SAFETY EVALUATION REPORT

BY THE

DIVISION OF FUEL CYCLE AND MATERIAL SAFETY

RELATED TO THE

NRC SPECIAL NUCLEAR MATERIAL LICENSE

FOR THE

EXXON NUCLEAR COMPANY

FUEL FABRICATION PLANT

RICHLAND, WASHINGTON

DOCKET NO. 70-1257

LICENSE NO. SNM-1227

JULY 1980

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I. INTRODUCTION

A. General

The primary function of the Exxon Nuclear Company (EN) plant at Richland, Washington, is the conversion of low enriched (less than or equal to 5 wt% U-235) uranium hexafluoride to uranium dioxide for use in fuel for light-water-moderated power reactors. Until early 1974, mixed uranium dioxide-plutonium dioxide fuel was produced in developmental quantities in the Mixed Oxide & Speciality Fuels (MO&SF) Building. Operations with plutonium have been discontinued since 1974 and nearly all of the plutonium is stored encapsulated in fuel rods or in sealed NRC-approved containers.

Current possession limits include 10,000 kilograms of U-235, of which 300 kilograms may be contained in uranium compounds enriched to a maximum of 7.2 wt% in the U-235 isotope and the balance contained in uranium compounds enriched to a maximum of 5 wt% in the U-235 isotope, and 100 kilograms of plutonium of which at least 90 kilograms is in encapsulated form. From time to time EN has processed limited quantities of uranium fuel enriched up to a maximum 13 wt% in U-235, under amendments to the license which have since terminated. To provide for such operations in the future, EN proposes to allow up to 200 kilograms of the 10,000 kilogram U-235 possession limit as uranium compounds enriched to a maximum of 19.99 wt% in U-235. The distribution of the 100-kilogram plutonium possession limit would be changed so that all would be contained in encapsulated fuel rods or NRC-approved containers except for 500 grams as PuO_2 contamination on fuel fabrication equipment and one milligram and not more than 1.5 millicuries as contained in sealed sources and standards.

B. Location Description

The Exxon Nuclear fuel fabrication plant is located on a 320-acre site, 0.9 mile west of the intersection of Stevens Drive, the main route to the DOE Hanford Reservation from the south, and Horn Rapids Road, a secondary highway to the west, within the north boundary of the city of Richland in southeastern Washington State. The site is 370 feet above sea level. Figure 1 shows the site in relation to major nearby geographic and geologic features, Figure 2 shows the Richland area and the plant, and Figure 3 shows the locations of the facilities on the site. Further geographic and geologic features of the site are shown on Figure 4.

C License History

The license was first issued to Jersey Nuclear Company on December 14, 1970, primarily to authorize possession and storage only of UF_6 at maximum 5% U-235 enrichment. The license was subsequently revised, on September 14, 1971, to authorize processing operations with low enriched uranium, but was conditioned to expire within 4 months and to require the submittal of supplemental information to the Environmental Report. The license was extended and amended to permit limited operations with mixed oxide in the Mixed Oxide & Speciality Fuels Building pending the environmental review. The name of the licensee was

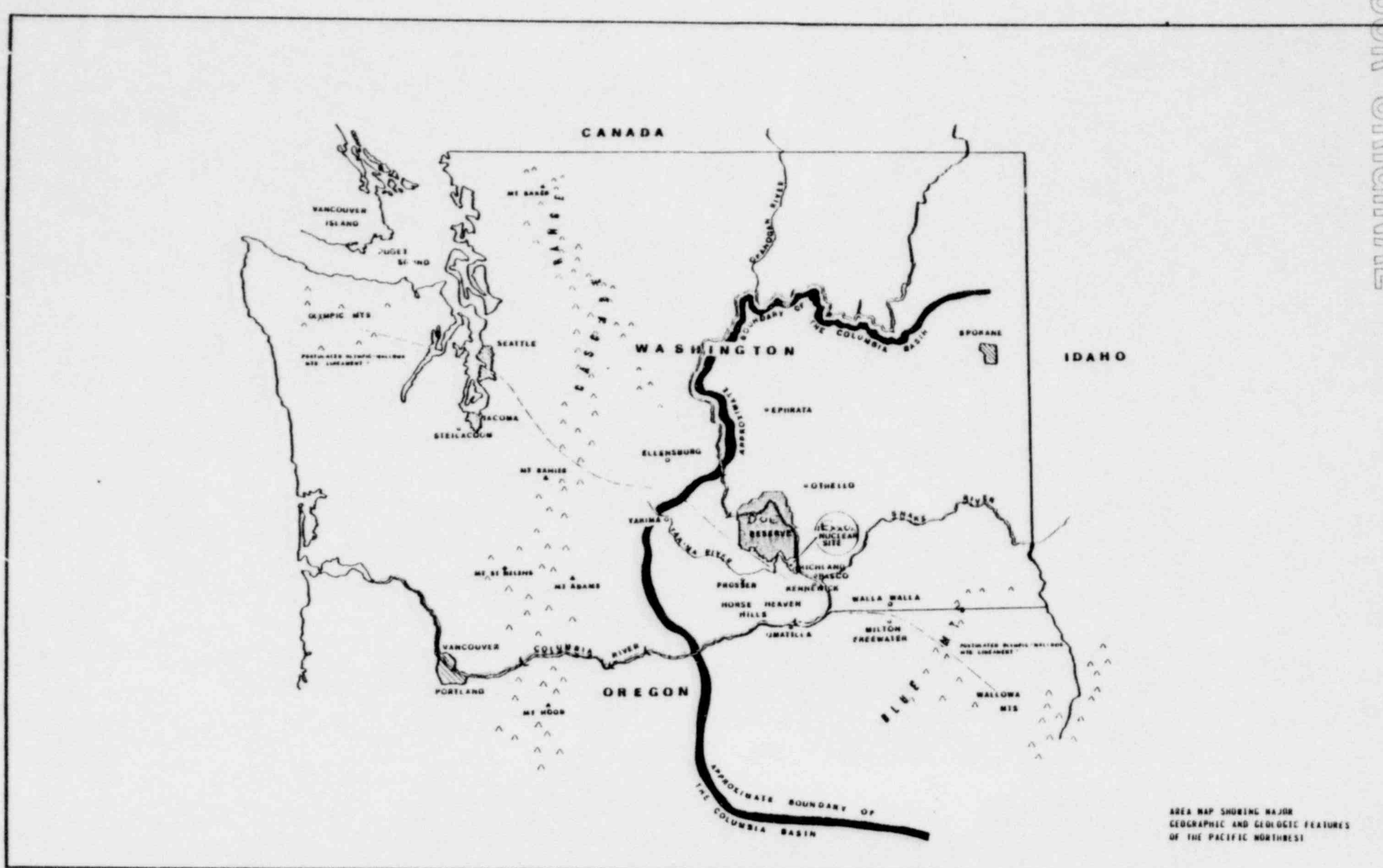
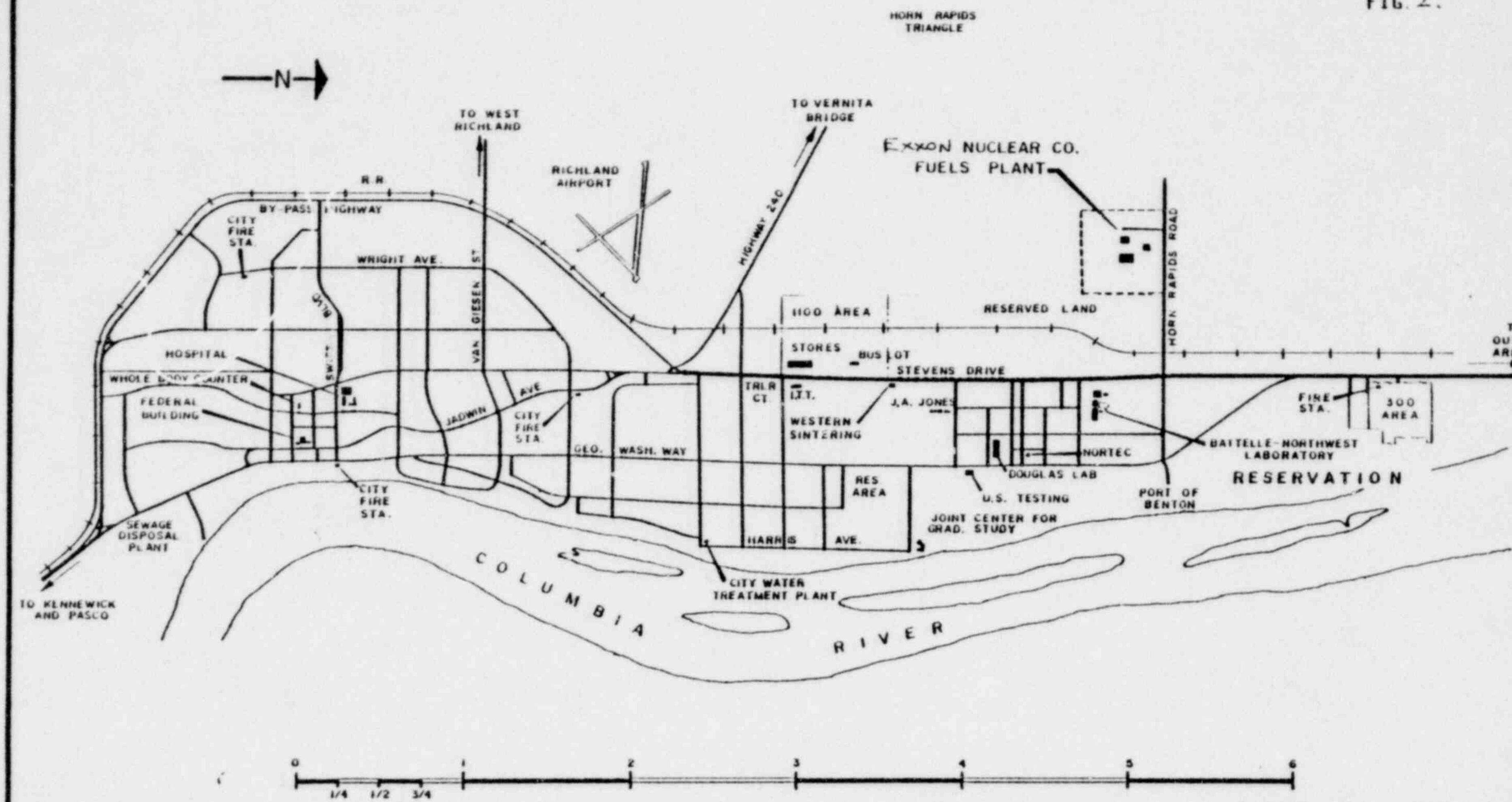

