MAR 14 1985
R2-B7

SAFETY EVALUATION REPORT
BY THE
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY
RELATED TO THE
NRC SPECIAL NUCLEAR MATERIAL LICENSE RENEWAL
FOR
WESTINGHOUSE ELECTRIC CORPORATION
FUEL FABRICATION PLANT
COLUMBIA, SOUTH CAROLINA

Docket Number 70-1151
License Number SNM-1107

I-1

MAR 14 1985

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

MAR 14 1985

I. INTRODUCTION

A. General

The primary function of the Westinghouse Electric Corporation (WEC) Fuel Fabrication Plant at Columbia, South Carolina is the processing of enriched uranium fuel and the fabrication of fuel assemblies containing enriched UO_2 and other components for light water moderated power reactors. The facility, as originally licensed on September 3, 1969, authorized the processing of low-enriched uranium compounds and possession and use of sealed PuO_2-UO_2 fuel rods for use in fabricating mixed oxide fuel assemblies. The current possession limits include 50,000 kilograms of U-235 as U($\leq$4.15%), 2500 kilograms as U(<5.0 w/o U-235), 0.35 kilograms U-235 of any enrichment, 5 grams of U-233 and 750 kilograms of plutonium.

B. Location Description

The Fuel Fabrication Plant is located approximately 10 miles southeast of Columbia, SC on a semi-rural site. The site, consisting of approximately 1156 acres, is nearly level. The plant sits on a knoll about 40 feet above the Congaree River. Figure 1 shows the geographical location of the site.

The manufacturing processes are contained within the main plant. Auxiliary services such as waste treatment and chemical storage are located in facilities on the south and west sides of the manufacturing plant.

C. License History

The initial license was issued on September 3, 1969, and was renewed on May 24, 1978. The licensee filed an application for license renewal on April 30, 1983. The current license which was to expire on May 30, 1983 has remained in effect in accordance with the timely renewal provisions of the regulations.

II. AUTHORIZED ACTIVITIES (PROPOSED)

A. General Summary

The proposed activities being assessed in this safety evaluation include the conversion of uranium hexafluoride to uranium oxide by either a wet ammonium diuranate (ADU) process or an Integrated Dry Route (IDR) process, the fabrication of fuel assemblies, the treatment of scrap, and the disposal of waste materials.

B. Process Descriptions

The proposed process steps being assessed in this safety review include:

1. Conversion of enriched UF_6 to uranium oxide by the ADU process.

2. Conversion of enriched UF_6 to uranium oxide by the IDR process.

MAR 14 1985

SITE LOCATION

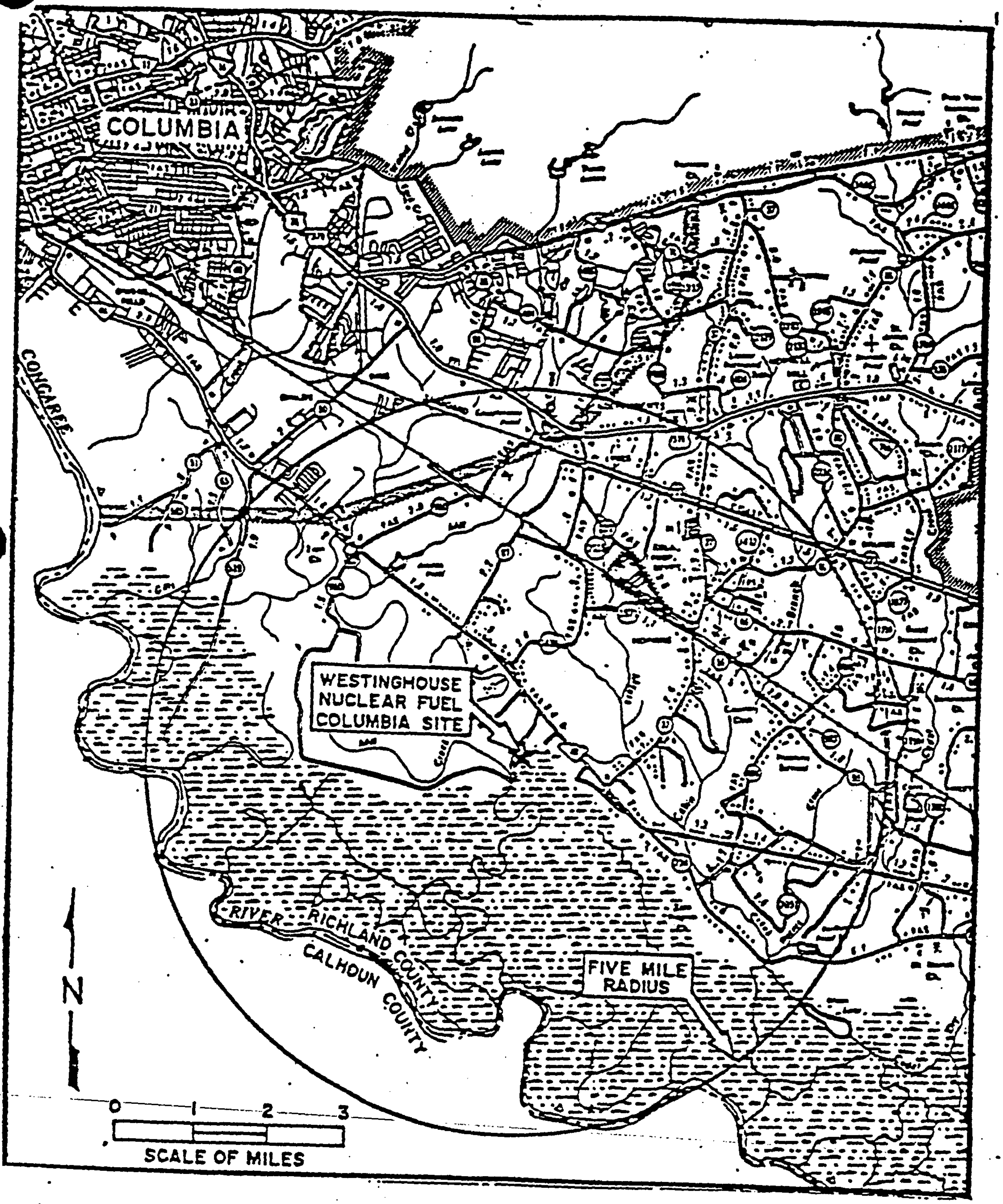


Figure 1

3. Fabrication of sintered UO_2 pellets.

4. Cladding of UO_2 pellets and assembly of fuel rods into fuel assemblies.

5. Processing of scrap uranium, including incineration, for recovery and recycle of uranium.

6. Laboratory operations.

7. Treatment of solid, liquid, and airborne waste streams for uranium recovery and disposal.

8. Offsite use of small quantities of unencapsulated uranium.

9. Offsite shipment and possession of reactor fuel assemblies.

III. POSSESSION LIMITS (PROPOSED)

The applicant has requested the following materials, forms, and quantities of special nuclear material:

Material	Form	Quantity
A. U-235	A. Any	A. 0.35 kg
B. U-235	B. Any, except metal, enriched to ≤5.0 w/o.	B. 75,000 kg
C. U-233	C. Any	C. 5 grams
D. Pu-238, Pu-239	D. Sealed Sources	D. 1.5 grams

The proposed possession limits exceed the current uranium possession limits in both quantity and enrichments but eliminate the current possession limit for plutonium in fuel rods. These limits will be included in the license as Conditions 6, 7, and 8.

IV. FACILITIES

The relative location of facilities at the Fuel Fabrication Plant are shown in Figure 2. The primary facilities under this license are:

A. Manufacturing Building

The authorized activities in this building include UF_6 conversion, pelletizing, rod loading, incineration and scrap processing in the Chemical Area, and fuel assembly fabrication and non-radioactive component fabrication in the mechanical area.

(1 pg withheld in entirety)

Ex. 2

B. Waste Facilities

Authorized activities include advanced treatment of liquid waste for recovery of trace quantities of uranium, the collection, storage and disposal of treated liquids, and the treatment and packaging of solid waste.

C. Storage Facilities

Authorized activities include the outdoor storage of UF_6 cylinders, tanks of uranyl/nitrate solution, and process chemicals. A facility is also provided for the packaging and storage of waste materials.

V. LICENSE APPLICATION

A. License Application

The safety review of the Westinghouse Electric Corporation renewal application included a revised application dated March 26, 1984. The revised application was submitted in response to the NRC staff review of the original renewal application dated April 30, 1983 and supplement dated December 12, 1983. The March 26, 1984 application was further revised on January 4, 1985.

