NUREG-1198

Release of UF_6 From a Ruptured Model 48Y Cylinder at Sequoyah Fuels Corporation Facility: Lessons-Learned Report

U.S. Nuclear Regulatory Commission

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Lessons-Learned Group

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ABSTRACT

The uranium hexafluoride (UF_6) release of January 4, 1986, at the Sequoyah Fuels Corporation facility has been reviewed by a NRC Lessons-Learned Group. A Model 48Y cylinder containing UF_6 ruptured upon being heated after it was grossly overfilled. The UF_6 released upon rupture of the cylinder reacted with airborne moisture to produce hydrofluoric acid (HF) and uranyl fluoride (UO_2F_2). One individual died from exposure to airborne HF and several others were injured. There were no significant immediate effects from exposure to uranyl fluoride.

This report of the Lessons-Learned Group presents discussions and recommendations on the process, operation and design of the facility, as well as on the responses of the licensee, NRC, and other local, state and federal agencies to the incident. It also provides recommendations in the areas of NRC licensing and inspection of fuel facility and certain other NMSS licensees. The implementation of some recommendations will depend on decisions to be made regarding the scope of NRC responsibilities with respect to those aspects of the design and operation of such facilities that are not directly related to radiological safety.

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GLOSSARY

AIT	Augmented Inspection Team
ALARA	As low as is reasonably achievable
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act; called "Superfund"
CFA	Cognizant Federal Agency
DOE	Department of Energy
DOT	Department of Transportation
EO	Emergency Officer
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FRERP	Federal Radiological Emergency Response Plan
FRMAC	Federal Radiological Monitoring Assessment Center
FRMAP	Federal Radiological Monitoring Assessment Plan
HHS	Department of Health and Human Services
HOO	Headquarters Operations Officer
IE	NRC Office of Inspection and Enforcement
IIT	Incident Investigation Team
LCO	Limiting Condition for Operation
LLG	Lessons-Learned Group
MOU	Memorandum of Understanding
NBS	National Bureau of Standards
NMSS	NRC Office of Nuclear Materials Safety and Safeguards

NRC	Nuclear Regulatory Commission
OELD	NRC Office of Executive Legal Director
OSHA	Occupational Safety and Health Administration
OSP	NRC Office of State Programs
PEF	Planned Expenditure Files
PSAS	Program Support and Analysis Staff
RCRA	Resource Conservation and Recovery Act
RDO	Regional Duty Officer
RCP	Radiological Contingency Plan
SF&C	Standard Format and Content (NUREG-0762)
SRP	Standard Review Plan (NUREG-0810)
TSCA	Toxic Substances Control Act
USDA	U. S. Department of Agriculture

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The Lessons-Learned Group wishes to acknowledge the enthusiastic and dedicated assistance provided by Messrs. R. K. Christopher and R. J. Bores, Region I, and Ms. Ann Savolainen, TIDC, Consultant.

EXECUTIVE SUMMARY

On January 4, 1986, at 11:30 a.m., a Model 48Y cylinder filled with uranium hexafluoride (UF_6) ruptured while it was being heated in a steam chest at the Sequoyah Fuels Corporation facility near Gore, Oklahoma. The incident resulted in the death of one plant worker and injuries to several others as a result of exposure to hydrofluoric acid, a reaction product of UF_6 and airborne moisture.

An Augmented Inspection Team (AIT) formed by the Nuclear Regulatory Commission Region IV Office determined that the incident occurred as a result of a cylinder containing UF_6 being grossly overfilled and then heated in a steam chest to facilitate removal of some UF_6. The heating of the overfilled cylinder caused expansion of the UF_6 as it changed from the solid to the liquid state and the further thermal expansion of the liquid as it was heated. The result was rupture of the cylinder by hydraulic overpressurization.

On February 20, 1986, the Lessons-Learned Group was formed by the Acting Executive Director for Operations to prepare a report based on experience gained from this event. The goal of the Lessons-Learned Group was to identify actions NRC might reasonably take from a licensing and inspection standpoint to prevent similar incidents, as well as to clarify NRC's regulatory role regarding facilities of this type. A further goal was to assess the adequacy of the NRC response to the incident, as well as the follow-on activities.

The observations and recommendations of the Lessons-Learned Group are predicated on the assumption that NRC regulatory authority has not been interpreted to extend to nonradiological aspects of fuel facility operations not directly associated with NRC licensed material. Although subject to clarification, it was assumed, that NRC should have regulatory interest in matters that directly or indirectly affect radiological safety.

The review of the UF_6 production process and the design of the facility (see Chapter 2) indicated that modifications to improve some design deficiencies could have prevented or mitigated the incident. The design modifications reviewed include monitoring to prevent overpressurization; better monitoring to avoid overfilling; redesign of filling, sampling, and heating stations to limit need for movement of heated cylinders; provisions for monitoring releases of hazardous materials. The LLG recommends that the NRC evaluate the recommendations relative to design modifications presented in Chapter 2 to determine whether NRC actions or additional requirements are warranted and also to amend the NRC regulations to require that certain NMSS licensees perform safety evaluations of any changes in process, operations or design of the facilities that would reduce safety margins or constitute a previously unreviewed safety question.

The licensee's radiological contingency plan (see Section 3.1) was developed but was not properly implemented or maintained. Training for contingencies appeared to be less than adequate. Offsite organizations who might be expected

to support an emergency response were not trained. The communications system was inadequate to handle the emergency, and emergency equipment and kits became unavailable during the event. It is recommended that NRC guidance be reviewed to determine its adequacy in these areas.

The review of the NRC response to this incident (see Section 3.2 and 3.3) indicated that emergency classification schemes used in the radiological contingency plans should be reviewed to assure they are consistent and trigger an appropriate NRC response. Training and guidance for NMSS and NRC Operation Center personnel relative to nonreactor emergency response need improvement. Additional recommendations are made relative to the NRC response to nonreactor events such as at Sequoyah.

The NRC-OSHA regulatory interface lacks precision (see Section 4.1). It is recommended that an opinion be prepared for publication in 10 CFR 8 that defines NRC regulatory authority with respect to radiological hazards in industrial chemical processing plants operating under NRC license. Further, an MOU should be concluded with the Department of Labor covering the NRC-OSHA interface. The NRC-EPA interface (see Section 4.2) lacks clarity with respect to notification of the National Response Center.

It appears that the guidance relative to the establishment of an Incident Investigation Team vs. an Augmented Inspection Team is not clear (see Chapter 5). The Lessons-Learned Group believes that the criteria for selection of an AIT vs. an ITT should be reviewed and clarified.

The Ad-Hoc Interagency Public Health Assessment Task Force provided the assessment of onsite and offsite health effects. The interface of such task forces with the NRC response team is not addressed in current procedures. The report of the task force was generated under tight time constraints and was said to be difficult to understand by local officials and individuals affected by the event (see Chapter 6). Recommendations are made relative to the data collection, analyses and health assessment activities following incidents and the relationship of these activities with the NRC response team.

Several incidents with safety significance similar to the Sequoyah event had previously occurred at facilities with NRC licenses, federal installations and foreign facilities. At least one event involving an NRC licensee was not reported because the licensee concluded the event was not reportable under 10 CFR 20 (see Chapter 7). For those events known to the NRC, the information was not available in a systematic or timely manner for use in inspection or licensing programs. The LLG recommends that the requirements and guidance for reporting incidents at fuel facilities and certain other licensed facilities be reviewed to ensure potentially significant events are reported to the NRC. In addition, the NRC should establish a formal system for obtaining, evaluating and disseminating information about such events.