CANADA
IDAHO
WASHINGTON
OREGON
VANCOUVER ISLAND
PUGET SOUND
OLYMPIC MTS
SEATTLE
TACOMA
STEILACOOM
MT BAKER
MT RAINIER
MT ST HELENS
MT ADAMS
MT HOOD
VANCOUVER
PORTLAND
COLUMBIA RIVER
ELLENSBURG
EPHRATA
OTHELLO
YAKIMA
YAKIMA RIVER
DOE RESERVE
NUCLEAR SITE
RICHLAND
PASCO
KENNEWICK
PROSSER
HORSE HEAVEN HILLS
UMATILLA
WALLA WALLA
MILTON FREEWATER
WALLOWA MTS
SPOKANE
OKANOGAN RIVER
SNAKE RIVER
APPROXIMATE BOUNDARY OF THE COLUMBIA BASIN
AREA MAP SHOWING MAJOR
GEOGRAPHIC AND GEOLOGIC FEATURES
OF THE PACIFIC NORTHWEST

Figure 1

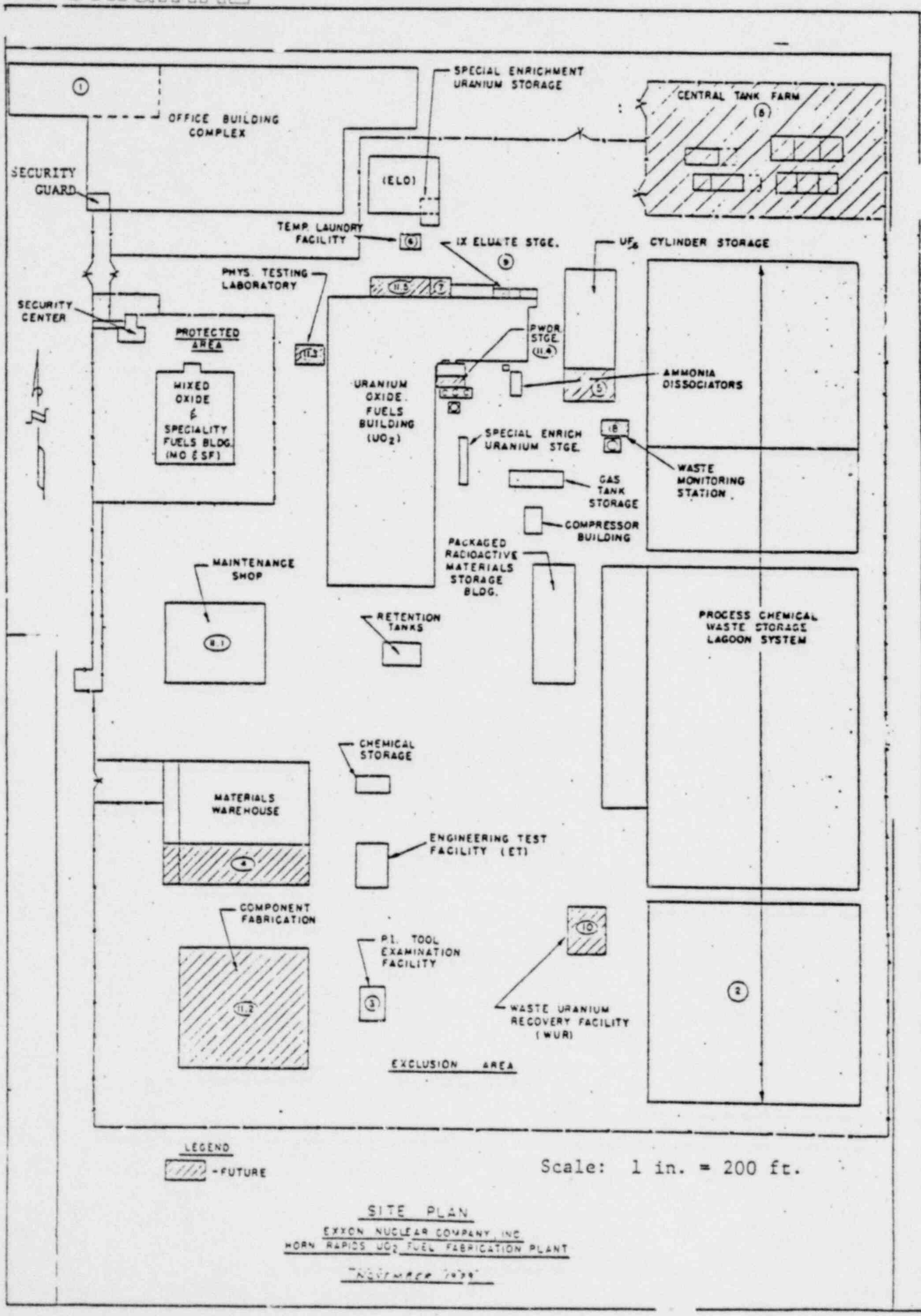
FIG. 2.



RICHLAND AREA
AND
EXXON NUCLEAR CO.
FUELS PLANT

POOR ORIGINAL

3



OFFICE BUILDING COMPLEX
SPECIAL ENRICHMENT URANIUM STORAGE
CENTRAL TANK FARM
SECURITY GUARD
TEMP. LAUNDRY FACILITY
IX ELUATE STGE.
UF6 CYLINDER STORAGE
PHYS. TESTING LABORATORY
SECURITY CENTER
PROTECTED AREA
PWDR. STGE.
MIXED OXIDE & SPECIALITY FUELS BLDG. (MO & SF)
URANIUM OXIDE FUELS BUILDING (UO2)
AMMONIA DISSOCIATORS
SPECIAL ENRICH URANIUM STGE.
WASTE MONITORING STATION
GAS TANK STORAGE
COMPRESSOR BUILDING
PACKAGED RADIOACTIVE MATERIALS STORAGE BLDG.
MAINTENANCE SHOP
RETENTION TANKS
PROCESS CHEMICAL WASTE STORAGE LAGOON SYSTEM
CHEMICAL STORAGE
MATERIALS WAREHOUSE
ENGINEERING TEST FACILITY (ET)
COMPONENT FABRICATION
P.I. TOOL EXAMINATION FACILITY
WASTE URANIUM RECOVERY FACILITY (WUR)
EXCLUSION AREA
LEGEND
- FUTURE
Scale: 1 in. = 200 ft.
SITE PLAN
EXXON NUCLEAR COMPANY, INC.
HORN RAPIDS UO2 FUEL FABRICATION PLANT

Figure 3

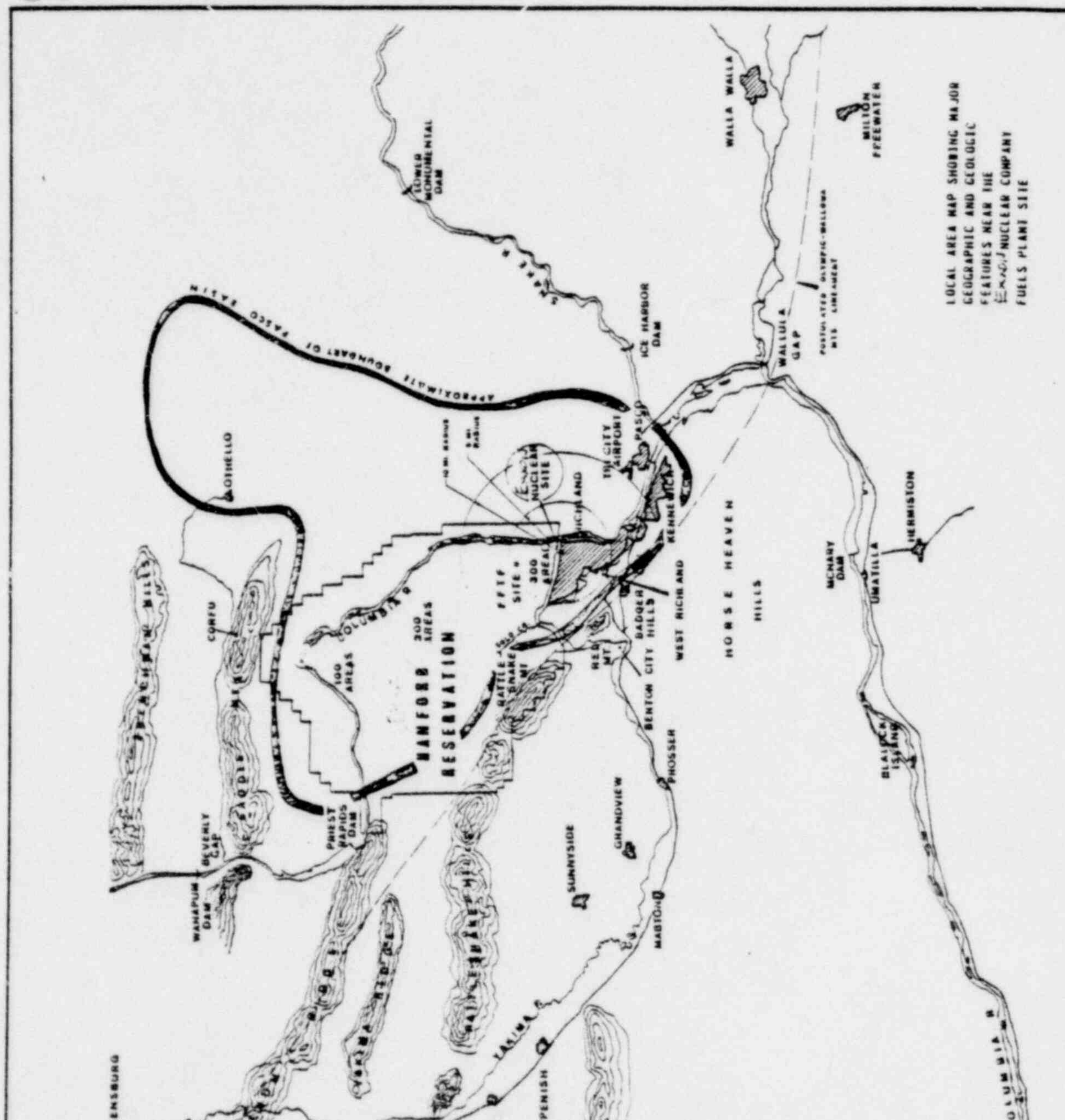

LOCAL AREA MAP SHOWING MAJOR GEOGRAPHIC AND GEOLOGIC FEATURES NEAR THE EXXON NUCLEAR COMPANY FUELS PLANT SITE
APPROXIMATE BOUNDARY OF PASCO BASIN
HANFORD RESERVATION
100 AREAS
200 AREAS
300 AREA
FFTF SITE
NUCLEAR SITE
RICHLAND
KENNEWICK
PASCO
TRI CITY AIRPORT
WEST RICHLAND
BENTON CITY
BADGER HILLS
RED MT
RATTLESNAKE MT
HORSE HEAVEN HILLS
PROSSER
GRANDVIEW
SUNNYSIDE
MABTON
TOPPENISH
WAPATO
YAKIMA
YAKIMA R
ELLENSBURG
OTHELLO
CORFU
WAHAPUM DAM
BEVERLY GAP
PRIEST RAPIDS DAM
ICE HARBOR DAM
LOWER MONUMENTAL DAM
WALLA WALLA
MILTON FREEWATER
HERMISTON
UMATILLA
MCNARY DAM
WALLULA GAP
COLUMBIA R
SCALE IN MILES

Figure 4

changed from Jersey Nuclear Company to Exxon Nuclear Company, Inc., in an amendment issued March 22, 1973. The license was revised and issued for a full 5-year term on July 18, 1974, following issuance of the Final Environmental Statements for the Uranium Oxide Plant and Mixed Oxide Fabrication Plants, in March and June 1974, respectively.

