.

SYNOPSIS OF MEETING:

Mr. Shea and others questioned whether this facility was a forerunner of several others to be located at this same site. The H. K. Ferguson Co. representatives stated that this Scrap Recovery Facility was Phase I and that there might be other facilities located in this same area; nevertheless at this meeting they wished only to have the Scrap Recovery Facility considered since other facilities are not firmed up as yet. Even this facility is being redesigned therefore tonnage thruputs are not available. Mr. Cantrell stated that the only figure available was that the plant expected to have a process liquor thruput of 150 gallons per day - although still under consideration.

Mr. Shea requested information on the water requirements and since the proposed plant was located in an area known to be an aquifer which may ultimately supply a good portion of the States groundwater requirements, what provisions were incorporated for protecting this water supply.

Mr. Gerber stated that a groundwater survey would be instigated next week. This phase in the construction is the first stage in a master plan which will take in account other facilities that are being planned for this area.

Mr. Gerber then discussed the SCRAP RECOVERY FACILITY.
The proposed facility will process non-irradiated fuel and fuel element scrap from United Nuclears' New Haven Plant which fabricates for the Navy as well as possibly from other sources. This plant will also process pickle liquor scrap containing uranium and zirconium. In addition the plant at Hematite, Mo. which converts UF_6 to UO_2 will send its liquors and reject scrap to be processed. The AEC will also ship scrap for processing therefore this plant will process:

pickle liquor
solids
UO_2 with or without cladding
U - Aluminum alloy

the product of the plant will be U_3O_8.

Mr. Sabo then asked if beryllium or plutonium would be processed in this plant and the answer was that no provisions were being made for beryllium, plutonium or uranium 233 at the present; possibly in 1968 or after, this may be a possibility.

Again Mr. Shea asked if this was only a piece of the total project and, if ultimately, a fuel fabrication plant would be built at this location. Mr. Cantrell answered that this was a possibility but that they wished the Scrap Recovery Facility only to be considered and this facility was to be a separate integrated unit.

Again the question was asked on thruput or total tonnage or any other figure that might indicate total capacity. H. K. Ferguson representatives were unable to supply any figure other than the 150 gpd of pickle liquor processing flow but did state - when questioned, that the equipment was being designed for a much larger size.

H. K. Ferguson Co. supplied the following information: shipment of liquor by tank truck or drums - via truck. The liquor would have o.6 to 1.5 gm/l uranium nitrate solution. Each drum would be analyzed and tagged on receival. The contents would be discharged to a feed adjustment tank where the fluoride ions would be complexed by aluminum nitrate. This would then be neutralized with anhydrous ammonia. Control of pH would prevent precipitation and geometrically safe configurations would be used. From here it would go to a TBP plus kerosene reflux tower for uranium separation.

The question was asked if this was a batch or continuous process with H. K. Ferguson replying it was continuous - geometric safety would be followed as given in 10 CFR 70. Maximum uranium content - assuming 100% enrichment for conservation - would not exceed 0.001 gm/1. Since the Navy was involved they would probably also be required to meet Navy specifications plus 10 CFR 70 and 71.

Continuing the discussion of the process: The TBP (tri butyl phosphate) is then stripped by nitric acid to get uranium; this is then denitrated to get U_3O_8. An alternate procedure which may eventually be used is the ammonia diuranate process with calcining.

Solid scrap is first digested with nitric, or if zirconium is present, hydrofluoric. This liquor then goes through as mentioned above.

Question was asked if the plant is subject to flooding (since the water could act as a moderator and/or reflector). The answer was no, it was high ground.

Questions were asked on the point at which waste is discharged, these are as follows:

1. acid waste (with some TBP and dissolved uranium that will not separate) from reflux columns or waste from ammonium diuranate process.
2. degraded TBP
3. solvent wastes from denitrating
4. leakages from process

Wastes from 1 will be neutralized, TBP decanted and released to river.
Waste 2 will be shipped offsite.
All sludges will be shipped offsite.
The release to the stream will be a maximum of 1 ppm in flouride, since the undiluted waste will be 7.6 - 8.2 pH which would contain 4-5 ppm of flouride (this assumes a 150 gpd process flow diluted to 500 gpd - although this was not so stated.