Licenses issued pursuant to 10 CFR 40 for source materials differ in concept from those issued pursuant to 10 CFR 50 for reactors in that the former do not cover the operations of the facility except to the extent that such operations may affect radiological safety (see Chapter 8). The LLG makes several recommendations relative to the scope of the license review process, license format, guidance to the licensee and NRC reviewers, and reviewer expertise.

NRC inspections at nonreactor facilities have historically focused on areas directly related to radiological safety and inspectors have been primarily qualified in those areas. Recommendations are made relative to the scope of inspections at fuel facilities, the allocation of inspection resources and fuel facility inspector qualifications.

It is recognized that use of the lessons learned from the Sequoyah incident must necessarily be functions of the Office of Nuclear Materials Safety and Safeguards and the Office of Inspection and Enforcement, respectively. The Lessons-Learned Group believes many of the recommendations in this report are fundamental to the task assigned the recently appointed Materials Safety Regulations Review Study Group, and should be used in formulation of that group's conclusions and recommendations.

1.0 INTRODUCTION

A Lessons-Learned Group (LLG) was formed at the direction of Victor Stello, Jr., NRC Acting Executive Director for Operations, on February 20, 1986, to prepare a "lessons-learned" report on the January 4, 1986, incident at the Sequoyah Fuels Corporation facility in Gore, Oklahoma that resulted in the release of UF_6 from a ruptured cylinder. The Sequoyah Fuels Corporation is a subsidiary of the Kerr-McGee Corporation. The members of the Lessons-Learned Group were the following:

James M. Allan, Chairman, Region I
Kathleen Black, Office for Analysis and Evaluation of Operational Data
Barbara A. Dalrymple, Liaison with Office of Nuclear Material Safety and Safeguards
Robert L. Fonner, Office of Executive Legal Director
L. Robert Gregor, Region III
John R. White, Region I

In accordance with its charter, the LLG was to accomplish its mission primarily through a review of staff reports being prepared and contacts with individuals involved or otherwise knowledgeable of the problems involved. They were to consider in the preparation of their report:

(1) Steps that might be taken both from a licensing and inspection and enforcement standpoint to prevent similar accidents, including the focus and orientation on safety issues during the licensing and inspection process.

(2) The clarity of the regulatory role of NRC in licensing and inspection of fuel facilities in relation to other federal and state agencies that have authority and responsibility to exercise regulatory oversight.

(3) The adequacy of the NRC response to the accident and the effectiveness of the follow-on actions, as well as improvements which might be made.

Members of the Lessons-Learned Group visited the Sequoyah Fuels Corporation facility at Gore, Oklahoma, the Allied Chemical Corporation facility at Metropolis, Illinois, and the Department of Energy facility at Paducah, Kentucky, to examine the facilities and their operations. The LLG also discussed licensing and inspection policies and procedures with those involved at NRC headquarters and at Region IV. Emergency preparedness and incident response aspects were also discussed with local, county, and state officials. The primary individuals contacted are listed in Appendix A.

Chapters 2 through 9 of this report describe the findings of the Lessons-Learned Group. Each Section includes a discussion of the findings and most are followed by recommendations. Recommendations are those lessons-learned that the LLG believes should be considered in review and evaluation of programs administered by the Office of Nuclear Materials Safety and Safeguards

and by the Office of Inspection and Enforcement, including NRC's response to emergencies.

While the Lessons-Learned Group's review primarily focused on the UF_6 Sequoyah facility cylinder rupture, certain of the LLG's recommendations are applicable to other NMSS licenses as well. The Lessons-Learned Group recognizes that requirements for NMSS licenses are not, and need not be, as extensive as for power reactor licenses, primarily because the potential onsite and offsite health and safety risk due to these licensed activities is not as great as for power reactors. NUREG-1140 points out, however, that certain NMSS licenses are readily distinguished from the majority of NMSS licenses by their potential for an accident which could affect the health and safety of the nearby public. The Lessons-Learned Group concludes that it is primarily this population of NMSS licenses that should be considered when determining the applicability of the Lessons-Learned Group's recommendations. It is also possible that certain NMSS licenses should be added to the population under consideration due to an unusually high potential for onsite health and safety without a corresponding offsite potential. The Lessons-Learned Group has not attempted to more specifically define the population of NMSS licenses which should be so considered. Dependent on the results of the determination of NRC regulatory authority over chemical hazards associated with licensed activities, it may be necessary to add additional NMSS licenses to the population under consideration.

Recommendations made by the Lessons-Learned Group were made without consideration of resources necessary to implement them. Such consideration is part of the task assigned the recently appointed Materials Safety Regulations Review Study Group.

While members of the Lessons-Learned Group were individually assigned tasks or assigned tasks as sub-groups, all members participated in the preparation and review of the entire report.

2.0 PROCESS AND FACILITY DESIGN

The Sequoyah facility is one of two uranium hexafluoride conversion facilities operating in the United States; the other facility is the Allied Chemical Corporation facility near Metropolis, Illinois. A number of deficiencies related to these facilities were identified during the review of the UF_6 cylinder rupture event by the Lessons-Learned Group. Modifications to correct these deficiencies could have prevented or mitigated the event. The LLG recognizes that because of the limited number of operating UF_6 conversion facilities in the U. S., plant design experience is limited. Therefore, the correction of design deficiencies identified during operations becomes an important method for improving the safety of these facilities.

The UF_6 production process starts with natural uranium ore concentrate (U_3O_8) received from milling operations. The two facilities convert the uranium ore concentrate through different chemical processes to UF_6. The UF_6 is drained as a liquid into 10-ton or 14-ton cylinders, where it solidifies before the cylinders are shipped to a government facility for uranium-235 enrichment in preparation for fabricating uranium fuel elements. The two processes are illustrated below:

Sequoyah UF_6 Conversion Process

Nitric acid dissolution of U_3O_8 to $UO_2(NO_3)_2$
Solvent extraction of $UO_2(NO_3)_2$ to remove impurities
Concentration of $UO_2(NO_3)_2$ to $UO_2(NO_3)_2 \cdot 6H_2O$
Denitration of $UO_2(NO_3)_2 \cdot 6H_2O$ to UO_3
Hydrogen reduction of UO_3 to UO_2
Hydrofluorination of UO_2 to UF_4
Fluorination of UF_4 to UF_6

Allied Chemical UF_6 Conversion Process

Hydrogen reduction of U_3O_8 to UO_2
Hydrofluorination of UO_2 to UF_4
Fluorination of UF_4 to UF_6
Distillation of UF_6 to remove impurities

According to the 1985 Safety Evaluation Report prepared by the NRC Division of Fuel Cycle and Material Safety in conjunction with relicensing of the Sequoyah facility, release of a large quantity of heated (liquid or gaseous) UF_6 is considered the most severe accident associated with the UF_6 conversion process that could affect health and safety of the public and the environment.

Uranium is handled in many different chemical forms in UF_6 conversion plants, but UF_6 is the only form which can be readily dispersed off site. Uranium hexafluoride (UF_6) will react with water to form hydrofluoric acid (HF) and uranyl fluoride (UO_2F_2). Since airborne moisture is a generally available water source, the reaction can be expected to occur if UF_6 is released to the

atmosphere. The reaction is exothermic (heat-producing) for UF_6 existing in the gaseous state; therefore, heated UF_6 (>134°F at atmospheric pressure) represents the only significant release hazard. Both the HF and the UO_2F_2 produced are hazardous chemicals. The HF is produced as a corrosive acid vapor that can severely harm the lungs and exposed portions of the body. The UO_2F_2, formed as particulate material, produces both radioactive and chemical effects when taken into the body, with the chemical effect being the most important because much of the uranium is present in soluble form. According to NUREG-1140, a UF_6 release of sufficient magnitude to be lethal due to HF burns on lung tissue or uranium chemical toxicity would not result in radiation doses exceeding one rem effective dose equivalent.