Exxon Nuclear filed an application for renewal transmitted by letter dated May 31, 1979, and since July 31, 1979, the license has remained in effect in accordance with the timely renewal provisions of Subsection 70.33(b) of 10 CFR Part 70. The renewal application consists of two sections. Section I, including the appendices, contains the proposed license conditions and Section II is the safety demonstration. The Section II information is primarily a listing of the applicable demonstration information as given to support past amendment applications and, hence, previously reviewed by the NRC.

II. AUTHORIZED ACTIVITIES

A. General Summary

The revised license would authorize Exxon Nuclear to perform the following activities at the Richland site:

Location	Material	Activities
UO_2 Bldg.	Uranium Compounds (up to 5 w/o U-235)	All operational steps of fuel manufacturing from UF_6 - UO_2 conversion to packaging finished fuel elements, scrap recycling and reprocessing, process tests, associated quality control activities.
	UO_2 (5 to 19.99 w/o U-235)	All operational steps of fuel manufacturing involving UO_2, associated quality control activities, no operations involving gas or liquid forms.
MO&SF Bldg	Pu & PuO_2-UO_2	Vault storage, repackaging, fuel rod down-loading, contaminated process equipment storage.
	UO_2 (up to 19.99 w/o U-235)	Storage, blending, pressing, sintering, fuel rod loading and down-loading, fuel rod welding, fuel rod autoclaving, fuel element assembly, process tests, associated quality control activities.

Location	Material	Activities
ELO Bldg.	Uranium Compounds (up to 19.99 w/o U-235)	All operational steps of fuel manufacturing involving uranium compounds, process tests, no operations involving UF_6 gas, no operations involving liquid forms of uranium of enrichments above 5 w/o U-235.
ET Bldg.	UO_2 (up to 5 w/o U-235)	Hydraulic flow tests involving single fuel elements.
WUR Bldg.	Uranium Compounds (Up to 5 w/o U-235)	Mechanical operations involved in recovering uranium from solid wastes.
Packaged Radioactive Materials Storage Bldg.	Uranium Compounds (up to 5 w/o U-235)	Storage of closed containers of product, scrap and waste materials which are free of significant external contamination.
Materials Warehouse	UO_2 (up to 5 w/o U-235)	Storage of closed and sealed containers of UO_2 powder, pellets, and fuel rods.
Special Enriched Uranium Storage Trailer	UO_2 (5 to 19.99 w/o U-235)	Storage of closed containers of UO_2 powder which are externally free of significant contamination.
Laundry Facility	Uranium Compounds (up to 5 w/o U-235)	Dry-cleaning of contaminated protective clothing and equipment.
UF_6 Cylinder Storage Areas	UF_6 (up to 5 w/o U-235)	Outside storage of UF_6 cylinders (full and empty).
SNM Accountability Measurement Station	Uranium Compounds (up to 5 w/o U-235)	Transfer, mixing, and sampling of contaminated liquid wastes.
Process Chemical Waste Storage Lagoon System	Uranium Compounds (up to 5 w/o U-235)	Storage and solar evaporation of contaminated liquid wastes.
Retention Tanks	Uranium Compounds (up to 5 w/o U-235	Interim storage of potentially contaminated liquid wastes.
Packaged Fuel Storage Areas	UO_2 (up to 19.99 w/o U-235)	Outside storage of fuel packed for shipment; the transport containers are closed, sealed, and properly labeled for shipment.

Location	Material	Activities
Packaged Waste Storage Areas	Uranium Compounds (up to 19.99 w/o U-235)	Outside storage of packaged contaminated materials; the outer containers are DOT Specification containers, and they are closed, and adequately sealed and labeled.

B. Process Description (UO_2 Building Operations)

1. Introduction - The main process operations are described under the headings of (a) conversion operations, (b) pellet fabrication, (c) fuel cladding, assembly and test, (d) scrap recovery, (e) liquid waste disposal, and (g) solid waste disposal.

2. Conversion Operations - The process of chemically converting the uranium fluoride raw material to uranium dioxide is carried out in a system of parallel process lines which use the conventional ammonium diuranate (ADU) process. These operations are carried out in closed equipment, generally cylindrical vessels of limited diameter or volume, designed to ensure nuclear criticality safety.

The UF_6 is received in standard 2-1/2-ton cylinders in NRC- and DOT-approved shipping packages. Prior to process use, UF_6 cylinders are stored in areas where they are protected from physical damage. As required, a UF_6 cylinder is removed from the storage area and connected to one of the conversion lines. The UF_6 is vaporized by heating the cylinder using steam or electrically heated air in the chests in the UF_6 vaporization areas near the conversion lines.

The vaporized UF_6 is hydrolyzed to uranyl fluoride (UO_2F_2) and hydrofluoric acid (HF) by mixture with water. The uranyl fluoride is subsequently converted to an ADU slurry by addition of ammonium hydroxide. The ADU slurry is dewatered by centrifugation and drying and fed to an externally gas-fired cylindrical calciner. In the calciner, the ADU is converted to the solid UO_2 by heat and the introduction of hydrogen. The ammonia and steam in the calciner off-gases are water scrubbed, dried, and double filtered through HEPA filters prior to discharge to the atmosphere. The UO_2 powder from the reduction furnace is either vacuum transferred to powder blending hoppers for subsequent processing or collected in storage containers, sampled and stored.

3. Pellet Fabrication - Dry powder from storage is blended, milled, slugged and granulated. Following any one of these steps the powder may be placed cans for storage. Following the addition of a lubricant and blending in the cans, the oxide powder is pelletized and the pellets sintered in a reducing atmosphere. The sintered pellets are ground to size, washed, dried, and inspected.

4. Fuel Cladding and Assembly - Fuel pellets are loaded into empty fuel capsules (tubes) which are then plugged and seal welded. The sealed rods are inspected, cleaned, autoclaved, and leak tested. The tested rods are assembled into fuel assemblies. Some of the fuel assemblies are hydraulically tested in the Engineering Test Facility (ET).

The nuclear criticality safety of the pellet fabrication and subsequent operations is based primarily on the use of favorable slab geometry.

5. Scrap Recovery - The basic process for the purification-recovery of contaminated scrap involves mechanical treatment, nitric acid dissolution, a cycle of solvent extraction for purification of the uranium, precipitation of the uranium as ammonium diuranate, and calcination-reduction of the ADU.

The scrap recovery operations use favorable geometry equipment or safe mass limits to ensure nuclear criticality safety.

6. Liquid Waste Disposal - All uranium contaminated liquid wastes and high level chemical liquid wastes are discharged to the onsite Process Chemical Waste Storage Lagoon System. The ultimate disposition of sludges and solids removed from the lagoons will be as solid radioactive waste buried at a licensed facility. Sanitary wastes, including drains from showers in the change rooms, discharge to a sanitary sewer system leading directly to the EN-City Lift Station (i.e., discharge to Richland sewer system). Process cooling waters, which are isolated from the actual process atmospheres by double physical barriers, are handled separately from sanitary and process chemical wastes. Cooling water may be discharged to the municipal sewerage system, used to irrigate the EN property, or discharged to the Process Chemical Waste Storage Lagoon System.

7. Solid Waste Disposal - Solids contaminated with radioactive materials are stored within the exclusion area in NRC-approved containers awaiting treatment and/or shipment. Uranium-contaminated solid wastes which contain amounts of uranium larger than desirable to discard are held for uranium recovery. Radioactive solid wastes are disposed of by a private waste disposal contractor who is licensed and equipped to manage such wastes. The continued integrity of the containers of waste in long term outside storage is confirmed by quarterly inspections.

8. Waste Uranium Recovery Facility (WUR) - Exxon Nuclear plans to recover the uranium from the stored contaminated solids in a new building to be known as the Waste Uranium Recovery Facility (WUR). (See Figure 3, page 5, for the location of the WUR on the site.) The construction of the WUR and dry operations, such as sorting, have been authorized by a recent amendment to the existing license. The WUR is to be licensed and built in two stages. The initial WUR Building will have a ground floor area of 2,400 square feet. The exhaust gases from the WUR will be double HEPA filtered, and continuously monitored and controlled to meet the concentration limits applicable to the UO_2 plant. Criticality safety for the dry end of the WUR will be assured on a safe batch basis. All storage areas associated with the dry end of the WUR

will be controlled on a safe batch basis. (The wet operations will be the subject of a separate amendment application.). The building was designed to meet a variety of national and local codes and standards including the Uniform Fire Code.

III. POSSESSION LIMITS

Material	Form	Quantity
A. URANIUM (Maximum of 10,000 kg of contained U-235)		
a. Uranium of any enrichment	a. any	≤ 35 grams for analytical purposes
b. Uranium compounds with uranium of over 5 wt% but not greater than 19.99 wt% U-235	b. any solid, but subject to special process requirements in Appendix I, Section 1	≤ 200 kilograms of contained U-235.
c. Uranium of ≤ 5 wt% U-235 enrichment	c. Any covered by authorized activities	Up to a maximum of 10,000 kilograms of contained U-235, including a and b above.
B. PLUTONIUM (Maximum of 100 kilograms)		
a. sources and standards	a. sealed	a. ≤ 1 milligram and ≤ 1.5 millicuries
b. PuO_2	b. contamination on internal surfaces of fuel fabrication equipment.	b. ≤ 500 grams
c. PuO_2 or PuO_2-UO_2	c. encapsulated in fuel rods or in sealed NRC-approved containers	c. Up to a maximum 100 kilograms of plutonium including a and b above.