On January 9, 1981, the licensee applied for a license amendment authorizing the operation of an Integrated Dry Route (IDR) Conversion Process. This amendment application was supplemented on December 23, 1981. On March 26, 1982, the licensee submitted a revised application which replaced the two 1981 submittals. In response to NRC questions, the licensee submitted a supplement on December 12, 1983. The revised March 1982 amendment application and the December 1983 supplement were included in the application for license renewal.

Members of the NMSS staff visited the site on several occasions. D.A. Cool accompanied a Region II Inspector on September 12-16, 1983. G.H. Bidinger accompanied the Region II Project Inspector on October 3-7, 1983. Comments on the renewal application from Region II, dated September 2, 1983 and September 19, 1984, were also considered during the review. On January 11, 1984, members of the NMSS staff and a Region II Inspector discussed the application with Westinghouse representatives. On November 27-29, 1984, the two NRC reviewers visited the site and held further discussions with the licensee.

B. Compliance History

For the period 1978-1981, 18 health and safety inspection reports were reviewed. Seventeen violations of license requirements were identified. All violations were classified as infractions or deficiencies in 1978 and 1979 and as level V or VI in 1980 and 1981. These are considered to be the least significant types of violations. However, the total number of violations is significant.

Since the start of 1982, 13 health and safety inspections identified 2 level V violations, 1 level III violation, and 1 level II violation. In this timeframe level V violations are the least significant. The level III violation concerns improper packaging of waste material which was shipped to an Agreement State licensee. The Agreement State issued a civil penalty to Westinghouse for the level II violation concerning improper packaging of waste material.

. Current Application

In the current revised application, the NRC staff has reviewed the applicant's commitments concerning organization and administration of the programs for radiation protection and nuclear criticality safety. The specific proposed commitments are in Sections 2 and 3 of the application. Proposed special authorizations and exemptions are in Section 4 of the application. Sections 2, 3, and 4 will be incorporated into the license. Section 1 of the application describes current or proposed activities at the site and demonstrates Westinghouse's administrative practices and technical capabilities.

VI. ORGANIZATION AND ADMINISTRATIVE PROCEDURES

A. Organization

1. Radiation Safety Responsibilities

The Columbia Nuclear Fuel Plant (NFP) is operated by the Nuclear Fuel Division (NFD). The Nuclear Fuel Division is a division of Nuclear Energy Systems group, a major Westinghouse operation. The NFD organization is shown in Figure 3.

The Columbia Plant Manager has overall responsibility for all NFD activities at the Columbia site.

Each line manager is responsible for safe operation of his function and facility. The first level manager, a shift supervisor, is responsible for the guidance and instruction of operating personnel. This responsibility includes assurance of availability of written manuals or procedures and assurance that all radiation protection and nuclear criticality safety procedures and controls are followed.

The Radiation Protection Component is responsible for the establishment and guidance of programs in radiation protection, nuclear criticality safety, environmental control, and emergency planning. The Component is required to be administratively independent of process supervision.

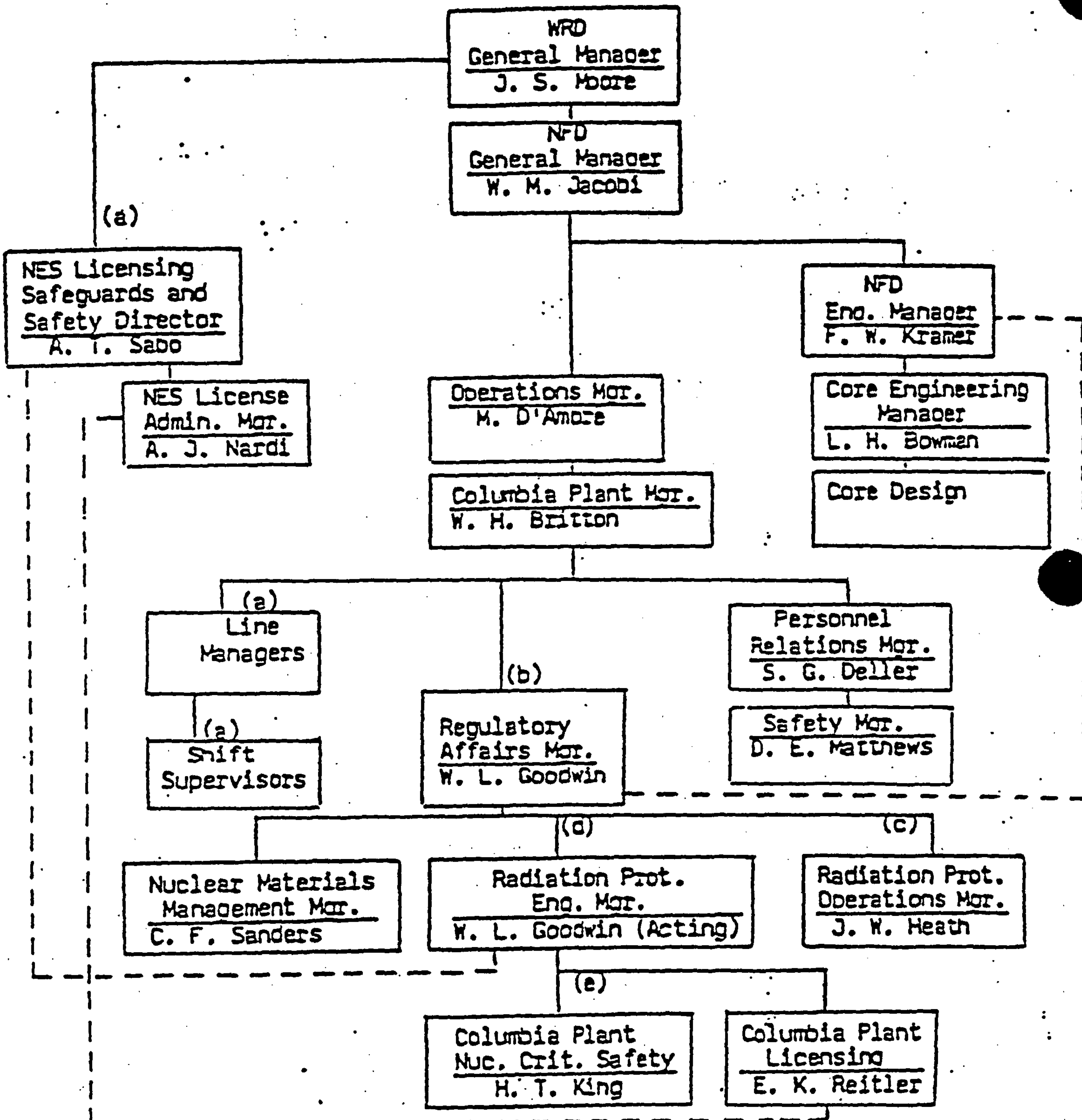
In the current NFP organization, the Regulatory Affairs Manager is responsible for the Radiation Protection Component. Activities of the Component have been assigned to two sub-component managers, the Radiation Protection Engineering Manager and the Radiation Protection Operations Manager. The Radiation Protection Engineering Manager is responsible for the establishment and implementation of programs in nuclear criticality safety, radiation protection, and environmental pollution control. The Radiation Protection Operations Manager is responsible for supervision of Radiation Protection Technicians.

The Nuclear Engineering Manager provides consultation services on nuclear criticality issues. The Nuclear Engineering Manager is responsible for the nuclear design of all pressurized water reactor fuel cores.

2. Minimum Qualifications

The applicant has specified minimum qualifications for the following positions:

WESTINGHOUSE ORGANIZATION



(a) Certain Intermediate Levels Omitted for Simplification
(b) Radiation Protection Component
(c) Radiation Protection Operations Component
(d) Radiation Protection Engineering Component
(e) Criticality Engineer

Figure 3

Plant Manager - The Plant Manager will have a bachelor's degree in science or engineering, or equivalent experience, and 5 years experience in nuclear plants or laboratories. The manager will be knowledgeable in policies and procedures at the NFD Plant.

Line Manager - A Line Manager will have a baccalaureate degree in science or engineering, or equivalent experience, and 2 years experience in nuclear plants or laboratories. The manager shall have demonstrated proficiency in the application of the radiation safety program and the nuclear criticality safety control procedures and reports to the Plant Manager through intermediate levels of management.

Manager, Radiation Protection Component - The Manager of the Radiation Protection Component will have a baccalaureate degree in science or engineering and 2 years of experience in radiation protection and nuclear criticality safety. Within the current organization, this manager is known as the Manager, Regulatory Affairs and reports to the Plant Manager.