Both the Sequoyah and the Allied Chemical facilities produce UF_6 by fluorination of UF_4. The UF_6, which is produced in a gaseous state, is collected in cold traps, where it is solidified by refrigerant cooling. Subsequent heating of the cold traps liquifies the UF_6 for transfer to cylinders, where the UF_6 cools to ambient temperature and again solidifies.

The cold traps and the cylinders contain the largest accumulations of heated UF_6 at the two UF_6 conversion facilities. The filled cylinders represent the greater risk because of their temporary use in the process, the large numbers of individual cylinders utilized, their typically larger inventories of UF_6, and their routine movement within the facilities before solidification occurs. Although the filled cylinders are considered to be the greater risk, several recommendations presented here with respect to the process and to facility design improvements are applicable to filled cold traps also.

2.1 Overpressurization Monitoring

2.1.1 Discussion

Because of the relatively high solidification temperature of UF_6 at atmospheric pressure (134°F), care must be taken to prevent solidification in process piping between the cold traps and the cylinders. Heating of these lines is required to prevent solidification of UF_6. Heating of the UF_6 is also required to remove UF_6 from the cold traps and for UF_6 sampling and removal from the cylinders. Because of the high thermal coefficient of expansion of both solid and liquid UF_6 (approximately 0.1% per degree Fahrenheit) and the large expansion during the transition from the solid phase to the liquid phase (approximately 33%), care must be exercised when heating UF_6 to prevent overpressurization. Traditionally, ample excess volume is provided in cylinders and process systems and heating limitations are utilized to prevent overpressurizations. Autoclaves, which are pressurized steam chests that can provide some protection in case of a UF_6 release from an enclosed UF_6 cylinder, are not utilized at either the Sequoyah or the Allied Chemical facilities. Autoclaves are used, however, at certain DOE UF_6 facilities.

Neither the Sequoyah facility nor that of Allied Chemical is equipped with instrumentation to measure pressure in a cylinder when the cylinder is being heated. Both facilities experienced unmonitored cylinder overpressurizations while heating cylinders in atmospheric pressure steam chests during the past 18 months. The Sequoyah event resulted in a cylinder rupture, while the Allied Chemical event fortuitously did not.

2.1.2 Recommendations

(1) Pressure-sensing instrumentation should be connected to UF_6 cylinders and cold traps any time heat is applied to them. Heat should not be applied to UF_6 cylinders or cold traps unless there is verification that a vent path is open to the associated pressure-sensing instrumentation. The pressure-sensing instrumentation should provide both alarm and visual display functions.

(2) Provisions should be made for overpressure relief or automatic heat termination upon overpressurization any time heat is applied to UF_6 cylinders or cold traps.

(3) The use of autoclaves for heating UF_6 cylinders should be evaluated in terms of providing an additional margin of safety.

2.2 Monitoring of Filling

2.2.1 Discussion

Fill limits for UF_6 cylinders are specified in ANSI N14.1-1982, "American Standard Packaging of Uranium Hexafluoride for Transport." These limits are designed to provide a free volume safety margin of approximately 5% when a cylinder filled to these limits is heated to 250°F. A cylinder filled beyond these limits is considered to be overfilled even though it may not be heated to 250°F. The fill limits were exceeded on numerous occasions at the Sequoyah and Allied Chemical facilities and were routinely exceeded prior to sampling at the Sequoyah facility.

Overfilling, even grossly overfilling a cylinder, does not in itself create a significantly increased potential for release of UF_6. Such potential results from grossly overfilling a cylinder only with subsequent application of heat to the cylinder. Overfilling is an integral part of the overpressurization scenario, however, and reasonable provisions should be made to minimize the likelihood of overfilling cylinders.

The cylinder that ruptured on January 4, 1986, at the Sequoyah facility was grossly overfilled because of the failure of the single method (mechanical scales) utilized for determining the quantity of UF_6 transferred to the cylinder. A similar failure resulted in another gross cylinder overfill in March 1986 at the Sequoyah facility. Heat was not applied to the overfilled cylinder in the March incident.

2.2.2 Recommendations

(1) At least two separate means should be utilized for determining the quantity of UF_6 loaded into cylinders or cold traps before applying heat to them. "Real time" quantification methods are preferred, such as load cells, mechanical scales, or flow integration. Alarms should be associated with the quantification methods.

(2) Licensees should be required to establish maximum fill limits for cylinders and cold traps based on suitable standards.

2.3 Facility Operations

2.3.1 Discussion

Upon completion of the filling process at the Sequoyah facility, the cylinders are moved by fork lift several times while still heated (that is, before the UF_6 has cooled and solidified). The movements are necessary at the Sequoyah facility because of separate locations for cylinder filling, sampling, heating, and cooling. Heated UF_6 cylinders are also moved at the Allied Chemical facility. However, at the Allied Chemical plant an overhead crane is used for most heated cylinder movements, and cylinder movement is not necessary for heating because the filling, sampling, and heating operations are located together. It is desirable to minimize movement of heated cylinders in order to minimize the potential for cylinder rupture due to handling accidents.

A significant change in facility operations at the Sequoyah facility resulted in the use of 14-ton cylinders in addition to 10-ton cylinders several years after operation commenced. This change was significant because the fill station was designed for the shorter 10-ton cylinders. Use of the 14-ton cylinders resulted in significant reductions in the safety margins associated with physical location of the cylinder on the filling station mechanical scale and the measurement range of the scale. Both these conditions contributed to the cylinder rupture on January 4, 1986.

2.3.2 Recommendations

(1) Movement of filled, heated UF_6 cylinders should be minimized. The use of combination filling, weighing, heating, and sampling stations should be evaluated for the Sequoyah facility.

(2) A requirement, generally analogous to 10 CFR 50.59 should be established requiring that certain NMSS licensed facilities perform engineering evaluations of proposed design changes to ensure that overall safety margins would not be compromised by the proposed changes.

2.4 Cylinder Specifications

2.4.1 Discussion

ANSI N14.1-1982 specifies the types of cylinder damage which require repair before continued cylinder use. (More specific information concerning cylinder defects is contained in the U. S. Department of Energy report, ORO-651, Rev. 4, "Uranium Hexafluoride: Handling and Container Criteria," dated April 1977.) During a December 1984 cylinder overpressurization incident, the Allied Chemical facility heated an overfilled cylinder which sustained damage (broken stiffening rings). The cylinder was not repaired prior to being reheated to remove solidified UF_6. Although no UF_6 was released, the margin of safety had been reduced because of the damage to the cylinder.

An additional specification in ANSI N14.1-1982 is that UF_6 cylinders should be inspected and hydrostatically tested at five-year intervals. The testing specification does not, however, call for such inspection and testing of filled cylinders. For filled cylinders the inspection and testing are to be completed

within the five-year period before they are refilled with UF_6. As a result many cylinders containing UF_6 have exceeded a five-year testing period and are in storage at both the Sequoyah and the Allied Chemical facilities. Filled cylinders are routinely heated to liquify the UF_6 for cylinder unloading upon receipt at the enrichment facilities.

2.4.2 Recommendations

(1) Overfilled UF_6 cylinders or filled cylinders which are found to be defective should be evacuated without increasing cylinder internal pressure above atmospheric and preferably without application of heat.

(2) The frequency of hydrostatic testing of UF_6 cylinders specified in ANSI N14.1-1982 should be reevaluated to resolve the differences in treatment of empty and filled cylinders.