IV. FACILITIES

Building or Facility	Activities
UO_2 Building	UF_6 conversion, pelletizing, ceramic processing, encapsulation, assembly of fuel rods into assemblies, laboratory operation, scrap recovery, loading of finished assemblies into shipping containers.
Mixed Oxide & Speciality Fuels Building (MO & SF)	Plutonium may only be stored except that plutonium may be removed from storage for repackaging or downloading of fuel rods. The main activity is fabrication of poison fuel (Gd_2O_3-UO_2) rods and speciality fuel fabrication operations including welding of thermocouples to fuel rods and assembly of speciality elements.
Packaged Radioactive Materials Storage Building	Storage of closed containers of product, scrap, and waste materials (free of significant external contamination).
Engineering Laboratory (ELO)	UO_2 fuel development on a pilot scale, including chemical and mechanical processing and testing.
Engineering Test (ET) Building	Hydraulic flow and mechanical testing of single completed fuel assemblies.
Waste Uranium Recovery Facility	Recovery of uranium from solid wastes by mechanical treatment.
UF_6 Cylinder Storage Areas	Outside storage of UF_6 cylinders - full or empty.
Process Chemical Waste Storage Lagoon System	Storage and solar evaporation of contaminated liquid wastes.
Special Enrichment Uranium Storage Buildings	Storage of closed containers of UO_2 powder which are externally free of significant contamination.
Laundry	Dry cleaning of contaminated protective clothing and equipment (uranium operations only).
Packaged Waste Storage Areas	Outside storage of packaged contaminated materials - the outer containers are DOT specification containers, closed, sealed, and labeled.

V. LICENSE APPLICATION

A. History of Regulatory Review

The safety review of Exxon Nuclear's renewal application included an evaluation of the application transmitted by letter dated May 31, 1979, the superseding application transmitted by letter dated February 22, 1980, and supplements transmitted by letters dated March 13, April 29, June 5, June 19 and June 27, 1980, a review of the compliance history, and a detailed review of the organization, administration, radiation protection, and nuclear criticality safety programs. Receipt of the renewal application and the intent to prepare an assessment and take licensing action were noted in the Federal Register on September 25, 1979 (44 FR 55254).

During the period of initial safety review, A. L. Soong and R. L. Stevenson spent November 27 through 30, 1979, at the ENI plant accompanying Mr. W. Cooley of Region V, Office of Inspection and Enforcement (IE) on an inspection. Mr. Cooley is the principal safety inspector of the Exxon Nuclear plant from IE. Draft questions (covering all aspects of safety and including comments from the IE inspector) resulting from the initial licensing staff reviews of the renewal application were discussed and explained to Exxon Nuclear personnel by Soong and Stevenson during the visit, and were formally sent Exxon Nuclear by letter dated December 10, 1979. A copy of the report of the visit by Soong and Stevenson, dated December 7, 1979, is in Docket File 70-1257. The report (No. 70-1257/79-08) of Cooley's inspection of the Exxon Nuclear plant was issued January 22, 1980. No items of noncompliance with NRC requirements were identified within the scope of the inspection. Answers to the NRC questions on the license renewal application were given with the Exxon Nuclear letter of February 22, 1980, and reflected in changed pages in the superseding application.

B. Compliance History

A review was made of the licensee's recent health and safety compliance history using reports of inspections made by Region V, Office of Inspection and Enforcement personnel. The period examined was August 1, 1974, through December 1979.

For the period reviewed, there were 15 inspections pertaining to health and safety, effluent control and emergency procedures. Items of noncompliance were identified in 4 of the 15 inspections. These non-compliance items concerned proper posting of criticality and radiation areas, inadvertent transfer of SNM in excess of consignee's license limit, incorrect storage of SNM, failure to maintain frequency of internal audits, and failure to maintain written procedures for opening packages. None of the noncompliance items identified in the over-5-year period reflected basic weakness in the program or resulted in adverse effects to the health of the employees, or to the health and safety of the public. Exxon Nuclear responded to the noncompliance items with prompt corrective actions that were reported to the Region V Office of Inspection and Enforcement.

C. Curre.c Application

In the application, Exxon Nuclear Company has demonstrated that it has the necessary technical staff with the proper qualifications to administer effective nuclear criticality and radiation safety programs. The following sections contain a description of the principal aspects of the Exxon Nuclear organization, administrative procedures, and nuclear and radiation safety programs, as proposed by Exxon Nuclear, and the additional license conditions developed by the staff of the Uranium Fuel Licensing Branch, Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety and Safeguards.

VI. ORGANIZATION AND ADMINISTRATIVE PROCEDURES

A. Organization and Responsibilities

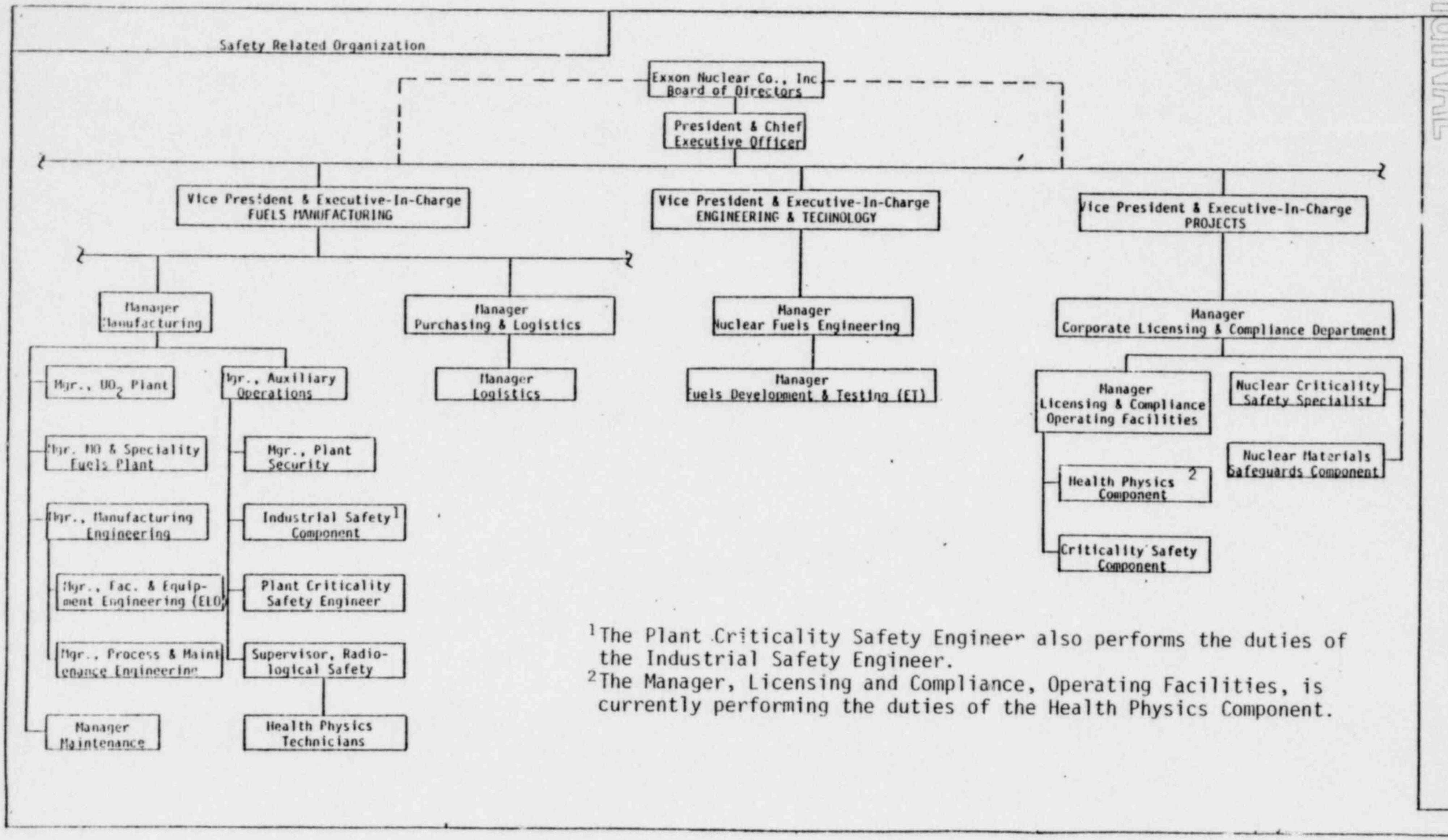
Operations at the Exxon Nuclear Richland site are administered by a staff organized according to Figure 5. The organization provides separate, independent and parallel lines of authority and reporting for the production and safety functions. Thus, within the Fuels Manufacturing Department, the plant safety and security staff report to the Manager, Auxiliary Operations, who has a position of authority comparable to the facility managers. Furthermore, the basic safety criteria are established by specialists within the Corporate Licensing and Compliance Department, which reports to the company president through a different chain of command than that of the operations groups. Exxon Nuclear has committed to a policy of safe operation without detrimental effects to the environs, and the responsibility for establishing and assuring adherence to the policy rests with the President, Exxon Nuclear Company. The President has implemented the policy through delegation to department managers responsible for radioactive material processing.

Fuels Manufacturing Department (FMD) Industrial Health and Safety Council

The Council meets monthly to review practices and trends in all areas of safety and to recommend changes to prevent recurrence of unusual incidents. Council membership includes the Vice President and Executive-in-Charge, FMD (Chairman); the Industrial Safety Engineer; the Manager, Auxiliary Operations; key safety engineers and specialists; and section and appropriate subsection managers of the Fuels Manufacturing and Corporate Licensing and Compliance Departments. Designated members of the Council make monthly inspections of housekeeping and safety practices and report the findings to the Council.

ALARA Committee

An ALARA Committee of the FMD Industrial Health and Safety Council maintains awareness of trends in employee radiation exposures and radioactivity releases. The membership of the Committee includes the Manager, Licensing and Compliance, Operating Facilities (chairman), the Health Physics Specialist, the Supervisor of Radiological Safety, and the Managers of Manufacturing Engineering,



[1] The Plant Criticality Safety Engineer also performs the duties of the Industrial Safety Engineer.