Manager, Radiation Protection - Engineering Component - The Manager of the Engineering Component will have a baccalaureate degree in science or engineering and will have 2 years experience in assignments involving radiation protection and criticality safety including 1 year of experience in performing criticality safety analyses. Within the Columbia organization, the manager is known as the Radiation Protection Engineering Manager and reports to the Regulatory Affairs Manager.

Manager, Radiation Protection - Operations Component - The Manager of the Operations Component will have 5 years of experience in the nuclear industry, including a minimum 2 years of relevant experience in radiation protection. Within the current Columbia organization, this manager is known as the Radiation Protecton Operations Manager and reports to the Regulatory Affairs Manager.

Nuclear Criticality Safety Engineer - The engineer will have a baccalaureate degree in science or engineering and a minimum 2 years experience in engineering, including 1 year experience in nuclear criticality safety. Currently, this individual is known as a Criticality Engineer and reports to the Radiation Protection Engineering Manager.

Nuclear Criticality Safety Services - This component will provide computed neutron multiplication values for fuel assemblies and maximum permissible values and spacing requirements for other units. Individuals who perform K-eff calculations shall have at least 1 year of experience in reactivity calculations and a baccalaureate degree in engineering, physics, or chemistry.

B. Administrative Practices

1. Written Procedures

The applicant has committed to processing licensed material in accordance with approved written procedures or instructions. Line Managers will be responsible for assuring that the procedures are available to appropriate personnel. Radiation protection and criticality control procedures will be issued by the Radiation Protection Component, approved by the Plant Manager, and incorporated into operating procedures by line management.

The licensee has committed to reviewing Regulatory Affairs procedures and Health Physics operating procedures on an annual basis. Operating procedures will be reviewed as necessary to update or incorporate changes in operations.

C. Inspections and Audits

The shift supervisor, under the Line Manager, is responsible for continuous evaluation of employee compliance with operating procedures. The Radiation Protection Component staff member on duty has the authority, through the shift supervisor, to forbid any operation which appears to be hazardous until the operation is reviewed by the line management.

Radiation Protection Component personnel will make continuing inspections of nuclear criticality safety and radiation protection requirements while performing normal duties. Observed items will be reported to the shift supervisor. Repeated items will be reported by the Manager of the Radiation Protection Component for corrective action by the Line Manager.

Radiation protection and nuclear criticality safety audits of operations are performed monthly according to a written plan. A Radiation Protection Component staff member and a representative of line management will perform the audits. Violations, corrective actions, and completion dates will be reported to the Plant Manager. Audit findings are subject to trend analysis by the ALARA Committee.

Data audits will be conducted quarterly by the Radiation Protection Component staff to assure that environmental releases are within regulatory limits. Trend analysis will be conducted at least every 6 months.

D. Personnel Training

New employees assigned to licensed activities will be given training in radiation protection and nuclear criticality safety practices. Training will be provided on the risks of low level radiation exposures, 10 CFR 19 and 20 requirements, ALARA practices, and emergency responses.

Employees who work with special nuclear material will be given refresher training at least every 2 years. Written tests will be used to evaluate the effectiveness of this training program. Records of the formal training will be kept for a minimum 2-year period.

VII. RADIATION SAFETY

A. Radiation Safety Administration

1. Organization

Responsibility for radiation safety at the Columbia facility is held by the Radiation Protection Component headed by the Manager of Regulatory Affairs. To fulfill this obligation, the Radiation Protection Component establishes, conducts, and evaluates programs to ensure the protection of workers and the environment.

The specific responsibilities of the Radiation Protection Component dealing with radiation protection include:

a. Review and approval of radiation protection aspects of changes to equipment and operations associated with the processing, handling, or storage of SNM.
b. Training and monitoring of training effectiveness.
c. Inspection and documentation of installed equipment for conformance with radiation protection requirements.
d. Audits and routine surveillance of activities for compliance with regulations, conditions, and the ALARA philosophy.
e. Review, approval, and maintenance of radiation protection procedures.

The positions within the Radiation Protection Component are presently occupied by individuals who exceed the basic qualifications. The minimum technical qualifications provide assurance that any individual chosen to fill these positions will have an adequate background and experience to effectively administer the radiation protection program.

2. ALARA Commitment

The ultimate responsibility for maintaining exposures As Low As Reasonably Achievable (ALARA) is vested with the production line management, with assistance from upper management and various service groups. ALARA policies, goals, and expectations are provided by the Regulatory Compliance Committee with specific ALARA recommendations and requirements generated by the Radiation Protection Component.

A review of all activities related to radiation safety is conducted semi-annually by the Regulatory Compliance Committee. The ALARA review includes analysis of audits and inspections made by the Regulatory Compliance Committee and the Engineering Section of the Radiation Protection Component, personnel exposure data, bioassay results, unusual occurrences, airborne radioactivity levels, effluent releases, and environmental monitoring. At the completion of this review, the Regulatory Compliance Committee determines:

a. If there are any upward trends developing in personnel exposures for identifiable categories of workers or types of operations, effluents or concentrations of effluents in environmental samples.
b. If exposures and effluents might be lowered in accordance with the ALARA concept.
c. If equipment for effluent and exposure control is being properly used, maintained and inspected.

The results of this review are documented in a formal report made to the Plant Manager, along with any recommendations for corrective action.

A discussion of the effects of the ALARA effort for each type of exposure at the plant is presented in Chapter VII.B.

3. Radiation Work Permits

The licensee has committed to a Radiation Work Permit (RWP) program governed by approved procedures which include approval of the RWP by the Radiation Protection Component prior to the start of the activity, specification of the requirements for the task, and monitoring of the task. A RWP is required when radiation protection requirements are not covered by operating procedures and one or more of the following conditions are met:

a. The concentration of radioactive contaminants is likely to be elevated 25 percent of MPC (locally) by the work under consideration.
b. Release of contamination outside of Contamination Controlled Areas is likely to result in contamination exceeding 220 dpm per 100 cm^2 for personnel or 50 dpm per 100 cm^2 to the environs.
c. The external whole body dose is likely to exceed 100 mrem in a week by the work under consideration.
d. The external dose is likely to exceed 75 percent of the applicable quarterly limit by the work under consideration.

These requirements are similar to those given in Condition 20 of the previous license and provide for RWPs when an operation not covered by procedure presents a potential for exposure or contamination.

B. Systems of Exposure Controls and Exposure Levels Experienced

1. Exposure Controls

Processing activities with low-enriched uranium present the potential for both external and internal exposures to radiation. Exposures are controlled through a system of monitoring and protective activities which include the following:

a. External exposure monitoring including whole body and skin dose measurements.
b. Ventilation systems designed to provide containment for radioactive materials and limit the airborne concentrations for occupied areas.
c. Air sampling programs to monitor the airborne concentration of radioactive materials in working areas and to predict the intake of radioactive materials into the body.
d. A bioassay program to monitor the accumulation and distribution of radioactivity in the body.
e. Protective equipment including clothing and shoes to limit contamination of the skin and respiratory protection to limit the inhalation of radioactivity.
f. Access control to prevent unauthorized entrance to areas where radioactive materials are present and to prevent the spread of contamination from areas in which uncontained uranium is handled.
g. Contamination control including surveys, action levels for investigation and decontamination, and release criteria for materials and equipment.

The exposure data and ALARA reports from 1978 to present were reviewed to assess the actions taken in each of these areas to reduce exposures. In keeping with the ALARA commitment, this information indicates that exposures have been steadily declining for the last several years. The following

subsections of this report will describe each of these areas with respect to the program requirements and the actual exposure history of the Columbia facility during the past license period.

2. External Exposure

External radiation exposure is monitored in accordance with the requirements of 10 CFR Part 20.202 using data from thermoluminescent dosimeters (TLD). TLD's are evaluated quarterly for men and monthly for women. The results of this monitoring for the pellet processing area are shown in Figure 4. The exposures in other areas of the facility are similar. These data indicate that actual exposures have averaged less than 20 percent of the quarterly whole body limit of 1250 mrem, and that since 1978, exposure levels have decreased steadily.

Figure 5 presents a summary of skin doses for the pellet area during the last 6 years. Due to the low penetrating power of the radiation, skin dose, especially that occurring on the extremities such as the hand, is a concern when dealing with uncontained uranium. During the last 4 years, skin doses for the pellet area have averaged less than 10 percent of the quarterly limit. Skin doses in other areas of the facility are generally less than those in the pellet area.

In addition to TLD's, neutron monitoring is provided for some employees. All individuals entering areas which have criticality monitors are provided with criticality monitoring badges. This system would allow the rapid determination of doses to each individual in the event of an accidental criticality.

3. Ventilation Systems

Ventilation equipment is designed and operated to move air from uncontaminated to contaminated regions of the facility. This is accomplished by exhausting air from the contamination control area, creating a slight negative pressure in this area with respect to the remainder of the facility. Within the contamination control area, additional ventilation equipment provides recirculating filtration of the working atmosphere.