2.5 Monitoring of UF_6 Releases

2.5.1 Discussion

If UF_6 is released, it reacts with water in the atmosphere, forming UO_2F_2 which is readily visible as white airborne particulate matter, and HF which is readily detected by its noxious odor. Both are perceptible at low concentrations. Workers are not continuously present in all plant areas, however, and therefore there is a potential for delay in identification of a UF_6 release. No monitors for detecting airborne or waterborne UF_6 releases were in use at the Sequoyah or Allied Chemical facilities in January 1986, even though acceptable monitors were commercially available (ionization detectors and conductivity detectors, respectively).

2.5.2 Recommendations

(1) Instrumentation for detecting UF_6 releases should be utilized in areas of potential airborne UF_6 releases and in conjunction with steam heating to detect UF_6 released to the steam condensate.

(2) The instrumentation for detecting UF_6 releases should provide alarm and/or automatic protection functions (for example, containment, emergency ventilation, or effluent cleanup).

3.0 RADIOLOGICAL CONTINGENCY PLANNING AND RESPONSES TO INCIDENT

The response to the UF_6 cylinder rupture at Sequoyah Fuels involved many different organizations: the licensee (both Sequoyah Fuels Corporation and the parent company, Kerr-McGee Corporation); NRC Headquarters; NRC Region IV; other federal agencies; and State of Oklahoma and local groups.

3.1 Licensee's Radiological Contingency Plan

The LLG reviewed the UF_6 cylinder rupture event from the radiological contingency perspective, noting observed deficiencies and concerns in the licensee's preparedness and response relative to the licensee's Radiological Contingency Plan; deficiencies in the plan relative to NRC standard format and content guidance in NUREG-0762 and acceptance criteria in the standard review plan, NUREG-0810; and possible areas for NRC guidance.

3.1.1 Plan Maintenance

3.1.1.1 Discussion

The contingency plan was generated primarily at the corporate office of Kerr-McGee (the parent organization of the Sequoyah Fuels Corporation), with some input from site management. Subsequent to submittal of the plan to NRC, the individuals who had prepared the plan left the corporation. The corporate officers who succeeded these individuals did not have indepth knowledge of the plan and their responsibilities established in the plan. Corporate audits of the contingency plan were conducted, but they were not of sufficient depth to identify problems in plan implementation or to evaluate the overall effectiveness of the plan. The plan had no clear specific assignments of responsibility for overall maintenance of the plan nor for various emergency functions.

The contingency plan was implemented at the site under the supervision of the individual responsible for health and safety. That individual maintained the specified emergency equipment and supplies and provided training to the site managers in the plan contents. At the time of the incident, the contingency plan had not been reviewed and updated as required and was outmoded in several areas.

3.1.1.2 Recommendations

(1) The individuals responsible for development, maintenance, updates and implementation of the contingency plan should be clearly identified at both the corporate and site levels.

(2) Audits of contingency plan implementation should be conducted by individuals not having direct implementation responsibility, and the audits should include evaluation of the appropriateness of the plan, procedures, facilities, equipment (including location of facilities and

equipment), training and periodic exercises in the spectrum of accidents or emergencies possible at the facility.

3.1.2 Training

3.1.2.1 Discussion

Training in fire fighting, medical first aid, and hydrogen fluoride hazards was provided periodically to specific site personnel. Contingency plan training at the site was conducted on a "trickle down" basis. The Health and Safety Manager trained area managers; the area managers trained their supervisors; the supervisors, in turn, trained shift-supervisors, who trained shift personnel. It appears to the Lessons-Learned Group that the contingency plan training protocol was not sufficient to assure that the plan would be adequately implemented. In addition, corporate personnel were not trained in the plan contents, specific notification chain, the emergency classification scheme contained in the plan, and their specific response roles. The notification to NRC of the cylinder rupture was made by corporate officials but was not made to the appropriate NRC office and did not include an indication of the emergency classification (that is, "general emergency"). The Lessons-Learned Group noted that an apparent violation was cited relative to contingency plan training in Inspection Report No. 40-08027/86-02.

Training of offsite support organizations was not provided (local or state police, hospitals, ambulance personnel, state and county health officials, civil defense personnel, etc.), nor did the contingency plan specify that such training should be provided. Offsite responders were not generally familiar with the type of hazards to which they might be asked to respond (See Section 3.3).

3.1.2.2 Recommendations

(1) A systematic training program should be established to familiarize all plant personnel with the general contents of the contingency plan and appropriate response actions. Specific training should be provided to individuals (both site and corporate) who might be assigned specific response functions and responsibilities.

(2) Offsite organizations who might be requested to support an emergency response should be invited to attend training specific to the response expected.

3.1.3 Exercises and Drills

3.1.3.1 Discussion

Radiological contingency drills and exercises had not been conducted in a meaningful manner to test the appropriateness of plans, procedures, facilities and equipment. The "drills" conducted were "talk through sessions" on a number of hypothetical emergencies. These "drills" involved limited staff and no hands-on response. Offsite support organizations were not involved in drills.

3.1.3.2 Recommendations

(1) Drills and exercises involving substantial staff response to a spectrum of simulated emergency situations should be conducted periodically. The simulated events should be based on prepared scenarios to demonstrate specific objectives, and they should be observed and critiqued by qualified personnel. Any deficiencies observed should be evaluated and responsibility for corrective action assigned and followed.

(2) Drills and exercises should periodically include the offsite organizations which might be called upon for support (local police, civil defense, health departments, etc.), as well as corporate personnel (see Section 3.3).

3.1.4 Facilities and Equipment

3.1.4.1 Discussion

The January 4, 1986 UF_6 cylinder rupture incident occurred outside and upwind of the process and administration building. Uranyl fluoride and hydrofluoric acid fumes were swept into the process building ventilation system. Within minutes, the entire building became uninhabitable. With the exception of an emergency kit at one of the access road guard posts, access to virtually all emergency equipment was lost during the incident. Additionally, the one available emergency kit located at the guard post did not have adequate and appropriate equipment.

First aid supplies, the site ambulance, radiological survey equipment, protective clothing, respiratory protection equipment, a source of water for decontamination and skin flushing (because of hydrofluoric acid contact) and essentially all communication equipment were lost, as well as the onsite radioanalytical laboratory. Also, employee emergency assembly areas (lunch room and break room) designated by the Radiological Contingency Plan were uninhabitable. Self-contained breathing apparatus were not readily available for employees leaving the plant areas through the noxious fumes.

In addition, with no offsite radio network and very limited telephone capability, local police could not recontact the facility for updates of the emergency status. Without communications to the plant, local police had difficulty in determining which individuals responding from off site should be allowed through access control points.

3.1.4.2 Recommendations

(1) Consider requiring a designated Emergency Operations Center (EOC) on site and an alternate EOC either off site or in another onsite location which is unlikely to be impacted by the incident. The EOC and alternate EOC should contain adequate communications capability and accommodations to provide for coordination of the onsite emergency response activities and notifications and coordination with offsite supporting organizations. The EOC or alternate EOC should be accessible 24 hours a day.

(2) Locations of emergency equipment and kits should be reviewed by the NRC and licensees so that in the event of an emergency in a given facility location, or inaccessibility of a large portion of the facility, access to adequate emergency equipment and facilities, including emergency decontam-

ination facilities, can be assured. Equipment caches should be in multiple locations.

(3) Consideration should be given to providing strategically placed "air capsule escape units" to allow workers to escape from portions of a facility in which there exists a potential for exposure to toxic fumes for more than a few moments.

(4) The facility communications system should include a radio system compatible with local police or other offsite responder communications systems. In addition, the licensee should attempt to identify beforehand to local and state police, insofar as practical, offsite individuals who would be called on for support in the event of an emergency at the site. Radio communications with police officials during an emergency can resolve specific issues.