[2] The Manager, Licensing and Compliance, Operating Facilities, is currently performing the duties of the Health Physics Component.

Figure 5

Maintenance, UO_2 Plant, and MO&SF Plant. The Committee makes a formal annual report to the FMD Industrial Health and Safety Council evaluating the employee exposures, release data, controls, and practicality of further improvement.

Vice President and Executive-In-Charge, Fuels Manufacturing

The Vice President and Executive-In-Charge, FMD, is the senior site representative. He is responsible for the overall management of the engineering, design, development and fabrication of nuclear fuel.

Plant Managers

The Plant Managers direct the operations of the fuel manufacturing facilities and are responsible for the safety and environmental effects of those operations. Their specific responsibilities include preparation of operating procedures, training of employees, compliance with license conditions, and membership in the Emergency Cadre and the ALARA Committee.

Supervisor, Radiological Safety

The Radiological Safety Supervisor directs the activities of the Health Physics Technicians. The radiological safety programs for which he is responsible are established in accordance with criteria provided by the Health Physics Component of Licensing and Compliance. The programs include air sampling, contamination and radiation surveys, bioassay, in vivo examination, and records. The Radiological Safety Supervisor has authority commensurate to Plant Managers and can shut down any operation he deems unsafe or not in compliance with license conditions.

Plant Criticality Safety Engineer

The responsibilities of the Plant Criticality Safety Engineer include preparation of criticality safety specifications based on criteria and analyses provided by Licensing and Compliance, auditing shop operations, and assisting in criticality safety training of personnel.

Manager, Licensing and Compliance, Operating Facilities

The Manager, Licensing and Compliance, Operating Facilities, is responsible for developing, administering and auditing the licensing, health physics, criticality safety and environmental surveillance programs for all Exxon Nuclear facilities at Richland. He has the authority to shut down any operation he deems unsafe, detrimental to the environment, or not in compliance with the license.

Health Physics Component

The Health Physics Component is part of the Licensing and Compliance, Operating Facilities Section of the Corporate Licensing and Compliance Department. The responsibilities of the Health Physics Component include providing technical bases, criteria, and methods related to health physics, compliance inspections, assistance in employee training, membership on the ALARA Committee, and establishing frequencies for bioassay, radiation surveys, and contamination surveys. This position is currently being filled by the Manager, Licensing and Compliance, Operating Facilities.

Criticality Safety Component

The Criticality Safety Component is part of the Licensing and Compliance, Operating Facilities Section of the Corporate Licensing and Compliance Department. The responsibilities of the Criticality Safety Component include providing technical bases, criteria, and methods related to nuclear criticality safety. The component also provides criticality safety analyses, assists in employee training, performs compliance inspections, and approves criticality safety specifications.

B. Minimum Technical Qualifications

Minimum technical qualifications have been established for the safety related staff positions, as follows:

Supervisor, Radiological Safety - The minimum qualifications of the Radiological Safety Supervisor will be a B.S. degree in a technical field with 5 years' experience in radiation safety, or, in the absence of a degree, 10 years' experience will be required.

Health Physics Technicians - The minimum qualifications of Health Physics Technicians will be a high school diploma with 2 years of radiation monitoring experience or an additional 2 years of radiation monitoring experience in lieu of a high school diploma.

Plant Criticality Safety Engineer - The minimum qualifications will be a B.S. degree in a technical field with 3 years' experience in nuclear activities, or an additional 6 years of similar experience in lieu of a B.S. In either case, at least one year of this experience will be in criticality safety.

Manager, Licensing and Compliance, Operating Facilities - The minimum qualifications of the Manager, Licensing and Compliance, Operating Facilities will be a B.S. degree in a technical field with 10 years' experience in the nuclear energy field, of which 4 will have been in positions with nuclear safety responsibility.

Health Physics Component - At least one member of the component will have a B.S. degree in science or engineering with 5 years experience in radiation protection, including at least 2 years of radiation protection experience allied with nuclear fuel fabrication.

Criticality Safety Component and Second Party Reviewer - At least one membe of the Criticality Safety Component and each second-party reviewer of nuclear criticality safety analyses will have a B.S. degree in science or engineering with at least 3 years of experience in nuclear criticality safety, including 2 years of criticality safety analysis.

C. Administrative Procedures

Organizational responsibilities and authorities are defined by upper Exxon Nuclear management through policies, job descriptions and procedures. The respective department managers approve written personnel qualifications for key positions below the department manager level. The hiring of managers and key specialists in plant operations, health physics, nuclear criticality safety and nuclear materials management is subject to approval by the cognizant vice presidents of the company.

Exxon Nuclear management is committed to assure that procedures important to plant operations are properly prepared and reviewed, are kept current and are followed by operating personnel. The information in Figure 6 illustrates, among other things, the responsibilities of the various management personnel and organizational components in the preparation, review and approval of written criteria and procedures important to plant operation. Figure 6 thus summarizes in readily comprehensible form certain administrative requirements defined in the text of the Conditions section of the license application. The figure helps make it clear that there is appropriate expertise and depth in the development and review of criteria and procedures at least equivalent to the corresponding requirements in the existing licenses for similar fuel processing operations.

To assure that long-term procedures such as manuals and operating procedures are kept current, they will be reviewed for updating at least annually. To assure that procedures are followed, any observed failure to follow procedures will be promptly corrected and any procedure found to be incorrect or which fails to describe actual operating practice will be promptly revised.

D. Audits and Inspections

Personnel responsible for safety audits are generally identified in Figure 6.

As noted in the description of responsibilities, monthly inspections of housekeeping and safety practices are made by designated members of the Fuels Manufacturing Department Industrial Health and Safety Council and results reported to the Council.

The Health Physics Component of Licensing and Compliance, Operating Facilities Section, makes monthly inspections of radiation protection practices and

APPROVAL & RESPONSIBILITY MATRIX

A - Prepare/Primary Responsibility
B - Approve/Accept/Concur
C - Implement/Execute
D - Inspect/Audit

A primed letter (e.g., A') signifies that the respective individual is responsible for the respective function only as it relates to his area of responsibility.

	Vice President & Executive-In-Charge Fuels Manufacturing	Manager, Manufacturing	Plant Managers	Manager, Manuracturing Engineering	Manager, Facilities & Equipment Engineering (ELO)	Manager, Maintenance	Manager, Auxiliary Operations	Manager, Plant Security	Industrial Safety Component	Plant Criticality Safety Engineer	Supervisor, Radiological Safety	Health Physics Technicians	Manager, Fuel Development & Testing(ET)	Manager, Logistics	Manager, Corporate Licensing & Compliance Department	Manager, Licensing & Compliance Operating Facilities	Health Physics Component	Criticality Safety Component	Nuclear Criticality Safety Specialist		
Position Responsibilities & Authorities	B	A'			A'								A'	A'	A'/B						
Position Professional Requirements		B'	A'	A'	A'	A'	A'						A'	A'	A'/B						
Radiation Protection Standards	B	B	B								C			B	B	B	A/C/D				
Radiation Safety Operating Procedures		B					B				A	C		B		B	D				
Radiation Work Procedures			B'/C'		B'/C'	B'/C'					A/D	D	B'/C'	B'/C'		B	D				
Nuclear Crit. Safety Bases & Criteria	B														B			B/C	A		
Nuclear Crit. Safety Standards	B	B	B							C/D					B	B		A/C/D	B		
Nuclear Crit. Safety Analyses										C								A/D			
Criticality Safety Specifications		B'	B'		B'					A/D			B'	B'		B		B/D			
Rad. & Crit. Safety Insp./Audit Programs							B'			A'/C	A'	C'				B'	A'/C	A'/C'			
Operating Procedures		B'	A'/C'		A'/C'								A'/C'	A'/C'							
Rad. Waste Treat. & Disposal Programs	B	A'	C'		A'/C'						D	D	A'/C'		B	B	D				
Environmental Surveillance Program	B														B	B/D	A/C				
Emergency Plan & Procedures	B	B	C'	C'	B'/C'	C'	A		C'		C'	C'	B'/C'	C'	B						
Access Controls		B'	A'/C'		A'/C'			A'/C'			D	D	A'/C'	A'/C'	B	B					
Training Programs		B'	A'/C'		A'/C'	A'/C'	B'	A'/C'	A'/C'	A'/C'	A'	C'	A'/C'	A'/C'			D'	D'			
Process & Equipment Changes		B'	B'	A'/C'	A'/C'	C'/D'			B'/D'	B'/D'	B'/D'	D'	A'/C'			B	B'	B'/D'			
Process Test Authorizations		B'	B'	A'/B	B'		B			B'/D'	B'/D'	D	B'			B	B'	B'			
Incident Investigations & Reporting	A	B'	B'		B'								B'	B'	B	B					
Records			A'	A'	A'	A'	A'	A'	A'	A'	A'	A'	A'	A'		A'	A'	A'			

Figure 6

exposure controls. Results of these inspections are documented, including any recommended corrective actions, and distributed to appropriate managers in the Fuels Manufacturing and Corporate Licensing and Compliance Departments.

As part of their normal activities, the Radiological Safety Supervisor and Health Physics Technicians make periodic inspections of all areas of the plant where radioactive materials are stored, processed or handled. Detected infractions are corrected on the spot. Serious infractions and noncompliance with license conditions are documented and distributed to appropriate managers.

The Criticality Safety Component of Licensing and Compliance, Operating Facilities, and/or the Plant Criticality Safety Engineer make at least monthly inspections of criticality safety practices at the plant. Results of these inspections are documented, including any recommended corrective actions, and distributed to appropriate managers in the Fuels Manufacturing and Corporate Licensing and Compliance Departments.

While performing their daily duties, Health Physics Technicians are alert for infractions of criticality safety specifications. Detected infractions are communicated to the Plant Criticality Safety Engineer.

E. Personnel Training

New employees are given initial instruction by knowledgeable personnel adequate to allow safe beginning of on-the-job training, with complete instruction accomplished within 2 weeks after starting work. In addition to the normal on-the-job-training, employees are instructed in radiation protection and criticality safety requirements and procedures, industrial safety, fire protection, and emergency procedures. The degree of training is commensurate with the employee's responsibilities and the extent of his contact with radioactive and fissionable materials.

Affected employees are notified and instructed when changes are made in radiation protection or criticality safety controls, or in emergency procedures.

Safety topics are routinely discussed in monthly safety meetings. Each employee routinely working with special nuclear material receives annual refresher training in radiation protection and criticality safety. Exxon Nuclear has committed to the maintenance of records of employee indoctrination and training for a minimum period of 5 years.