Local containment of radioactive material is provided through enclosures and hoods located at work stations. Some of the processing equipment is completely enclosed in a primary containment structure. Air moving systems which service primary containments, production hoods, etc., are designed and operated to maintain at least 100 linear feet per minute into all openings.

Air from ventilation systems employed for radiation protection purposes is subjected to HEPA filtration prior to release to the work area or the environment. HEPA filters are replaced on a routine schedule or when airborne radioactivity, air flow velocities, or filter differential pressure indicates the need for more frequent replacement. The maximum differential pressure for HEPA filters is 8 inches of water for negative pressure systems, and 4 inches of water for recirculating, positive pressure systems. The proper operation of these filter systems is determined by inplace DOP testing of final HEPA filters and by monthly testing of all recirculating systems by either DOP testing or air sampling.

MAR 14 1985

AVERAGE QUARTERLY WHOLE BODY DOSE
PELLET AREA - 1977 to 1983

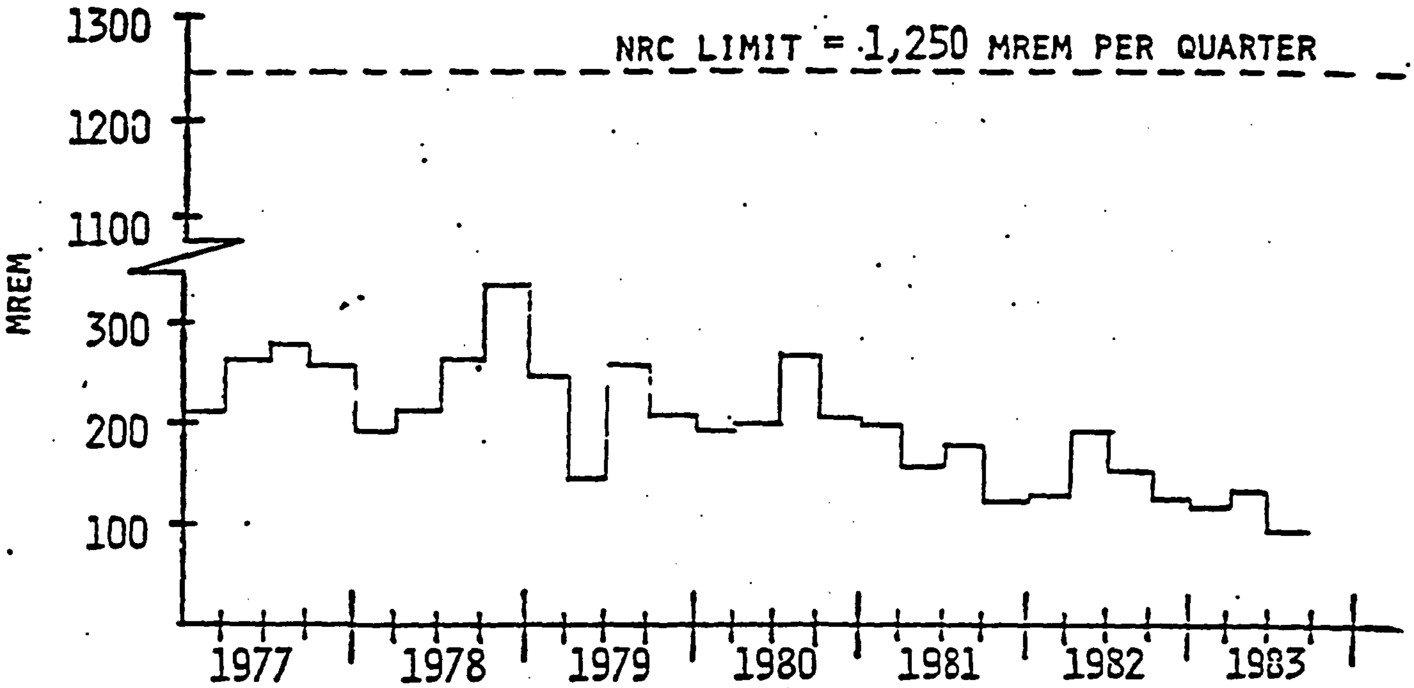


Figure 4

AVERAGE QUARTERLY SKIN DOSE
PELLET AREA - 1977 to 1983

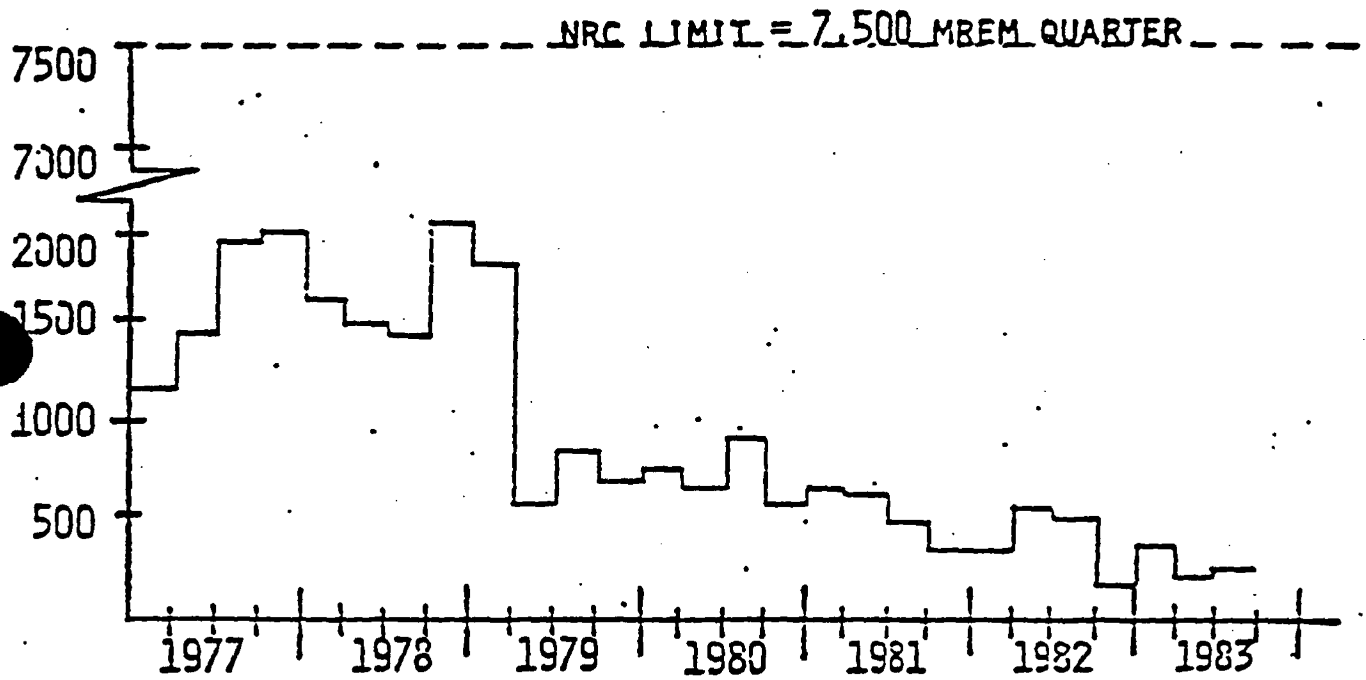


Figure 5

4. Air Sampling

The purpose of air sampling at the Columbia facility is twofold. The first objective is to monitor the working atmosphere and detect any material releases which might occur. The second objective is to demonstrate compliance with the requirements of 10 CFR Part 20.103 for exposure of personnel to airborne radioactivity. To fulfill these two objectives, air samplers must be located at the point where a worker is likely to inhale radioactivity, i.e., individual work stations where uncontained materials are handled. It is important that the air samples be representative with respect to the actual inhalation potential for an individual located at the work station. Additional samples are also taken to assess the radioactivity in the general working environment and to monitor nonroutine operations which are not adequately covered by the permanent sampling program.

Airborne radioactivity areas are established in accordance with 10 CFR Part 20.203 and are continuously sampled by permanently mounted air samplers.

Sample filters are changed and analyzed each shift (approximately every 8 hours). If excessive dust loading is observed, the filters are changed and analyzed immediately. Additional air sampling for nonroutine operations is provided by portable air samplers and impingers.