3.2 NRC Response

There were two aspects of the NRC response: (1) the headquarters and Region IV activities, and (2) the formation and dispatch of a response team from Region IV to the site.

3.2.1 Headquarters and Region IV Activities

The NRC Headquarters Operations Center at the Maryland National Bank in Bethesda, MD, and the Incident Response Center in the regional office are focal points of activities in response to an incident or operational event. The procedures that determine how NRC responds to an event are based on the licensee's classification of the event and the NRC assessment of event severity. In the Normal Mode, NRC headquarters and regional personnel jointly assess the initial information without activating the centers.

The NRC Standby response is initiated by a decision of a Regional Administrator or an Executive Team Member (or, if neither is available, the Emergency Officer) when the incident is judged to be sufficiently uncertain or complex that there is a need to use the facilities of the Operations Center.

The NRC response usually goes to Standby when a licensee classifies an event as warranting an Alert at the site. Higher modes of response (Initial Activation or Expanded Activation) may be initiated for events classified as Site Area Emergency or General Emergency. The classification scheme for events is given in NUREG-0654, Rev. 1, "Criteria for Preparation and Evaluation of Radiological Response Plan and Preparedness in Support of Nuclear Reactors." NMSS provided the same scheme to their licensees for use in preparing the radiological contingency plans.

In Standby, the responsible regional office staffs its Incident Response Center. The Headquarters Operations Center is staffed by a team led by an Executive Team member or his designee. Each center evaluates the available information, makes appropriate notifications, and prepares for rapid activation should it become necessary. The Regional Administrator, or his designee, normally leads the NRC response in this mode.

Transition of NRC from the Normal Mode to the Standby (or higher level) Mode has some immediate implications. From a NRC headquarters standpoint, notification calls are made to DOE, FEMA, EPA, and HHS, and if appropriate to the FBI, FAA, or DOT. Comparable calls are made by the appropriate NRC region to regional offices of the same federal agencies and to state agencies. In the case of Initial Activation, the NRC Regional Office dispatches a team to the site normally led by the Regional Administrator or his designee, as the Site Team Leader. The team normally includes appropriate technical staff, as well as a Public Affairs Coordinator, an Emergency Response Coordinator and a Government Liaison Coordinator.

In addition to using the classification of an event by a licensee as the basis for a transition from a Normal Mode to a Standby Mode, the NRC Emergency Officer has additional guidance in NUREG-0981 and the Operations Center procedures to assist in deciding to notify FEMA and other agencies. The guidance states that FEMA will be called if there has been a release of radioactive material in excess of a specified level or if an accidental, unplanned, or uncontrolled release results in the evacuation of a building.

3.2.1.1 Discussion

Sequoyah Fuels used the reporting criteria of 10 CFR 20.403 and 20.405(a) to develop the classification scheme for events in its Radiological Contingency Plan. The type of event that occurred on January 4, 1986 at the Sequoyah Fuels facility had been used in the plan as the first example of an event classified as a "general emergency." For reactors, an event categorized as a Site Area Emergency or a General Emergency represents an event for which the NRC will make a transition to Initial Activation.

In the Normal Mode of operation of the Operations Center, the Headquarters Operations Officer and the Emergency Officer are the individuals charged with the receipt of the notification of the event and the early assessment of it, respectively. The individuals on duty at the NRC Operations Center during the Sequoyah event had received training in nuclear power plant operations and use of reactor event classification schemes but had not received comparable training for those fuel facility or materials licensee facilities that are required to have radiological contingency plans. Essentially none of the personnel serving as Headquarters Operations Officers and few serving as Emergency Officers had training relative to nonreactor facilities.

A member of NMSS received the initial notification of the event and notified the NRC Operations Center. No apparent decision was made by NRC to enter the Standby (or higher) Mode and to formally notify other federal agencies. Although the Sequoyah Radiological Contingency Plan was available, the NMSS personnel involved in the event apparently did not consult the plan and did not correlate the rupture of the UF_6 cylinder with the severity classification in the plan. The licensee did not identify to NRC its emergency classification of this event, nor did the NRC inquire as to the licensee's classification of the event. Consequently, the NRC did not consider the event to be a "general emergency" and did not initiate a Standby (or higher) Mode of NRC response.

Region IV, which had defined both an "alert" and a "general (emergency)" for fuel facility, byproduct materials and transportation events in the Region IV Supplement to the NRC Incident Response Plan, did not correlate their definitions with the Sequoyah event to determine whether it warranted designation of at least the "alert" level. Furthermore, they also did not correlate the severity of the event with the transition to the Standby (or higher) Mode.

Since this incident was a prompt event in that the releases had essentially terminated by the time NRC was notified, and since the next higher mode of NRC response was termed Standby, there was a perception on the part of many of the NMSS, IE, and Region IV personnel who came to or were called by the respective operations centers that the event was over, and hence, formal notification of other agencies, or transition to Standby, was unnecessary.

It is clear that neither NRC Region IV nor headquarters staff responded to the event in the same manner as they would have to a reactor accident. If NRC had gone to the Standby Mode, there would have been an established lead individual (Executive Team member) at the Operations Center.

Consequently, without the benefit of an established lead (Executive Team) individual, at the Operations Center, the Site Team on several occasions had to resort to contacting individual NRC offices directly for support (for example, making contacts for expertise in evaluating uranium and hydrofluoric acid exposures; obtaining specific expertise for the Site Team; attempting to obtain appropriate laboratory facilities, funding and expertise; and providing for extended Site Team staffing). Because the requests were perceived as coming from Region IV to NRC offices, rather than from the Site Team Leader/Director of Site Operations to the Executive Team, responses to some requests were apparently not given priority (for example, evaluation of uranium and hydrofluoric acid exposure data). Additionally, a Headquarters Executive Team could have assisted the Site Team in responding to media questions relative to facility background information unrelated to the current event. A full regional response team, including an Emergency Response Coordinator, a Government Liaison Coordinator and a Public Affairs Coordinator, could have relieved much of the workload on the NRC Site Team technical members by screening telephone calls, assisting with logistics, and handling media calls.

In addition to the lack of preplanning for nonreactor events, the Lessons-Learned Group identified some concerns in NRC training.

(1) Most of the Operations Center personnel and personnel designated to be Emergency Officers lacked training in nonreactor events.

(2) NMSS training exercises had been infrequent and had not focused on fixed-site events. Fuel facility and material exercises had not involved the NRC Regions or licensees.

(3) There appeared to be a perception that the emergency was over when the initial release was over, even though little information was available to assess either the onsite or offsite consequences or the likely cause of the event.

3.2.1.2 Recommendations

(1) The events described in the radiological contingency plan required of certain NMSS licensees should be reviewed to develop a consistent analysis and classification of events. The resulting classification should be used in NRC decision criteria to initiate transition of the NRC from a Normal Mode to higher response modes.

(2) Training and guidance should be provided to Headquarters Operations Officers and Emergency Officers relative to the handling of nonreactor events. The NRC Regions should develop additional training and awareness of nonreactor events and suitable response modes, and should assure that radiological contingency plans and other facility information are readily available.

(3) Periodic NMSS training exercises should include events at fixed sites and involve the NRC Operations Center and regional personnel.

3.2.2 Regional Response to Event

3.2.2.1 Notification

3.2.2.1.1 Discussion

Region IV received notification of the January 4, 1986 event when the Headquarters Operations Officer (HOO) paged the Region IV Duty Officer (RDO). The HOO had received the notification from an NMSS staff member who was contacted at home by a Kerr-McGee corporate staff member. The HOO was asked to contact the responsible Region IV Section Chief. When the Section Chief could not be contacted, the RDO was called. The RDO proceeded to the Region IV Office because of its close proximity to his residence and initiated regional contacts from there because of the available multiple phone lines. The response of the Region IV staff to the event was prompt, considering that it was a nonduty-hours, weekend response.