F. Records

In the Conditions section of the license application, Exxon Nuclear has committed to the maintenance of records of various required actions (such as the records of criticality analyses, internal audits, FMD Industrial Health and Safety Council meeting reports, and routine surveys) for a minimum period of 5 years except where NRC specifies longer retention times for specific records.

VII. NUCLEAR CRITICALITY SAFETY

A. Introduction

The Exxon Nuclear system of nuclear criticality safety at the Richland site is based on:

1. Technical criteria using established policies, analytical methods, data and safety margins.

2. Qualified nuclear criticality safety staff with specified responsibility and authority.

3. Administrative requirements for written operating procedures, review of criticality safety analyses, audits of operations, posting of limits and training.

An important element, listed in item 3 foregoing, is that the criticality safety criteria provide for reviews by two different qualified reviewers of changes that involve criticality safety considerations. It is also relevant that there is a depth of criticality safety experience in the Corporate Licensing and Compliance Department, beyond that required to meet the stated license requirements.

B. Technical Criteria

The technical criteria that Exxon Nuclear uses to establish the criticality safety of a proposed, revised or new operation are provided in the License Conditions section of the renewal application. The important criteria are as follows:

1. The basic policy is the double contingency policy enunciated as follows, "Process and equipment designs and operating procedures incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent errors, accidents, equipment malfunctions, or changes in process conditions before a criticality accident is possible." This policy accords with accepted practice throughout the U.S. nuclear industry and is endorsed by Regulatory Guide 3.4, Revision 1, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors."

2. Where double batching is possible, mass limits are held to no more than 0.45 of the minimum critical mass. Where double batching is not possible, the mass is limited to no greater than 0.80 of the critical mass. Mass limits have been based on data and calculations reported in Documents TID-7028, DP-1014, ARH-600 and other standard references such as the Handbook of Criticality Data (UK Authority Health and Safety Branch) as well as a validated calculation using the KENO IV Code with Knight-modified Hansen-Roach cross sections.

3. Cylinder diameters, slab thicknesses, and unit volumes are limited to 90 percent, 85 percent, and 75 percent, respectively, of the critical values. These margins and those given in paragraph 2 above are comparable to those used in the Nuclear Safety Guide, TID-7016, Rev. 1, and are widely used throughout the nuclear industry.

4. The optimum (limiting case) conditions of water moderation credible for the system are assumed in setting limits.

5. Unit limits are based on full wall reflection unless less than full reflection can be assured under both normal and credible abnormal conditions.

6. The licensee spaces the process equipment and stored units to meet the following general criteria:

   a. The spacing between units within an array is limited by mechanical means.

   b. For single units and multi-unit arrays that have been experimentally measured or for which calculational methods accurately or conservatively reproduce experimental values, the multiplication factor does not exceed 0.95 at a 95 percent confidence level.

   c. When the indicator of the reactivity of the array is the critical number of units in the array, the allowable number of units does not exceed 0.50 of the calculated critical number.

   d. The mechanical integrity of equipment or storage arrays is adequate, for both normal and credible abnormal conditions, to prevent deformations or rearrangements so extensive as to constitute a contingency.

7. The licensee analyzes the spacing of the process equipment and stored units using one of the following methods:

   a. Calculations using validated Monte Carlo type computer code-cross section combinations such as KENO and the Hansen-Roach cross sections.

   b. The solid angle method in TID-7016, Rev. 1, with the additional constraints that the method not be applied to arrays susceptible to interspersed moderation or reflected by reflectors more effective than water at the outer cell boundaries.

8. The licensee controls the movement of special nuclear material, e.g., no more than one safe batch may be moved at a time when introducing or removing material from a work station.

9. The licensee categorizes and externally posts facilities and plant areas as to permissible firefighting techniques, to help minimize the probability of criticality from such activities.

C. Organization and Administrative Requirements

The organization charts, general responsibilities and qualifications of the safety-related positions, including those for nuclear criticality safety, are given in Section VI, Organization and Administrative Procedures.

The first level nuclear criticality safety supervisor for this facility is the Plant Criticality Safety Engineer, who reports to the Manager, Auxiliary Operations. The Plant Criticality Safety Engineer receives technical guidance from the Criticality Safety Component in the Corporate Licensing and Compliance Department. The responsibilities of the Plant Criticality Safety Engineer are summarized in VI.A.

In addition to the requirements for qualified staff and the established technical criteria, the licensee's criticality safety requirements involve several important administrative requirements:

1. All changes involving nuclear criticality safety considerations must be analyzed by a qualified analyst and reviewed by a qualified reviewer. Preoperational audits of the new equipment or process changes that require a nuclear safety analysis are made by the Manager, Maintenance, the Plant Criticality Safety Engineer, the Criticality Safety Component, and the Supervisor of Radiological Safety. All new or modified facility and process equipment is subjected to acceptance testing before release for routine operation.

2. In addition to the preoperational audits, there is an indepth system of audits of operations at stated intervals by:

   a. the Plant Criticality Safety Engineer,

   b. the Criticality Safety Component of Licensing and Compliance, Operating Facilities, and

   c. representatives of the FMD Industrial Health and Safety Council.

3. Requirements to ensure incorporation of the criticality safety limits in criticality safety specifications and maintenance of these specifications in the work or storage areas to which they apply.

4. Requirements for the posting of nuclear criticality safety limits.

5. Requirements for training of operations personnel (see Section VI.E for additional details).

6. Safety policies and abnormal events or problems are reviewed by a permanent Fuel Manufacturing Department Industrial Health and Safety Council consisting of senior management and key safety personnel at the site.

D. Conclusion

The nuclear criticality safety review and our conclusion that the controls are acceptable are based on the following:

1. The license conditions as revised to improve clarity, correct discrepancies and ensure continued compliance with accepted practice. The basic policy underlying these conditions is in accordance with Regulatory Guide 3.4, "Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors."

2. The demonstrated qualifications of the nuclear criticality safety personnel and the depth of expertise available in the Exxon Nuclear organization for the solution of problems, including personnel competent in the use of accepted computer codes, and for auditing.

3. The conformance of the technical criteria for nuclear criticality safety with established U.S. practice.

4. The validity of the nuclear criticality safety analyses made under the license, including the demonstration sections.

5. The history of safe plant operation with respect to nuclear criticality safety since the original license was issued.

VIII. RADIATION SAFETY

A. Radiation Safety Administration

The Radiological Safety Supervisor reports to the Manager, Auxiliary Operations, and is responsible for maintaining a radiation safety program which is established in accordance with criteria provided by the Health Physics Component of the Corporate Licensing and Compliance Department. He is also responsible for the protection of plant employees and the public and for inspecting plant operation for compliance with the license and radiological regulations. He is authorized to suspend any operation which he believes threatens the health and safety of the employees or the public. Any change in radiological safety operating procedures is prepared by the Radiological Safety Supervisor, and reviewed and accepted by the Health Physics Component of the Corporate Licensing and Compliance Department. This approval procedure ensures proper health and safety review of all standard requirements affecting radiological safety.

In detail, the responsibilities of the component headed by the Supervisor, Radiological Safety, include:

1. Review and approval of health physics aspects of changes to operating procedures associated with the processing, handling or storage of SNM,

2. Approval of radiation work permits,

3. Routine surveillance of operations, and

4. Conducting training courses in health physics.

Overall objectives of the program are to ensure adequate containment of radioactive material and to reduce the levels of radiation exposure to meet the ALARA goal.

The positions of Supervisor of Radiological Safety and Manager, Licensing and Compliance, Operating Facilities, are filled by individuals who must meet the minimum qualifications stated in Part VI of this report. These minimum technical qualifications assure that these individuals have an academic background, or equivalent, complete with special training in health physics and professional experience.

Two special features of the radiation safety administration, the radiation work procedure and the ALARA Committee, are described in detail below.

Radiation Work Procedure

For any operation or maintenance work involving work or entry into a system containing SNM, not already covered by an effective operating procedure or where there is a potential for release of contamination, a radiation work procedure is prepared by the Supervisor, Radiological Safety, and approved by the Manager, Licensing and Compliance Operating Facilities, and the manager(s) of the affected operation.

ALARA Committee

The ALARA Committee is responsible for assuring implementation of the ALARA regulatory requirement pertaining to radiation workers. The Committee membership consists of the Manager of Licensing and Compliance, Operating Facilities, the Health Physics Specialist, the Supervisor of Radiological Safety, Manager of Manufacturing Engineering, Manager of Maintenance, Manager of the UO_2 Plant, and Manager of the MO&SF plant. The Committee is specifically responsible for conducting periodic reviews and assessments of occupational radiation exposures (internal and external), radioactive material releases to unrestricted areas and any related abnormal occurrences. The Committee meets semiannually and prepares an annual report to the FMD Industrial Health and Safety Council that summarizes the status of the ALARA program and makes recommendations on how to achieve the ALARA goal.

The activities of the ALARA Committee, the monthly plant inspections of radiation protection safety and nuclear criticality safety, the employee training program, and the administrative procedures for reviewing pertinent changes by the health and safety organization demonstrate Exxon management's commitment to comply with the ALARA concept.

B. System of Exposure Controls and Exposure Levels Experienced

External Exposure

Because of the radioactive decay characteristics of uranium, external exposure has generally not been a problem in uranium fuel fabrication plants and Exxon's Richland plant is fairly typical. (The operations with plutonium in the Exxon plant were discontinued in 1974. The radiation exposure contributed by the stored plutonium will be limited). External exposure is evaluated and controlled on the basis of the data from personnel dosimeters as well as by beta-gamma dose-rate surveys. The dosimeters are read and evaluated on a quarterly basis. Exposure trends are analyzed at least every 6 months by the ALARA Committee to ensure that ALARA goals are being met. An administrative investigation will be conducted when a dosimeter result exceeds 500 mrem.

The external exposure data submitted by Exxon Nuclear for the period from 1977 through 1979, as indicated by Table 1, show that annual personnel external exposures are typically less than 0.4 rem, or approximately 10 percent of the allowable exposure limit.

Internal Exposure

Introduction

In a fuel fabrication facility, radioactive material may enter the body by breathing contaminated air or by ingestion as a consequence of poor personal hygiene and failure to self monitor. Once in the body, the subsequent distribution and excretion of the uranium is a function of the physical and chemical characteristics of the specific material. In the Exxon plant at Richland, protection of the operating personnel from excessive internal exposure is provided by the use of:

1. Plant ventilation systems designed to limit the concentrations of radioactive material in breathing air in the plant working areas.