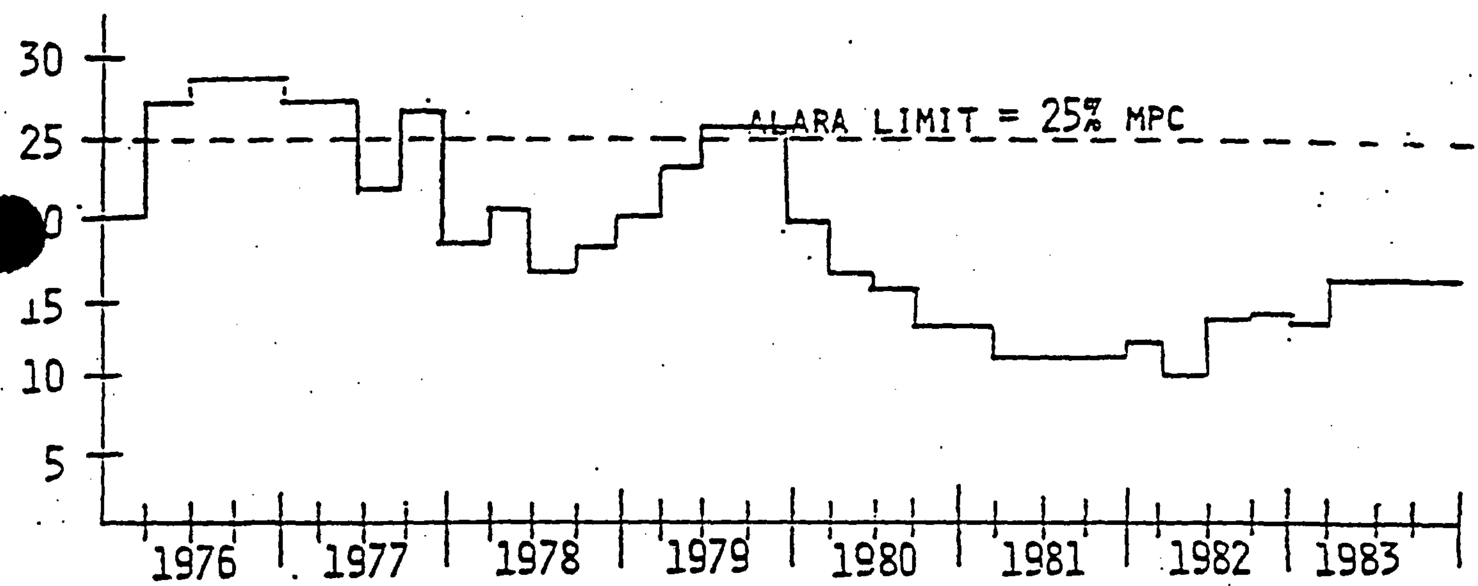
The results of the air sampling program for the Conversion and Pellet Areas are shown in Figures 6 and 7 respectively. These data indicate that the averag area air concentrations decreased during the time period between 1976 and 1982. However, during 1983, there was a rise in air concentrations. This rise corresponds to the same time period during which there was an increase in production at the facility. The licensee has indicated that further efforts are underway to reduce airborne concentrations as part of the ongoing ALARA program, including improved containment for the new IDR conversion lines.

WEC has indicated that permanently mounted air samplers are located "where potential airborne concentrations are deemed to exist as determined by the Radiation Protection Component." In addition, Section 2.2.6.1 provides a commitment to operating air sampling equipment at routinely occupied work stations whenever work is in progress. These commitments provide for an air sampling program which will monitor the general airborne contamination levels within the plant, and monitor individual's exposure through sampling at the locations where work is being conducted. This system is considered to be sufficient to meet the requirements of 10 CFR 20.103(a)(3) for suitable measurements of concentrations of radioactive materials in air.

Section 2.2.6.3 of the license renewal application provides that air sampling representativeness of existing fixed samplers shall be performed every 2 years for those samplers averaging less than 10 percent of MPC (provided that the samples are not required for exposure evaluations), annually for all other fixed samplers, and following substantive equipment or ventilation changes. Under this system, the licensee is required to annually evaluate the representativeness of all air samplers which are used to calculate worker exposures. The 2-year time period would apply only to those samplers which monitor the general working atmosphere and which average less than 10 percent MPC. The representativeness of new equipment or processes will be evaluated on an annual basis for at least 2 years irrespective of the average MPC measured.

MAR 14 1985

AVERAGE QUARTERLY AIR CONCENTRATIONS
CONVERSION AREA - 1976 to 1983



MAR 14 1985

AVERAGE QUARTERLY AIR CONCENTRATIONS
PELLET AREA - 1976 to 1983

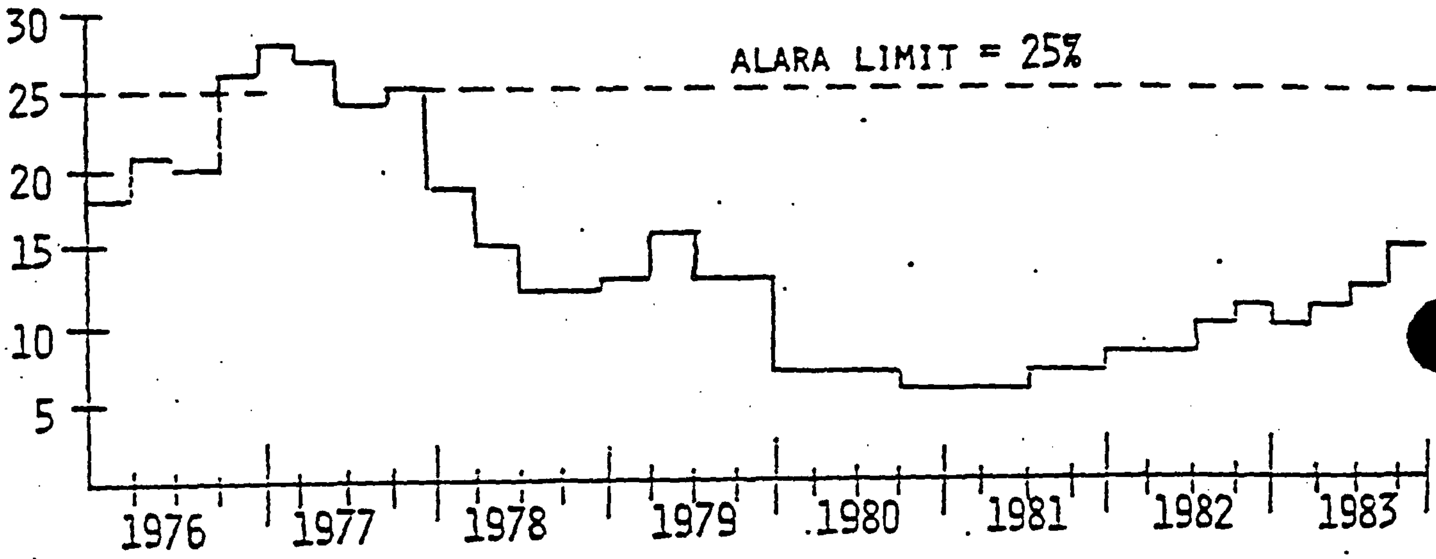


Figure 7

In some situations, no substantive equipment, ventilation, or operational changes will have occurred during the annual time period between representativeness evaluations. In these situations, the requirement for an evaluation of representativeness through appropriate air sampling techniques may be waived provided that an engineering evaluation has demonstrated that no changes have occurred. Thus, the representativeness of all samplers will be examined at the prescribed intervals, although actual additional air sampling may not be performed. Such an approach is considered appropriate by the staff since it maintains the requirement for an evaluation of the conditions to which workers are exposed and the validity of the measurements being performed.

5. Bioassay

The internal deposition and retention of uranium materials is determined through a bioassay program which includes both urinalysis and in vivo lung counting. The purposes of this program are primarily for preparatory evaluation of workers prior to employment, exposure evaluation with respect to trends in body burden, and for diagnostic purposes in cases of known or suspected exposure.

The bioassay program at the Columbia facility is not designed to demonstrate compliance with the internal exposure limitations of 10 CFR Part 20.103.

Urine sampling frequencies are based upon those given in NRC Regulatory Guide 8.11 and depend upon the quarterly average of airborne uranium. Currently, the frequency of analysis is monthly for workers in areas where transportable (inhalation class D) materials are handled. The minimum detection level for uranium in urine at the Columbia facility is approximately 2 ug U/L. Urinalysis results for 1977 through 1983 are presented in Figure 8 for the Conversion Area of the facility. The Conversion Area is the primary area in which transportable uranium materials are handled, and consequently, exposures to transportable materials in this area are greater than for other areas of the plant. These results indicate that workers in the Conversion Area have averaged approximately 7 to 8 ug U/L during the last several years, and that exposures generally decreased during the period of the last renewal.