3.2.2.1.2 Recommendation

If call-in of regional staff is anticipated or sustained communications are expected, early use of the Regional Incident Response Center should be considered to facilitate preliminary evaluation of the event and notification of the regional staff (if a fan-out notification is not used).

3.2.2.2 Onsite Response

3.2.2.2.1 Discussion

Region IV dispatched a four-person technical team headed by the Director, Division of Radiation Safety and Safeguards, within 2.5 hours of the first notification. The initial NRC response team did not include the regional Emergency Response Coordinator, the Government Liaison Coordinator, or the Public Affairs Coordinator. These individuals were dispatched to the site during the following two days. Had they been dispatched earlier, their onsite presence could have relieved the technical team of much of the administrative, coordination and communication problems encountered and enabled a more exped-

itious establishment of a coordinated response. The first press conference was held before the NRC Public Affairs representative arrived on site.

The NRC Site Team worked with the licensee and the State of Oklahoma to provide daily press briefings. This effort resulted in a drastically reduced number of media calls to the site relative to the event and led to a "single voice" concept of discussing the event, recovery and impacts. NRC also initiated action to have some additional long-distance telephone lines installed at the licensee's facility to improve communications between the NRC Operations Center, Region IV and the NRC Site Team.

The Site Team established levels for the cleanup (decontamination) of the nearby highways that were below levels permitted by the license in the licensee's unrestricted areas under normal plant operating conditions.

In the area of onsite and offsite sampling, a sample and data coordination function was established to plan, coordinate and track sampling and analyses and to provide means for evaluating the quality of the sampling and analyses performed by the various groups and laboratories. The NRC personnel necessary to perform these functions arrived on site on Monday, January 6. The licensee and the State had collected and analyzed many samples by this time.

Because of differing sampling and analytical methods used by the state and the licensee during the first several days, the results could not be intercompared. Through NRC efforts, a standardized sampling protocol was established, and a uniform sample identification system and a sample location coordinate system were established to allow intercomparison of results. Samples were split for NRC contractor analyses as well. The Department of Energy, through EG&G, provided assistance in the data coordination area and in the later establishment of a computerized data base.

3.2.2.2.2 Recommendations

(1) When there is significant media interest locally during or following an event, regularly scheduled press briefings coordinated with licensee, NRC and state responders should be considered. The current experience indicated the value of the "unified voice" approach for updating the status of an event. The result was the much reduced impact from separate inquiries to response team members.

(2) NRC should be prepared to initiate the installation of additional telephone lines early in an event at facilities with limited installed communications capability.

(3) NRC should have predetermined criteria for acceptable onsite and offsite contamination levels, preferably based on projected dose commitments or health impacts. Such criteria should be readily available and distributed so that ad-hoc acceptability criteria need not be generated under crisis conditions.

(4) The NRC team responding to contamination events should include an individual or individuals responsible for coordinating sample collection and data analysis. (For a response to a reactor event, an Environmental

Team Leader would normally be dispatched with the initial Site Team.) The person assigned the sample and data coordination function should be retained in that position sufficiently long to assure sampling, analyses and data handling consistency. If personnel assignments are changed, sufficient turnover time must be allowed to assure smooth transition. Specific training, exercises and drills should be conducted in sample collection and data handling. The sample data should be entered into a computerized data base as early as possible for ready analyses and sorting by all parties with need for the data.

(5) The need for establishing standardized sampling and sample preparation procedures and the means of intercomparing laboratory results should be recognized and met early in any event involving multiple organizations.

3.3 Responses of Other Federal Agencies and Other Groups

3.3.1 Other Federal Agencies

3.3.1.1 Discussion

NRC has rather well defined emergency response procedures for nuclear power reactors, as well as for nonreactor events, provided NRC enters the Standby (or higher) Mode. The procedures clearly define the agencies that have to be notified and the order of notification. In the case of the Sequoyah incident, however, the notification of other federal agencies did not follow the prescribed procedures, since NRC never entered a formal response mode. Few official notifications of federal agencies were initiated by NRC. For instance, FEMA received information about the accident through the United Press International wire and then called the NRC Operations Center. The Occupational Safety and Health Administration (OSHA) learned of the incident through the public media. Coast Guard personnel (Arkansas River Navigation System) saw the UF_6 release cloud and detected the odor at their station on the river, and called the EPA regional office (Dallas, Texas). The EPA regional office called the Sequoyah facility in Gore, Oklahoma, and determined that there had been a substantial release of UF_6. The EPA regional office called the Oklahoma State Department of Health and proffered assistance. The NRC Operations Center placed a call to the EPA National Response Center about 8:30 p.m., January 4, 1986. The EPA then called the Center for Disease Control (CDC) in Atlanta to apprise them of the incident. CDC in turn called the Oklahoma State Health Department.

The EPA regional office sent a technical representative to the site. He remained on the site for a number of days and reported daily on the status of activities. OSHA responded by sending personnel to the site on Sunday, January 5, 1986. After several conferences with Sequoyah management and NRC personnel, OSHA determined that NRC essentially had jurisdiction and left the site without completing an investigation. OSHA representatives returned to the site later in January, at the request of NRC, and again concluded that NRC had jurisdiction. A representative of DOE called the Operations Center on Saturday afternoon, January 4, 1986. The NRC Site Team Leader requested monitoring support and an aerial monitoring system survey from DOE (see Section 4).

Several federal agencies provided personnel to develop the health effects report. The Ad-Hoc Interagency Health Effects Task Force was comprised of representatives from EPA, USDA, HHS, NRC and consultants. (Only federal agency participants are given here; see Chapter 6.)

3.3.1.2 Recommendations

In the event of an emergency involving an impact on public health and safety, other federal agencies may need to respond on a timely basis with personnel, equipment, or procedures for obtaining pertinent information. These agencies should be notified of an event as early as possible (see Section 3.2).

3.3.2 Oklahoma Department of Health

The Oklahoma Department of Health is a statewide organization with local (county) health officers being the local representatives of the State Health Department. Both the local (Sequoyah County) and State Health offices participated in the response to the Sequoyah incident.

3.3.2.1 Sequoyah County Department of Health

3.3.2.1.1 Discussion

Because of an independent air-monitoring program established by the Sequoyah County Health Department more than one year before the release on January 4, a resident whose home was in the path of the release had the home telephone number of the Administrative Director of the Sequoyah County Department of Health. The resident called the Administrative Director at home when she became aware of the release (that is, her home became engulfed in the cloud). He advised her to leave her house. The Administrative Director proceeded to the plant and was briefed by plant personnel. He then drove through the residential area south of the release point to ensure that residents had evacuated or were all right. He discussed information about treatment with the residents he contacted.

Employees of the Sequoyah County Department of Health and other counties were used for offsite sample collection (soil, water, and vegetation) from January 5, 1986 through January 17, 1986. Until an NRC employee, assisting in the standardization of sampling protocols, accompanied the Sequoyah County Department of Health employees and requested shoe covers and protective clothing, the Department of Health employees were not specifically aware of personnel contamination concerns. (It should be noted that protective clothing was not actually required for offsite areas. However, until sample analyses were available, prudence would have dictated that shoe covers and protective clothing be worn.)