2. An air sampling and analysis program for monitoring the concentration of radioactivity in working areas to confirm proper functioning of the ventilation-filtration system and detect the presence of elevated concentrations.

3. A bioassay program to monitor and detect any significant deposition of radioactive material in the body.

4. Protective clothing, shoes and gloves to minimize direct contact with the radioactive material.

5. Respiratory protective equipment to limit the inhalation of airborne radioactive material.

Table 1

Annual External Radiation Exposure Data (rems)
Exxon Nuclear Company

Group	1977		1978		1979	
	Av.	Max.	Av.	Max.	Av.	Max.
UF_6 Conversion & Scrap Recovery Areas	0.18(2)	0.40	0.22(2)	1.01(1)	0.37	0.67
UO_2 Pellet Area	0.23	0.50	0.25	1.30(1)	0.40	1.12
UO_2 Fuel Rod Handling Areas	0.11	0.18	0.11	0.32	0.29	0.88
Mixed Oxide & Specialty Fuels Plant	0.13	0.28	0.14	0.28	0.24	0.45
ELO Facility	0.07	0.11	0.09	0.17	0.16	0.23
Quality Control (Including Analytical Laboratories)	0.07	0.34	0.15	0.35	0.21	0.74
Maintenance	0.04	0.25	0.08	0.23	0.12	0.26

(1) Dosimeter (or holder) contaminated.

(2) Includes data recorded from contaminated dosimeter (or holder).

6. Surveys to detect the presence and extent of radioactive contamination.

7. Procedures, including action levels, for investigation, control and decontamination of contaminated surfaces.

8. Arrangements for emergency evacuation of the building, based on installed alarms, procedures, personnel instruction and practice alerts.

Description of Room Air and Equipment Ventilation Systems

The ventilation system in the Exxon Nuclear plant consists of air supply and exhaust systems. Outside air is brought into various plant areas by the air conditioning equipment through inlet filters and all exhausted air from process areas is filtered through a HEPA filter before discharge through the stack. The stack blower is connected to an emergency backup power system for use in the event of an AC power failure. Exhaust air is continuously monitored prior to release. In the fuel fabrication building, room air is recirculated and continuously monitored. If the recirculated air exceeds a specified concentration level, it is diverted to the facility exhaust air system without recirculation.

The corrosive exhausts generated by the etch, UF_6-UO_2 conversion and uranium scrap reprocessing processes are passed through a scrubber, a dryer and double HEPA filters and released through the stack. The ventilation system at Exxon Nuclear is designed and maintained to limit the spread of airborne contamination by maintaining air pressure gradients so that airflow is directed from the working area into the process equipment, glove boxes and hoods.

Monitoring of Air Concentration Levels

The ventilation system was designed and is operated to move air from areas of low contamination potential to areas of higher contamination potential. The concentration of radioactivity in the room air is monitored using fixed sampling heads mounted at work locations where the potential for airborne contamination exists. The filters from these samples in the process areas are changed and counted on a daily basis. Internal exposures from airborne radioactivity may be estimated from the hours an individual works at each assigned location and the corresponding air concentrations. The proper location of the sampling head to provide representative air samples is evaluated at least once every year and whenever any significant process or equipment changes are made. The action levels for airborne radioactivity in the plant are set so as to comply with 10 CFR Part 20 limits. The air quality in the plant is also maintained through tests and maintenance of the ventilation system and filters. For example, tests will be performed periodically to determine that air flows are from uncontaminated areas to contaminated areas. HEPA filters are replaced when the differential pressure across the filter exceeds 3 inches of water, and hood face velocities are maintained at a minimum of 125 linear feet per minute.

The minimum frequency for checking the pressure drop across the filters and the average face velocity into ventilated enclosures is monthly.

In-Plant Airborne Activity Levels

The concentrations of airborne radioactivity in various working areas for the past 3 years are shown in the following table:

Average Airborne Concentration Levels
in Exxon Nuclear Plants, Expressed as % of MPC

Area	1977	1978	1979
UF_6-UO_2 Conversion and Scrap Recovery	20	20	25
UO_2 Pellet	<10.0	<10.0	12
UO_2 Fuel Rod	<10.0	<10.0	<10
Analytical Lab	<10.0	<10.0	<10
PuO_2 Process Equip. and Storage Area	<0.1	<0.1	<0.1

As the table indicates, the average airborne concentration level in the work areas in the main facility is less than 25 percent of the MPC level specified in 10 CFR Part 20.

Program of Engineered Improvements

As can be seen in the preceding section, except for the UF_6-UO_2 conversion and scrap recovery area and the UO_2 pellet production area, which average 25 percent and 12 percent respectively of the airborne radioactivity concentration specified in 10 CFR Part 20, the average air concentration of radioactivity in work areas is consistently less than 10 percent of MPC. The higher concentrations of radioactivity in air in the UF_6-UO_2 conversion area and UO_2 pellet areas are attributable to increasing production rates and to frequent cleanouts between processing of different enrichments. In order to further improve the levels of room air contamination in the conversion and pellet areas, Exxon management has committed to a program intended to reduce these levels to as low as reasonably achievable. The program has the following main elements:

1. Equipment and Facility Modifications (1978-1979)

   a. Installed heaters on the offgas plenum assemblies of the UF_6-UO_2 calciners and installed a secondary off-gas system to minimize plugging of the offgas ducts.

   b. Installed steam control valves and heaters on UF_6 gas lines to minimize plugging of these lines and reduce the frequency of gas line cleanout.

   c. Installed utility hoods in the UF_6-UO_2 conversion areas to accommodate the cleanup of equipment within the hood rather than at unenclosed workbenches.

d. Replaced the UO_2 powder blending station with a closed system to control the dispersion of airborne contamination.

2. Additional Administrative Controls

a. Increased emphasis by Exxon Nuclear management in training sessions on contamination control and cleanup.

b. Improved local air monitoring program to provide air intake measurements representative of the air actually breathed by the operators.

3. New Facility Modifications

In its 1980 capital equipment budget, Exxon Nuclear has committed $750,000 to improve the existing ventilation system in UF_6-UO_2 conversion and UO_2 powder/pellet production areas. The improvement includes the installation of new exhaust systems and a scrubber in the UF_6-UO_2 Conversion Line No. 2 process exhaust.

C. Bioassay Program

Internal exposure for both uranium and plutonium is evaluated and controlled by a bioassay program. The bioassay program for uranium is conducted in accordance with detailed provisions similar to those in Regulatory Guide 8.11. The pertinent parts of the license application include the definition of sampling frequencies, types of analyses to be used, action levels and action to be taken.

The Exxon Nuclear bioassay program for plutonium is a minimal program that is adequate for the storage of plutonium at the Exxon plant. At the present time, no guides have been developed by the NRC for plutonium biossay. Exxon's program for plutonium bioassay, however, is equivalent to the program of other NRC licensees and is deemed adequate for the inactive storage and form of plutonium authorized by this revised license.

D. Use of Respiratory Protective Equipment

The conditions for use of respiratory protective equipment defined in Regulatory Guide 8.15 are required by 10 CFR 20.103(c) and will apply to the revised license. The Office of Inspection and Enforcement inspected the licensee's program for use of respiratory protective equipment against Regulatory Guide 8.15 and found the program in compliance.

E. Control of Surface Contamination

The restricted areas of the Exxon Nuclear Richland Plant are zoned contamination control areas, intermediate areas and general areas. Each defined area is surveyed routinely for any undesirable surface contamination. The frequency of this survey and action levels for cleanup are based on the use to which the areas are committed and on the potential hazard presented by the presence of surface contamination.

The specifications for the control of surface contamination used by Exxon Nuclear are within the limits used at other nuclear facilities with similar types of material and potential for contamination.

They are summarized as follows:

Guide to Surface Contamination Control Levels

Areas	Action Levels Removable, Alpha	$\frac{dpm}{100cm^2}$	Survey Frequency	
	U	Pu	U	Pu
Contamination Control	10,000	500	weekly	daily
Intermediate	500	200	daily	daily
General*	200	background	weekly	weekly

*General areas where food is allowed will be surveyed daily.

When contamination levels in any area exceed the appropriate action level, decontamination action will be taken immediately.

To ensure that the radiation detecting instruments function properly, the instruments are calibrated every 6 months.

Release of equipment and packages from the plant site is in accordance with Annex C guidance. (A copy of Annex C is included in Section XII of this report following the license conditions.)

F. Effluent Control

Exxon is committed to a program to maintain releases of radioactive materials to levels as low as reasonably achievable (ALARA). Important aspects of this program include:

- Establishment of action levels for radioactive concentrations in effluents so that any abnormal operation will be promptly corrected and the radioactive concentration in the effluent held below the limit specified in 10 CFR Part 20.
- Use of written procedures, reviewed and approved by Radiological Safety, for processes that discharge radioactive material to the environs.

At the Exxon Nuclear facilities, potentially contaminated exhaust air is exhausted through at least one set of absolute filters and discharged through stacks which are continuously monitored for particulate and gaseous activity. Data reported by the licensee show that the annual average airborne uranium release from the Exxon Nuclear UO_2 Plant (1976-1978) is less than 1 percent of the MPC limit specified in 10 CFR Part 20. Therefore, the environmental impact of the airborne releases from facility operation is very small.

All uranium*-contaminated liquid wastes and high level chemical waste solutions are discharged to the onsite process chemical waste storage lagoon system for storage and solar evaporation. The lagoons are lined with two layers of an impervious plastic liner to prevent the contents from seeping into the groundwater. Furthermore, there is a leak detecting system, including underground wells and sampling tubes, under the liner to provide leakage detection capability for the lagoons. Exxon is investigating methods (such as centrifugation, filtration, and ion exchange) for possible uranium recovery from the contents of these lagoons. However, the ultimate disposition of sludge and solids removed from these lagoons will be as solid radioactive waste buried at an approved site.

Sanitary wastes generated by the plant employees, and process cooling water are not expected to contain significant quantities of uranium. These liquid wastes are discharged through the separate sewer system to the EN-City Lift Station where the total combined liquid effluent is then pumped to the Richlard municipal sewerage system. The liquid effluent is continuously sampled as it is pumped to the municipal sewerage system, and the composited samples are analyzed daily for pertinent radioactive materials and chemicals. Any increase in the radioactive material content of the samples above background is cause to take appropriate corrective action.

Effluent releases from the Exxon facility are and have been within all license conditions and regulatory requirements for discharge of radioactivity to unrestricted areas. A detailed description of the effluent releases from the Exxon Nuclear facilities and the impact resulting from the overall plant operation will be published in the Environmental Impact Appraisal related to the license renewal.