In vivo lung counting is also used for bioassay analysis to determine the quantity of uranium present in the lung. Count times are usually 20 minutes in length, giving a minimum detection level of approximately 80 ug of ^{235}U. In vivo counting frequencies are based upon the potential for inhalation exposure using NRC Regulatory Guide 8.11 and are currently performed quarterly. Figure 9 presents the lung count data for workers in the Pellet Area of the plant. Exposure levels in other areas are generally lower than those shown in Figure 9. These data indicate that lung burdens have generally been below the minimum detection level and that lung burdens have been decreasing during the last several years.

Westinghouse has committed to action levels and actions as given in Tables 3.2.4.1 and 3.2.4.2 of the application for urinalysis and in vivo counting. These levels provide for confirmation, investigation, and work restrictions depending upon the measured levels.

MAR 14 1985

AVERAGE QUARTERLY URINALYSIS RESULTS
CONVERSION AREA - 1977 to 1983 .

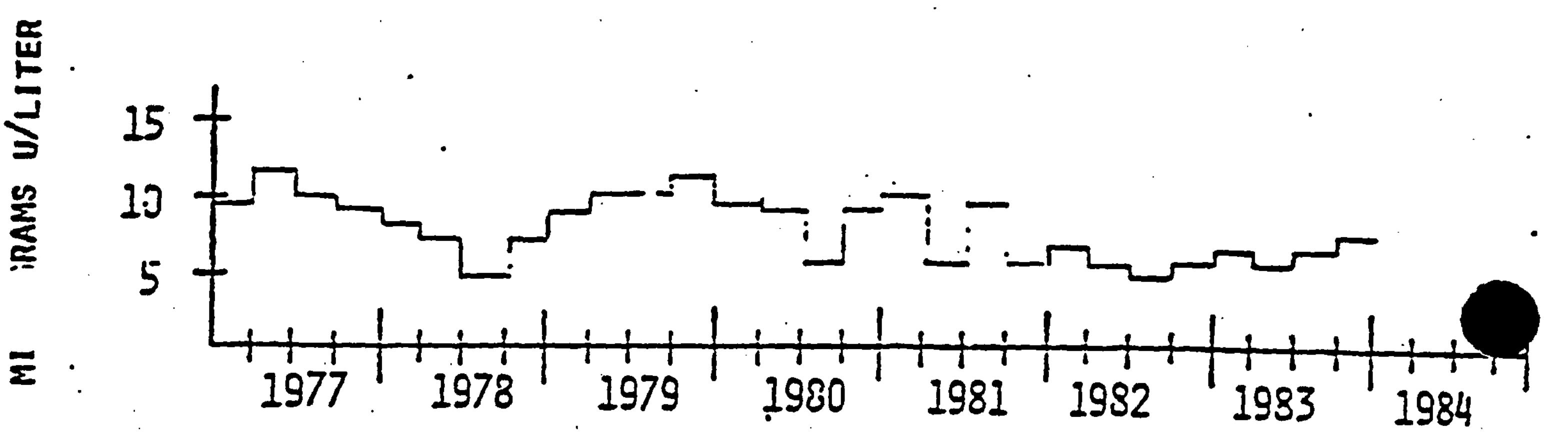


Figure 8

MAR 14 1985

AVERAGE QUARTERLY IN VIVO LUNG BURDEN
PELLET AREA - 1977 to 1983

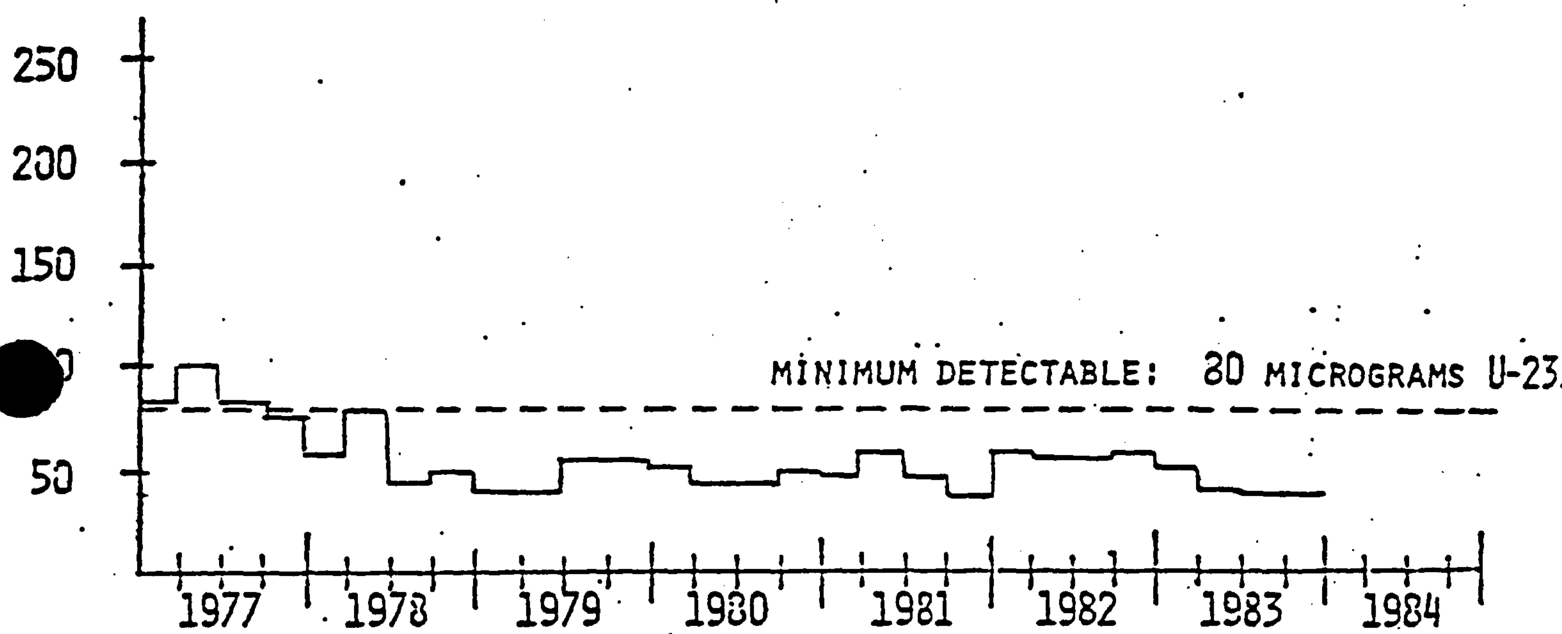


Figure 9

6. Protective Equipment

Protective clothing in the form of coveralls, lab coats, shoe covers, safety shoes, hardhats, eye shields, etc., is required for personnel entering the manufacturing areas consistent with the work assignment and area. Protective clothing such as coveralls and shoe covers, which prevent contamination of the worker, is required for all personnel entering the Controlled Area.

Respiratory protection in the form of full-face respirators and supplied air masks is provided for personnel dealing with activities in which airborne concentrations of uranium may be excessive such as nonroutine operations, maintenance, and waste handling. The respiratory protection program includes training of the workers, individualized fitting and checks, and a facility to clean and refurbish used respirators. The conditions under which respiratory protection devices may be used for credit in determining exposures are given in 10 CFR Part 20.103. These conditions include protection factors and respirator testing requirements and are incorporated into the license through the general requirement for compliance with 10 CFR Part 20.

7. Access Control

Areas which are used to process uncontained uranium are designated as "Controlled Areas" within the larger confines of the plant restricted area. Access points to the Controlled Area are provided with stepoff pads and change rooms to prevent the spread of contamination. The stepoff pad provides the boundary between uncontaminated and potentially contaminated areas. Survey instruments are located at each access point, and all personnel exiting these areas must be surveyed. Instructions are posted which describe the survey techniques and procedures for decontamination and instrument operation checks.

All access points to the Controlled Access Area are posted in compliance with the requirements of 10 CFR Part 20.203 with the exception of §20.203(f). Due to the large variety and number of containers present, a sign bearing the legend "Every container or vessel in this area may contain radioactive material" is posted at all access points in place of "radioactive material" labeling on each container. In spite of this, almost all containers are labeled with enrichment and activity or quantity data for material accounting purposes. Process equipment and vessels are not individually labeled.

8. Contamination Control

The NFD facilities are divided into three types of areas for the purpose of contamination control. In order of increasing allowable surface activity, these are the "Clean Area", "Limited Area", and "Controlled Area". Table 3.2.5.1 of the application summarizes these areas in terms of removable activity and minimum survey frequency. Contamination on process equipment is not included in these survey requirements. These frequencies and action levels are consistent with the guidance in Regulatory Guide 8.24.