The day after the UF_6 release (5 p.m. CST Sunday, January 5), a 24-hour "hot line" was established by the State of Oklahoma using telephone lines of the Sequoyah County Department of Health. The county office staffed the phones for five days and responded to about 350 calls. Personnel of the county office believe the "hot line" to be essential in any incident of the type experienced. They expressed a feeling that their response on the "hot line" might have been

improved if they had had more information concerning the effects of exposure to hydrofluoric acid and other materials. At the state level, Department of Health personnel did not believe that the people answering the "hot line" had to be knowledgeable about the health effects of exposure to hydrofluoric acid. In the State's opinion, personnel staffing the phones could collect information on caller's symptoms and relay the information to others who could give expert guidance to the callers.

3.3.2.1.2 Recommendations

(1) Personnel of local agencies that might be called upon to respond to emergencies should be given training (see Section 3.1.2, Training).

(2) NRC should consider routine use of a "hot line" (a rumor control line) in response to nonreactor events. (State and local emergency plans for reactor sites presently require "hot line" (rumor control) provisions).

3.3.2.2 State Department of Health

3.3.2.2.1 Discussion

Personnel in the Oklahoma Department of Health were notified of the Sequoyah Fuels Corporation incident by Kerr-McGee corporate personnel and by the Administrative Director of Sequoyah County Department of Health. The State Department of Health deployed personnel to the site with instruments on Saturday afternoon, January 4. These individuals were responsible for setting up the "hot line." The telephone used for the "hot line" was that of the Sequoyah County Department of Health only because that office had telephone equipment suitable for such use. Other county health department offices in the State of Oklahoma do not have such equipment.

The Oklahoma State Health personnel provided assistance in the collection of samples through the county health personnel and analyzed samples at their Oklahoma City laboratories. They are continuing to collect data on environmental samples.

3.3.3 Sequoyah Memorial Hospital, Sallisaw, Oklahoma

3.3.3.1 Discussion

An employee of the Sequoyah Fuels Corporation called the Sequoyah Memorial Hospital in Sallisaw when it was determined that the plant physician was unavailable. A hospital employee was informed that there had been an accident at the Sequoyah facility and that personnel would be coming to the hospital for treatment. The hospital employee relayed the information to the emergency room.

The emergency room physician was informed that people who had been exposed to hydrochloric acid would be coming in for treatment. It was not until several patients had arrived and been examined that the physician was informed that the chemical to which the people had been exposed was hydrofluoric acid.

A nurse whose husband was affiliated with the Sequoyah Fuels Corporation was able to provide some information about UF_6. At 1:15 p.m. CST, January 4, 1986, the emergency room physician, concerned about radioactive contamination, called the Sequoyah facility. A Sequoyah employee was then sent to the hospital with a G-M counter. Low levels of contamination were detected in the hospital treatment areas.

The hospital staff had available in the emergency room a treatment protocol for hydrofluoric acid injuries that Kerr-McGee had provided to them in 1982. In addition, a hospital laboratory had access to a hazardous material manual published by DOT.

The physician on duty when the first patients arrived from the Sequoyah facility was assisted by other physicians who were called to the hospital. A number of Gore, Oklahoma, residents who reported to the emergency room were examined on the afternoon of January 4.

The hospital medical staff believed that the hospital capabilities were adequate to handle the number of individuals who arrived at the hospital following the event and exposure to hydrofluoric acid. The hospital staff had no knowledge of the radiological contamination problems which could result from exposure to UF_6 or its reaction product, UO_2F_2. Furthermore, they did not have a plan or supplies needed to deal with a radiological contamination problem.

With the exception of the previously received copy of the hydrofluoric acid treatment protocol, the hospital staff had received no training from Sequoyah Fuels Corporation or Kerr-McGee. (It should be noted that Sequoyah Memorial Hospital was not the hospital named in the Sequoyah Fuels Radiological Contingency Plan). Many of the plant personnel at work on the day of the accident were from Sallisaw and were familiar with Sequoyah Memorial Hospital. It was also noted that the Sequoyah facility Radiological Contingency Plan identified Muskogee General Hospital as the primary health care facility, however, the staff at that hospital had not received training relative to radiological hazards by Sequoyah Fuels either. Subsequent to the accident, the Sequoyah Memorial Hospital received many calls from the media, and the staff had to seek out information with which to respond to the inquires.

3.3.3.2 Recommendations

Hospital staff who might reasonably be expected to deal with injuries from a major accident should be trained to deal with all aspects of the injuries. Radiological plans and and their use in drills are desirable (See Section 3.1.2, Training).

3.3.4 Local Police and State Highway Patrol

3.3.4.1 Discussion

The uranium hexafluoride released from the Sequoyah facility traveled from the plant across Interstate 40. Several local police departments (Gore Police, Vian Police, County Sheriff) and the Oklahoma State Highway Patrol were used to close Interstate 40 and State Route 10. The Gore police were notified by the Sequoyah facility early and the officer on duty actually observed the UF_6 release cloud. He closed State Route 10 and called the Vian police and the

Sequoyah County Sheriff's Office. The Kerr-McGee corporate office in Oklahoma City had called the State Highway Patrol regarding Interstate 40.

The Gore police maintained control of the road block at State Route 10 (controlling access to the Sequoyah facility from the north). As news of the incident quickly spread through Gore, many people wanted to get to the site, but the officer at the road block attempted to rigidly restrict access to the site. He informed representatives of the Lessons-Learned Group that the Gore police, a small force, would have benefited had they been provided identification of those facility personnel who should be admitted to the plant after an incident or that some special badging system might help (see Section 3.1). None of the police officers that the Lessons-Learned Group spoke with (Gore Police and Oklahoma State Highway Patrol) had any previous training regarding Sequoyah Fuels Corporation operations. A meeting with plant personnel and law enforcement groups had been scheduled for late 1985, but since only Gore Police Department personnel could attend, that meeting was cancelled.

3.3.4.2 Recommendation

Radiological contingency planning should include site control plans and methods for implementing site access control. Local law enforcement groups that might be called on in an emergency should be trained (see Section 3.1.2).

4.0 FEDERAL AND STATE AGENCY INTERFACES

After the Sequoyah Fuels Corporation incident, a number of questions were raised about the response of federal and state agencies. These questions were raised both within the NRC, and in other federal agencies. The NRC Office of Inspection and Enforcement was tasked to prepare a report on federal and state agency responses. That report, entitled, "UF_6 Release at the Sequoyah Fuels Corporation Conversion Plant Near Gore, Oklahoma, January 4, 1986: A Review of Federal and State Responsibilities for Regulating Health and Safety Hazards at NRC Licensed Uranium Fuel Fabrication and Conversion Plants," (see memorandum Taylor to Stello, May 15, 1986), furnishes the primary basis for the following discussion and the lessons-learned recommendations.

4.1 NRC-OSHA Interface

4.1.1 Discussion

Both NRC and the Occupational Safety and Health Administration (OSHA) have regulatory authority in industrial plants where some, if not all, activities are carried out under an NRC license. Under the OSHA Act, however, OSHA authority is limited to occupational health and safety concerns not subject to the regulatory authority of other federal agencies or, in the case of the Atomic Energy Act, Agreement State Agencies regulating Atomic Energy Act materials. Although the IE report correctly concludes that there is an adequate legal foundation for full coverage of health and safety concerns, the Lessons-Learned Group believes that there has been enough confusion within both NRC and OSHA over the mutual perception of each agency's role to create an interface problem. The interface problem results from the failure of NRC to closely define the scope of its regulatory coverage relative to that of OSHA. A consequence of the failure of NRC to closely define its regulatory sphere is a tendency on the part of OSHA to see NRC regulation more broadly than NRC might intend it. The March 13, 1986 letter from Patrick R. Tyson, Acting Assistant Secretary for Occupational Safety and Health, Department of Labor, to NRC Chairman Palladino commenting on OSHA's role in the Sequoyah incident illustrates the point (see Appendix C). Even though the death and injuries were due to hydrofluoric acid and not to any compound of uranium, OSHA concluded in that letter that the matter was beyond its jurisdiction and subject to that of NRC. Because the OSHA Act precludes OSHA from acting in areas where other federal agencies regulate, the burden is on NRC to clearly define the limits of its authority with respect to occupational health and safety. It should not be left to OSHA to determine the scope of NRC jurisdiction in order to determine the need for OSHA action.