The question was asked of H. K. Ferguson Co. about minimum flow in the stream. Figures were given on stream flow since 1940 which gives 7.4 cfs minimum (or approximately four million gallons per day).

The question was asked by Mr. Sabo if averaging would be used in the discharge of radioactive materials and if river dilution was to be used in calculations. H. K. Ferguson replied that 10 CFR 20 figures would be used as the maximum concentration - no averaging and this was to be at plant outfall, with no benefit to be taken in calculations for river dilution.

Dr. Shearer then stated that TBP was very toxic to marine life 0.17% was 50% lethal and what quantity was expected to be discharged to the stream. H K. Ferguson Co. stated that decanting would be employed and they would furnish further information on this.

H. K. Ferguson Co. then discussed air pollution, exhaust prefilters, absolute filter and acid fume scrubbing. Hood face volocities of 100 fpm indraft would be employed.

Mr. Maine asked why the sewers were designed for approximate 1/4 mgd - as observed from the H. K. Ferguson drawings by interpreting size to capacity. H. K. Ferguson Co. replied that sewers were designed for the complex rather than just this plant, for economy reasons. When asked H. K. Ferguson Co. replied that sewage flow was not part of the dilution for process waste.

Questions were asked on floor diking, pans under certain parts etc. H. K. Ferguson Co. had looked into this.

Badging would be employed. Badges would contain indium foils for neutron monitors - criticality.

J. J. Sabo

PRELIMINARY DRAFT

For Administrative Use Only

A Review of the Environmental Hazards Associated with Fuel Fabrication Pertaining to the Rhode Island Fuel Fabrication Facility Based Upon the Following Information:

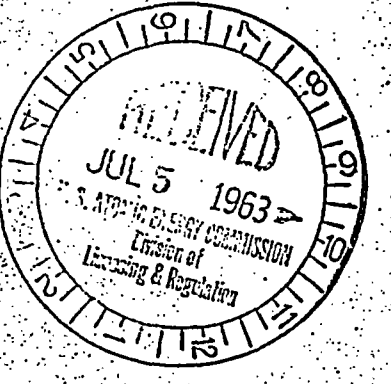
Literature As Listed in the Reference Section of this Report

This report was prepared at the request of the Nuclear Facilities Environmental Analysis Section, Technical Operations Branch, Division of Radiological Health, USPHS and is submitted to the Section for review and is to be considered as only a portion of the over-all review being conducted by the Section.

Submitted by: Allen G. Leary
Name

Sanitary Engineer
Title

NFEAS, TOB, DRH, USPHS
Organization



Date Submitted: May 15, 1963

E 4821

May 14, 1963

Fuel

The fertile elements that may be encountered in the fuel are U^{238}, Th^{232}, and natural uranium. Natural uranium may present a health hazard due to the toxicity of occluded radium as well as the radon which is liberated.

Fissionable materials may include U^{235}, U^{233}, or Pu^{239}. Pu^{239} again may present a health hazard due to its chemical toxicity.

The uranium fuel may be in the form of the dioxide, hexafluoxide, uranium cermets, or uranium metal. The metal presents a fire hazard.

Fuel Conversion Operations

It is assumed that no fuel enrichment operations will be carried out at a plant of this type, but probably will involve conversion of enriched and unenriched uranium and fabrication of the final fuel elements. This assumption is made due to the extremely high capital cost required for the construction of an enrichment plant.

In the conversion of uranium hexfluoride to either uranium metal or the dioxide, fluorides will be liberated and measures for their control will be necessary.