Cleanup of contaminated areas is required within three working shifts when the average contamination level in the area exceeds the appropriate action level. Immediate decontamination is required if the average contamination level is greater than five times the appropriate action level. The area for determining the average contamination level will be a maximum 10 m^2. When action levels

are exceeded, further sampling to determine the extent of the contamination is required and is considered to be appropriate to prevent the spread of contamination and the overexposure of personnel. Operating procedures used at the facility provide for survey frequencies in excess of those committed to in the license application.

Release of materials and equipment for unrestricted use is requested in Section 4.1 of the renewal application and is addressed in Section XIII of this report.

C. Effluent Control

1. Air Effluent

All potentially contaminated air removed from the facility is passed through HEPA filtration prior to release. Some gaseous streams, such as from the incinerator and scrap recovery solvent extraction system, are also subjected to other methods of cleaning, such as wet scrubbers and disentrainment chambers, in addition to final HEPA filters. Gaseous effluents are sampled continuously for radioactivity and chemical contaminants such as fluoride and ammonia.

2. Liquid Effluent

Liquid wastes consist of two types: sanitary wastewater and industrial wastewater. The raw waste streams are monitored for radioactivity before leaving the plant area. Release from process areas is made on a batch basis from quarantine tanks. Liquids with a uranium activity greater than 30 pCi/ml are recycled for further uranium removal. Once discharged from the plant, liquids are further processed by the Advanced Wastewater Treatment Process to reduce uranium concentrations to less than 1 ppm. At the present level of operations, approximately 97 mCi of alpha activity and 45 mCi of beta activity are released each year. The concentration of alpha and beta activity is approximately 0.64 and 0.31 pCi/ml respectively, which constitutes 2.2 and 0.9 percent of the MPC given in 10 CFR Part 20 Appendix B.

Chemical contaminants present in the liquid waste are removed through precipitation of fluorides with lime, distillation of ammonia, and settling of the solids in holding lagoons. Following treatment, liquid wastes are discharged by pumping them to the Congaree River.

3. Solid Effluents

Solid wastes are segregated on the basis of contamination. The contaminated wastes are then further segregated in combustible and non-combustible categories. After the uranium content is determined, combustible contaminated materials are incinerated. Non-combustible contaminated materials are disposed of by shipment to the Chem-Nuclear Barnwell burial facility. Materials to be shipped for disposal are packaged for transport in accordance with 10 CFR Part 71 and the appropriate Department of Transportation criteria. These wastes are stored on a covered pad adjacent to the plant building until transported.

Solid chemical waste products, primarily calcium fluoride, are produced in which the concentration of uranium is less than 30 pCi/g. This concentration of enriched uranium for homogenous mixtures of material falls within the criteria established in the NRC Uranium Fuel Licensing Branch Technical Position for "Disposal or Onsite Storage of Thorium or Uranium From Past Operations." Since the concentration of uranium meets the staff criteria for unrestricted disposal, these materials may be disposed of as requested by WEC in Section 4.5 of the application. WEC has committed to the maintenance of records regarding these wastes and their disposition.

D. Conclusions

Upon completion of the radiation safety review of the licensee's renewal application and compliance history, the staff has concluded that Westinghouse Electric Corporation has provided the necessary technical staff and radiological safety program to ensure the health and safety of employees and the environment. The conditions described above were developed by the staff to clarify certain NRC requirements and further ensure radiological safety at the Columbia facility.

VIII. NUCLEAR CRITICALITY SAFETY

A. Administrative Requirements

Plant policies and procedures are maintained in the Regulatory Affairs Procedures Manual. All modifications of processes, equipment, or facilities will be approved by the Radiation Protection Component prior to initiation of the proposed modification. The modification will be reviewed and approved by the Manager of the Radiation Protection Component or the Nuclear Criticality Safety Engineer.

If an error in an analysis of a proposed modification would violate the double contingency principle, as defined in Subparagraph 2.3.1.2 of the application, the Manager of Radiation Protection Engineering or his designee will require an independent review by a senior member of the Component as defined in Subparagraph 3.3.7 of the application. In addition, this individual will have 2 years of directly relevant nuclear criticality safety experience.

The applicant has established administrative control requirements for transfers of uranium oxide from geometrically favorable containers to moderation control containers, for handling uranium of unknown enrichment, for assuring mechanical integrity of equipment, and for controlling moderating materials in moderation control equipment and material.

Criticality safety analyses will include a floor plan to show spacing of process equipment and fixed storage locations. This is done to record spacing requirements to control and limit neutron interaction. Storage of enriched uranium will be subject to posting of limits, designated locations specified by floor markings or devices, and/or physical restraints for individual or stacked containers.

B. Technical Requirements

The applicant has established tables for Maximum Permissible Values (MPV) for mass and geometry controlled units. These MPV were derived by applying safety factors to critical mass data for optimum moderated and full water reflected units. The MPV have been established for aqueous uranium solutions, homogeneous uranium oxide-water mixtures, and heterogeneous uranium oxide-water mixtures.

The applicant also proposes to use computer codes to calculate subcritical units. The computer codes are or will be validated in accordance with ANSI/ANS 8.1-1983 requirements. The k-effective value, plus bias from the validation requirement, plus 2 sigma will not exceed 0.95.

Other units will be established subject to concentration control (less than 5g U-235 per liter for liquids), to moderation control (H/U ≤ 0.5 for U(≤ 4) and H/U ≤ 0.3 for U(≤ 5)), and by use of fixed poisons. The fixed poisons include Raschig rings used in accordance with requirements in ANSI/ANS 8.5-1979, except for specified exceptions, and other fixed poisons in non-liquid applications. Fuel elements will also be considered as subunits and will have calculated k-effectives of ≤ 0.95.

Criteria to limit neutron interaction between units has been established in the application. The applicant has provided criteria for a surface density method, with limits for the maximum individual unit size and the minimum areas so that the effective surface density of the unit does not exceed a specified value. Criteria also has been provided to use the solid angle method in TID-7016, Rev. 2, and the KENO Monte Carlo code.

Moderation control and concentration control units will not be considered in the interaction analyses provided such units are outside the surface density areas assigned to interacting units.

The applicant has also established criteria for moderation control areas. Unnecessary moderating materials will be eliminated from such areas. Necessary moderating materials will be minimized and will be authorized on a case-by-case situation. Moderator additions to process materials will be done on a batch basis so that large additions of moderator are unlikely.

Fire-resistant or noncombustible materials will be used for building components and equipment. Combustible wastes will be stored in closed metal containers. Fire extinguishers will be available for fire fighting.

Containers of uranium compounds will be sampled, sealed, and analysed for moisture before being moved into a moderation control area. A second individual will review documentation before moving a "dry" geometry-control container into the moderation control area and transferring the material to a moderation control container. Moderation control containers will be closed except when transfers are being made into or out of the moderation control containers.

One type of moderation control container, i.e., a bulk container, will be used for transport from the moderation control area to the process area. During transport, the container will be enclosed inside a barrier to protect against transport accidents, e.g., puncture. The bulk container will be inside another

water barrier before being connected to process equipment to preclude the accidental introduction of moderating materials. The bulk containers are designed, fabricated, and tested in accordance with requirements for DOT Specification 56 portable tanks. Closure devices are inspected for integrity prior to each closure.

The applicant has used previously established criteria for moderation control for a new Integrated Dry Route (IDR) UF_6 to UO_2 conversion process. The IDR process will be inside a moderation control area.

C. Demonstration of Nuclear Criticality Safety

In Section 1.8, the applicant presented bases for MPV which are presented as proposed license conditions in Section 2. The bases are presented for optimumly-moderated uranium solutions, uranium oxide-water mixtures, and heterogeneous uranium oxide-water mixtures, and for "dry" moderation control units.

The applicant provided historical information on Raschig ring performance to justify exceptions to requirements in the ANSI/ANS-8.5-1979 standard for use of rings for secondary control. When rings are used for primary control, the ANSI requirements will be satisfied.

Neutron interaction of units will be controlled by the surface density method, the solid angle method, or the KENO-IV Monte Carlo code. For the surface density method, geometry control and mass control units will be limited to a "fraction critical" of $\leq$0.3 and spacing such that the "surface density" will be $\leq$0.25 of the reflected critical slab thickness of the same material. The criteria for using the surface density method, the solid angle method, and validated KENO or equivalent calculations are adequate.

The applicant provided an example of validation of computer codes which were then used to calculate critical parameters for trays of close packed and undermoderated fuel rods. The same codes can be used to calculate k-effective for fuel assemblies. Assemblies are limited so that k-effective will not exceed 0.95.