G. Conclusion

Upon completion of the radiation safety review of the licensee's application and compliance history, the staff has concluded that the Exxon Nuclear Company has the necessary technical staff at the Richland facility to administer an effective radiological safety program. Conformance by Exxon Nuclear to their proposed conditions as well as to those developed by the staff of the Uranium Fuel Licensing Branch should ensure a safe operation and the quick detection of unfavorable trends or effects by Exxon Nuclear or IE with prompt corrective action. The ongoing program of engineered improvements to reduce radiation levels should result in a gradual reduction in airborne activity.

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*There are no sources of plutonium-contaminated liquid waste at the Exxon Nuclear plant.

IX. EMERGENCY PLAN

Exxon Nuclear has submitted an emergency plan in accordance with Regulatory Guide 3.42 which meets the requirements of 10 CFR 70.22(i). The plan was reviewed by the staff using the elements listed in Section IV of 10 CFR Part 50, Appendix E, to judge the adequacy of the plan. The staff finds that the emergency planning for the Richland site meets the requirements of 10 CFR Part 50, Appendix E, and provides a basis for an acceptable state of emergency preparedness.

The Exxon Nuclear emergency plan is incorporated in the license by reference in Appendix III in the license condition section of the renewal application.

X. FIRE SAFETY

Fire safety at the Exxon Nuclear site is based primarily on:

1. A low inventory of combustible material.

2. The use of burning devices, gas detection equipment, and asbestos curtains where necessary to prevent explosions and fires around sintering furnaces and ovens.

3. The use of chemical fire extinguishers.

4. Plant personnel trained in the use of fire extinguishers.

5. Fire detection instruments and automatic alarms.

6. Preplanned emergency response procedures which include assistance, if required, from local fire departments.

The Richland site is periodically inspected for fire safety by inspectors acting for the insurance underwriter. The most recent relevant inspection was performed on June 27, 1978, and the results of the inspection are summarized in the letter from American Nuclear Insurers to Mr. Robert Purcell shown in Part 5 of Attachment A of the renewal application. The report of an inspection by the Richland City Fire Department on February 13, 1980, of fire protection features and practices in the plant is also given in Attachment A, Part 6.

In the section on the effects of postulated accidents given in the Environmental Statement for the Uranium Oxide Plant, it was concluded that no release of radioactive material to the environs was likely to occur as the consequence of a sintering furnace explosion or autoclave explosion.

In the Environmental Statement for the Mixed Oxide and Speciality Fuels Plant, the postulated accidents involving fires or explosions were analyzed as to possible resulting individual doses. Based on an assumed evacuation within 2 hours after accident initiation, maximum (lung) doses to an individual at the site boundary were calculated to be 0.5 mrem and 7 mrem for a hydrogen explosion and glovebox solvent explosion, respectively. These analyses were based on the assumption that the facility would be in full operation when the accidents occurred.

The staff concludes that the impact of a fire at one of the Richland facilities would be quite limited and that existing fire safety provisions for the site provide safety protection adequate for the Exxon Nuclear facilities.

XI. PLANT DECOMMISSIONING

General Decommissioning Plan

Exxon Nuclear, by letter dated June 16, 1978, and supplements transmitted by letters dated December 12, 1978, and January 9, 1979, submitted a general decommissioning plan for the Richland site including the buildings and the lagoons. The objective of the plan is to take residual contamination levels to the values of Table I of the NRC guidelines, "Guidelines For Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source or Special Nuclear Material," November 1976. The Table I values are acceptable levels for release of facilities and equipment for unrestricted use.

The decommissioning plan also includes a discussion of the general considerations for decontamination of the plants and site, the procedures to be followed during decontamination and an estimate of the costs for decontaminating the Richland plants and site.

The Exxon Nuclear decommissioning plan for the Richland site was reviewed by the staff and appears to be adequate in that the objective complies with NRC Guidelines, the procedures proposed are reasonable, acceptable to the staff and should allow the objective to be attained, and the estimated costs appear to be realistic.

Financial Plan

The staff has evaluated the Exxon Nuclear financial commitment and finds that, although it does not contain a financial security arrangement that would guarantee decommissioning funds, it offers the assurance of an officer of the parent corporation (Exxon Corporation) that the parent corporation will provide the necessary funds (three million dollars) for decommissioning. The staff finds that the Exxon Corporation commitment is a very small fraction of the worth of the corporation. Accordingly, the staff accepts the letter commitment from the Corporate Senior Vice President as adequate assurance that the facilities will be decontaminated at the end-of-plant life so that they can be released for unrestricted use.

The Exxon Nuclear commitments for decommissioning are incorporated in the license by reference in Appendix II of the license condition section of the renewal application.

XII. CONCLUSION

Upon completion of the safety review of the licensee's application and compliance history, the staff has concluded that the activities authorized by issuance of a revised license to Exxon Nuclear Company, subject to the conditions developed by the staff of the Uranium Fuel Licensing Branch, will not constitute an undue risk to the health and safety of the public. Furthermore, the staff has determined that the application fulfills the requirements of 10 CFR 70.23(a) subject, however, to the imposition of whatever additional license requirements may be determined necessary as a consequence of the environmental impact appraisal now being made. The issuance of a full, 5-year term renewal license should be held in abeyance until the additional requirements have been determined.

The staff, therefore, recommends that the Exxon Nuclear Company license be revised it in its entirety, in accordance with the statements, representations and conditions contained in Part I and the appendices to Part I of the licensee's application transmitted by letter dated May 31, 1979, and supplements, subject to the following conditions and continued on a timely renewal basis until completion of the environmental appraisal:

9. Authorized Use: For use in accordance with statements, representations and conditions contained in "License Conditions," Part I and the Appendices to Part I (Special Conditions, Decommissioning Plan, Emergency Plan) of the licensee's application transmitted by letter dated May 31, 1979, and supplements transmitted by letters dated February 22, March 13, April 29, June 5, June 19, and June 27, 1980.

10. Authorized Place of Use: The licensee's existing facilities near Richland, Washington, as described in the referenced application, Table 1.3-1.

11. All areas in which radioactive materials are stored, handled, or used shall be posted with caution signs meeting the requirements of Title 10, CFR Part 20.203, except that of 20.203(f). In lieu of 20.203(f) requirements, a sign bearing the legend "Every container or vessel in this area, unless otherwise identified, may contain radioactive material," shall be posted at entrances to each building in which radioactive materials are used, stored, or handled.

12. Notwithstanding the evaluation of training effectiveness as described in the last paragraph under 3.10 on page 3.59 of the License Conditions section of the application, the effectiveness of refresher training shall be evaluated using written tests conducted for such purpose and signed by the individual being tested.

13. The licensee is exempted from the monitor alarm requirements of Section 70.24, 10 CFR Part 70, in the areas specified below:

    a. SNM Accountability Measurement Station, and

b. waste lagoons.

14. Release of equipment and packages from the plant site or to clean areas onsite shall be in accordance with the attached Annex C, dated November 1976.

A. L. Soong
Radiation Safety

R. L. Stevenson
R. L. Stevenson
Project Manager

Approved by
W. T. Crow, Section Leader
Uranium Process Licensing Section

(Relevant to Condition 14)

ANNEX C

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE, OR SPECIAL NUCLEAR MATERIAL

U. S. Nuclear Regulatory Commission
Division of Fuel Cycle and
Material Safety
Washington, D.C. 20555

November 1976

The instruction in this guide in conjunction with Table I specify the radioactivity and radiation exposure rate limits which should be used in accomplishing the decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The limits in Table I do not apply to premises, equipment, or scrap containing induced radioactivity for which the radiological considerations pertinent to their use may be different. The release of such facilities or items from regulatory control will be considered on a case-by-case basis.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table I prior to applying the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces of premises, equipment, or scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to, special circumstances such as razing of buildings, transfer of premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such requests must:

   a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature, extent, and degree of residual surface contamination.

   b. Provide a detailed health and safety analysis which reflects that the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishs that contamination is within the limits specified in Table I. A copy of the survey report shall be filed with the Division of Fuel Cycle and Material Safety, USNRC, Washington, D.C. 20555, and also the Director of the Regional Office of the Office of Inspection and Enforcement, USNRC, having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. The survey report shall:

    a. Identify the premises.

    b. Show that reasonable effort has been made to eliminate residual contamination.

    c. Describe the scope of the survey and general procedures followed.

    d. State the findings of the survey in units specified in the instruction.

Following review o the report, the NRC will consider visiting the facilities to confirm the survey.

TABLE I

ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDES[a]	AVERAGE[b c f]	MAXIMUM[b d f]	REMOVABLE[b e f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm $\beta\gamma$, 100 cm^2	15,000 dpm $\beta\gamma$, 100 cm^2	1,000 dpm $\beta\gamma$, 100 cm^2

[a]Where surface contamination by both alpha- and beta-gamma-emitting muclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d]the maximum contamination level applies to an area of not more than 100 cm^2.

TABLE I

[e]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination of objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

APPENDIX I
Bases for Numbered License Conditions

There are fewer numbered license conditions (14) recommended in this action than has been typical in similar licensing actions taken during the past 3 years. The apparent reduction is a result of the licensee's incorporating essentially all requirements in the proposed license condition section of his renewal application, which is incorporated into the license by reference in Condition 9. Typical of the items for which specific conditions were thus rendered unnecessary are the emergency plan, decommissioning plan, overall gaseous radioactive release limit and requirements for Radiation Work Procedures.

The numbered license conditions (other than the nine standard items such as name, address, and possession limits, and Item 9 referred to above) are listed in the preceding section. The additional conditions arise from requirements in the regulations that call for specific authorization, and the staff's judgment that certain procedures deemed important to safety or to monitoring should be more specifically defined. The conditions are explained below.

Condition 11. This condition provides for an alternative posting arrangement (exemption to 20.203(f)(1) and (2)) which is justified by access limitation meeting 20.203(f)(3)(vi).

Condition 12. (Evaluation of refresher training effectiveness). It is intended that this condition require written testing of operators (at a maximum 2-year interval) as a measure of refresher training effectiveness. The staff considers written testing to be a worthwhile measure of training effectiveness when coupled with other measures, such as the supervisor's observation of individual worker job practices.

Condition 13, which exempts certain areas from the criticality alarm requirements, is based on the essential incredibility of accidental criticality in the identified areas.

Condition 14, concerning release of equipment and packages from the plant site, imposes requirements for such release that have become standard.