In converting UF_6 to the dioxide, the hexafluoride is hydrolyzed with a dilute solution of ammonia to form a precipitate of ammonium diuranate. This is filtered off, dried, and then heated in a mixture of steam and sintered at 1,700°C to increase its density. (1)

The first step in converting UF_6 to the metal is the conversion to tetrafluoride by heating in a tower with hydrogen, derived by cracking ammonia, at about 375°C:

$$UF_6 + H_2 \longrightarrow 2HF + UF_4$$

The finely powdered tetrafluoride is then heated in a steel mold or bomb with high purity magnesium or calcium:

$$UF_4 + 2\ Mg \longrightarrow U + MgF_2$$

When the hexafluoride is a highly enriched product, a modified conversion procedure to the tetrafluoride is employed. Instead of heating the reactor vessel as a whole, advantage is taken of the highly exothermic reaction between hydrogen and fluorine. Hydrogen gas, fluorine gas, and

hexafluoride vapor are introduced into the vessel in that order. Solid uranium tetrafluoride is produced and must be constantly removed to avoid the possible accumulation of a critical mass. (1)

Wastes from these processes will include aqueous solutions and slags of magnesium or calcium fluoride. The aqueous solutions will contain some uranium and uranium daughters. Radium would also be present if virgin ore were being processed. The slags will also contain some uranium which may be recovered if it is economically feasible. (2) Slightly contaminated gases may also arise from these operations, especially contamination with uranium particulate matter. (3)

Fabrication of the Fuel Elements

If the elements are to be fabricated of uranium metal from ingots, these ingots must be melted down and cast into rods. This is followed by rolling and/or machining. The rods are then straightened, heat-treated and given any further machining such as cutting, threading, grinding, etc., prior to cleaning and degreasing. The elements are then canned or clad, sealed, inspected and tested. (4,5)

Wastes that arise in these processes will include slag from casting and material from cleaning crucibles and equipment. There may also be a pickling process after casting which could give rise to some liquid waste. A heat treating bath or quenching water could possibly become contaminated and require disposal. (4,5)

Machining and rolling operations primarily present a dust problem that must be

controlled by proper exhaust. Coolants also trap the dusts and minimize the possibility of combustion. Grinding and shearing are particularly contaminating operations. Turnings, ends from ingots and rolled rods, and other solid fuel materials are recovered for recycling. (4, 5, 6)

Agents used for cleaning and degreasing such as trichloroethylene and citric acid will present a decontamination or disposal problem. (5)

Other aqueous wastes will include those from the decontamination of the plant, equipment and clothing. Solids will include incinerator ash, as well as obsolete equipment and material. Contaminated equipment will arise from reprocessing fuel element fabrication scrap. (2)

Other raw materials and methods of fabrication will give wastes quite similar to those already mentioned. There is always the potentiality of accumulation of a critical mass where these fuels are handled, but control should not be difficult when working with the solid fuel. Plutonium production and fabrication will necessitate remote handling due to its high alpha-activity. (7) The external radiation hazard due to uranium increases very rapidly with enrichment due to the increased U-234 content. Several basic criteria for the safe handling of enriched uranium are given by Harris and Solon. (8)

Cladding and Moderator

The most serious problem that may be encountered in the processing of cladding and moderators would be associated with the use of beryllium. If beryllium escapes into the air, it can cause dermatitis upon sufficient

contact with the skin. Inhalation of beryllium or its compounds may result in the serious effect called berylliosis. If beryllium is to be used, special attention must be given to design of the building, equipment and enclosures, ventilation, and treatment and disposal of all liquid and gaseous effluents. Particular attention must be given to assure against fires and fire hazards since fires would cause dispersal of beryllium. Frequent or continuous monitoring is necessary in working areas where beryllium or its compounds may be released or may accumulate. (9)

Summary

Some of the hazards that might be encountered in a plant where fuel conversion and fabrication operations are carried out have been delineated. If natural uranium is handled, there will be danger of contamination with chemically toxic radium as well as the radon hazard. If plutonium is handled, it also presents a toxicity hazard. Uranium metal presents a fire hazard due to its pyrophoricity. If beryllium is used in production of cladding or moderating materials, it will present another chemical toxicity problem. In conversion of the hexafluoride, fluorides might be released.

In handling any fissionable material, precautions must always be taken to guard against criticality accidents. Alpha contamination is also a problem with all of these fuels, particularly with Pu^{239} and enriched uranium. In any rolling, punching, shearing, grinding, or other machining operations on the fuel, there will be a problem of radioactive dusts.

Existing fuel fabrication facilities have not been contacted to find what their actual operating experience has been. This avenue of information shall be explored further.

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