The demonstration of process safety using the above criteria for the ADU conversion process, the UO_2 powder processing, the fuel assembly fabrication bulk handling of UO_2 scrap recovery, incineration, laboratory operations, and waste treatment is provided in Section 1.9. The safety demonstration for the new Manufacturing Automation Project (MAP) which includes the IDR UF_6 conversion process is also included. The IDR conversion process uses four vaporizers, two kiln systems, and three blenders.

UF_6 cylinders are heated to processing temperatures by spraying hot water on a cylinder inside a vaporizer chest. The hot water reservoir inside the chest is maintained at a safe slab thickness for UO_2F_2. Water from this chest is normally pumped to the liquid effluent treatment system for disposal. In the event of a UF_6 leak, a conductivity cell in the vaporizer would detect the contamination and would divert the water to a safe sump. Emergency cooling of the UF_6 cylinder would be accomplished by automatically terminating the hot water spray and manually initiating a chilled water spray.

The conversion kilns and blenders are located inside moderation control barriers. Each kiln system consists of a slab-shaped changer where the vaporized UF_6 and superheated steam are contacted. The resultant UO_2F_2 falls to the bottom of the chamber where a scroll moves the material into a rotating kiln. Hydrogen and steam are introduced into the product end of the kiln so that, by counter-current flow, fluorides are stripped from the material which is converted into uranium oxide. The excess steam and hydrogen fluoride (HF) are removed through filters on top of the conversion changer. After filtration, the HF is condensed and is stored in slab tanks. The HF is available for reuse if free of uranium contamination or is neutralized to recover the uranium.

The conversion kiln systems are highly instrumented to ensure nuclear criticality safety by moderation control. Instruments monitor flow, pressure, and temperature. Upset conditions will result in shutdown of a system by automatic closure of control and safety valves which are installed in series in the UF_6, steam, and H_2 lines.

Product UO_2 from the kilns is discharged continuously into a check hopper where the UO_2 is sampled for moisture. Acceptable "dry" powder is transferred to one of three bulk blenders or to moderation control containers. Unacceptable UO_2 is transferred to geometry control containers for transfer to uranium recovery.

The bulk blenders are used to homogenize the "dry" UO_2 powder, to blend "dry" U_3O_8 from scrap recovery with the UO_2, and to add porosity control material. The rate of addition and quantity of hydrogeneous porosity control material is carefully controlled to ensure that moderation control is maintained in each bulk blender. Prior to use the applicant will analyze the porosity control additive to ensure proper identification of the material. The additive will be stored outside the moderator barrier and will be batched into the blender area. The blenders are interlocked so that only one additive batch can be charged to the blender before the blender is completely emptied.

The blended powder may be pneumatically transferred to pellet line feed hoppers or transferred to moderation control containers for storage within the moderation control barrier. The process operations and nuclear safety controls for pelletizing and fuel rod fabrication are identical, with one exception, to existing processes and control. The exception is a vibratory mixer for addition of a die lubricant. The applicant used a KENO calculation to show that the mixer would be safely subcritical with optimum moderation and reflection.

D. <u>Staff Conclusion</u>

The staff has concluded that the proposed controls are adequate. This is based on:

1. The history of safe operations using essentially the same nuclear safety controls of the Columbia plant and for the IDR process, the BNFL plant.

2. The demonstrated qualifications of the Criticality Staff Component.

3. The proposed license conditions which are not significantly changed from current conditions.

4. The safety analyses which demonstrate sufficient, valid applications of the proposed administrative and technical requirements.

IX. ENVIRONMENTAL MONITORING

The applicant has an environmental monitoring program which starts with conduit monitoring of liquid and airborne effluents. This program also includes ambient air, groundwater, surface water, vegetation, and soil sampling. Surface water samples are collected offsite in the Congaree River.

The adequacy of this program is being evaluated and will be reported in the "Environmental Assessment for Renewal of Special Nuclear Material License No. SNM-1107" for the Nuclear Fuel Division's Fuel Fabrication Plant, Westinghouse Electric Company, Columbia, SC.

X. RADIOLOGICAL CONTINGENCY PLAN

The applicant has committed to maintain a Site Emergency Plan which satisfies 10 CFR 70 and NUREG-0762. The licensee will implement, maintain, and execute the response measures of his Radiological Contingency Plan, submitted to the Commission on September 30, 1981, and supplemented on July 20, 1983, February 24, June 1, July 24, and September 11, 1984. The licensee will also maintain implementing procedures for his Radiological Contingency Plan as necessary to implement the Plan. This Radiological Contingency Plan and associated implementing procedures supersede the emergency planning requirements of 10 CFR 70.22(i) as they refer to onsite planning and notification procedures. The licensee will make no change in his Radiological Contingency Plan that would decrease the response effectiveness of the Plan without prior Commission approval as evidenced by a license amendment. The licensee may make changes to his Radiological Contingency Plan without prior Commission approval if the changes do not decrease the response effectiveness of the Plan. The licensee will maintain records of changes that are made to the Plan without prior approval for a period of 2 years from the date of the change and shall furnish the Chief, Uranium Fuel Licensing Branch, Division of Fuel Cycle and Material Safety, NMSS, U.S. Nuclear Regulatory Commission, Washington, DC 20555, and the appropriate NRC Regional Office specified in Appendix D of 10 CFR Part 20, a report of each change within 6 months after the change is made.

XI. FIRE SAFETY

The main facility was designed in accordance with the Southern Building Code. The building consists of concrete floors, concrete side panels over steel framework, and a builtup roof (steel decking, insulation, asphalt and gravel). The fire protection system meets the code except that certain areas do not have sprinklers installed to satisfy nuclear criticality safety requirements. The facility is insured by American Nuclear Insurers. An inspection report, dated September 21, 1983, recommended improvements in the fire safety program.

XII. PLANT DECOMMISSIONING

At the end of plant life, the licensee has made a commitment to decontaminate the facility and grounds in accordance with the general decommissioning plan submitted in the enclosure to the letter dated April 29, 1983 so that the

facilities and grounds can be released for unrestricted use. The financial decommissioning plan submitted by letter dated April 26, 1978, is incorporated as a condition of the license.

XIII. EXEMPTIONS AND SPECIAL AUTHORIZATIONS

In Chapter 4 of the application, the licensee requested several exemptions and special authorizations, as follows:

4.1 The applicant has requested authorization to remove equipment and materials from contamination controlled areas for unrestricted uses in accordance with the "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Byproduct, Source, or Special Nuclear Material," July 1982. The staff recommends approval of this request.

4.2 The license requests authorization to use up to 15 grams U-235 for demonstration and testing at offsite locations in the United States, except in Agreement States. The material would be under the control of a Westinghouse employee except during transport. The staff recommends authorizing this activity.

4.3 Records with specified maximum contamination limits may be removed from the facility without special controls. The staff recommends approval of this activity.

4.4 The applicant requests exemption from the requirements of 10 CFR 70.24 for specified areas containing not more than 700 g U-235, for specified areas for packages containing less then 350 g U-235, and for storage areas for shipping containers. The staff recommends approval of this exemption.

4.5 Industrial wastes, such as calcium fluoride, contaminated with not more than 30 picocuries uranium per gram of material, would be released to a chemical disposal site or a landfill without NRC control. The staff recommends approval of this request.

4.6 The licensee requests authorization to possess finished fuel assemblies at reactor sites for the purpose of loading the assemblies into shipping containers and delivery of such containers to a carrier. The staff recommends approval of this activity.

The NRC staff recommends the following license condition to authorize specific exemptions and special authorizations requested by the applicant:

> The licensee is hereby granted the exemptions and special authorizations in Sections 4.1 through 4.6, Chapter 4 of the application.

XIV. CONCLUSION

Upon completion of the safety review of the licensee's application and compliance history, the staff has concluded that the activites authorized by the issuance of a renewal license to Westinghouse 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).

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The staff has discussed the renewal and the proposed license conditions with the Region II Project Inspector and his supervisor. Region II has no objection to the issuance of the renewal.

The staff, therefore, recommends that the Westinghouse license be renewed to revise it in its entirety, in accordance with the statements, representations and conditions in the revised application dated March 26, 1984 subject to the following additional conditions:

9. Authorized Use: For use in accordance with statements, representations, and conditions contained in Chapters 2, 3, and 4 of the application dated March 26, 1984, and supplement dated January 4, 1985.

10. Authorized Place of Use: The licensee's existing facilities at Columbia, South Carolina.

11. The licensee is hereby granted the exemptions and special authorizations in Section 4.1 through 4.6, Chapter 4 of the application.

DONALD A. COOL

D. A. Cool
Radiation Safety

Original signed by
George H. Bidinger

G. H. Bidinger
Project Manager

Original Signed By:
W. T. Crow

Approved by:

W. T. Crow
Section Leader