NRC has not defined with precision what it believes to be the scope of its authority and responsibility with respect to chemical hazards at facilities with NRC licensed activities. Interviews have revealed that divergent views exist.

Although a few tentative steps toward resolution of these issues have been taken (see, for example, in Appendix C, the legal memorandum prepared by the NRC Office of the Executive Legal Director on October 10, 1984, advising that the chemical effects of uranyl fluoride may be considered in emergency planning rulemaking, and the NRC response to Question 9 asked by Congressman Markey after the Sequoyah incident), these few steps are not definitive enough nor sufficiently authoritative to establish a clear and concise framework for the OSHA-NRC interface.

4.1.2 Recommendations

(1) An opinion should be prepared for publication in 10 CFR 8 that precisely defines the scope of NRC regulatory authority with respect to nonradiological hazards in industrial chemical and other plants operating under NRC license. The opinion should address the nonradiological hazards of the licensed materials and the reaction of those materials with process and other chemicals present at the plant.

(2) A Memorandum of Understanding (MOU) should be concluded with the Department of Labor covering the OSHA-NRC interface. The MOU should incorporate the conclusions of the opinion developed under recommendation 1, and should describe in detail the scope of hazards subject to Atomic Energy Act regulation. Under the MOU, occupational hazards that are then not precisely the regulatory responsibility of NRC would be under OSHA regulatory jurisdiction.

4.2 NRC-EPA Interface

4.2.1 Discussion

The Environmental Protection Agency administers a number of laws that are relevant to incidents in industrial chemical-processing plants. Among these are the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also called "Superfund"), Resource Conservation and Recovery Act (RCRA), Toxic Substance Control Act (TSCA), Clean Air Act (CAA), and Federal Water Pollution Control Act (FWPCA). CERCLA gives EPA sweeping authority to respond to releases of hazardous material, including undertaking immediate cleanup action if warranted by the health and environmental hazards and risks. With two limited exceptions not relevant to the Sequoyah incident, CERCLA covers releases of source, byproduct, and special nuclear material because all radionuclides have been listed as hazardous under CAA. Under RCRA, EPA may respond by civil or criminal enforcement action to the spilling of hazardous chemicals (other than source, byproduct, or special nuclear material) onto the ground or into water without an RCRA permit.

TSCA allows EPA to set rules by which toxic chemicals may be produced and distributed in commerce (excluding, however, source, byproduct, and special nuclear material). TSCS regulations cover premanufacture notice and registration, testing, labelling, use and disposal of identified chemicals. (TSCA regulations applied in plant do not affect OSHA jurisdiction.) Although none of the current TSCA-listed chemicals appear to have been involved in the incident, the implications of TSCA for NRC licensed activities should not be overlooked. The CAA and FWPCA provisions are directed at regular effluent

releases to the environment and have little significance for releases resulting from accidents such as at Sequoyah.

Under the Clean Water Act, EPA has established a National Response Center that is administered by the U. S. Coast Guard. Under CERCLA, any release of a hazardous substance in excess of a reportable quantity must be reported immediately to the National Response Center. Because EPA has not yet established reportable quantities for radionuclides by rule, the statutory quantity of one pound applies to the reporting of releases of radionuclides. The Sequoyah Fuels Corporation did not report the release of the UF_6 to the National Response Center "immediately." While CERCLA requires reporting to the National Response Center, the accompanying criminal penalty for failure to report refers only to a failure to report to the "appropriate agency of the United States Government." The criminal penalty provision is ambiguous with respect to a situation like the Sequoyah incident, where the licensee did not report to the National Response Center, but did report to the NRC.

4.2.2 Recommendation

NRC licensees should be reminded through an IE Information Notice of their obligation to report releases above reportable quantity limits to the National Response Center and the potential of a criminal penalty under CERCLA for failure to do so.

4.3 NRC-State Interface

4.3.1 Discussion

Because Oklahoma is not an Agreement State, the NRC does not have an institutionalized framework for an ongoing regulatory relationship. (If Oklahoma were an Agreement State it would have had full regulatory responsibility for the Sequoyah facility.) The State of Oklahoma does perform some regulatory functions for environmental protection under both state law and by delegation from EPA for selected environmental programs. The exercise of these authorities does not appear to conflict with the NRC regulation of the Sequoyah facility for radiological health and safety.

5.0 AUGMENTED INSPECTION AND INCIDENT INVESTIGATION TEAMS

A draft of NRC Manual Chapter 0513, NRC Incident Investigation Program, was circulated for comment in December 1985. The Manual Chapter, in Parts II and III, defines investigation initiatives for responses by an Augmented Inspection Team and an Incident Investigation Team.

5.1 Augmented Inspection Teams

5.1.1 Discussion

An Augmented Inspection Team (AIT) is under the direction and control of a Regional Administrator and is composed of personnel from the regional office, augmented by technical staff from NRC headquarters and other regional offices. Draft procedures for AIT response to operational events were issued by IE for interim use on December 19, 1985, and were revised in a draft issued on April 19, 1986. General comments as to the objectives and actions to be employed by an AIT are taken from these documents. The objective of an AIT is to conduct a prompt, thorough, fact-finding assessment of the probable cause of an operational event.

5.1.1 Discussion

An AIT was formed sometime after 3:00 p.m. (CST) on January 4, 1986 to conduct the fact-finding assessment of the Sequoyah facility incident. The decision to activate an AIT was made jointly by the Region IV Regional Administrator and NRC Headquarters. The team members were drawn from NRC Region IV staff, including an inspector who had previously inspected the Sequoyah facility and a member from the Uranium Recovery Field Office in Denver, Colorado. The AIT also included a technical specialist from NMSS.

The team's charter was oral and the scope was limited to (1) determining the facts surrounding the incident, (2) identifying any generic and specific safety concerns related to the incident, (3) documenting these findings and conclusions, (4) establishing the probable cause of the incident, and (5) determining the specific nature of the cylinder rupture.

The AIT review of this incident, conducted on site over a two week period, determined that the probable cause of the cylinder rupture was hydraulic overpressurization. During the course of the investigation several actions were undertaken. The existence of an organic contaminant as a potential cause of the rupture was eliminated. Interviews with licensee personnel directly or indirectly involved with the incident were conducted off site. Arrangements were made to conduct a metallurgical analysis of the ruptured UF_6 cylinder, and to assess the performance of the cylinder-filling scale involved in the incident. Experts from the National Bureau of Standards (NBS) examined the scales for accuracy.

The findings of the AIT were published as Volume 1 of NUREG-1179, "Rupture of Model 48Y UF_6, Cylinder and Release of Uranium Hexafluoride," February 1986. This report contains the facts established in the investigation, and concludes that the probable cause of the incident was the rupture of the cylinder as a result of hydraulic overpressurization. The results of the metallurgical analyses of the cylinder along with the AIT review of a second cylinder overfill event, which occurred on March 13, 1986, will be reported in Volume 2 of NUREG-1179.

5.2 Incident Investigation Team

5.2.1 Discussion

An Incident Investigation Team (IIT) is a group of technical experts, usually five members, led by a senior NRC manager who has not been significantly involved with the licensing and inspection of the affected facility. The IIT performs the NRC investigation of significant operational events.

Objectives of an IIT are to conduct a prompt, thorough, systematic and independent investigation of the safety significance of operational events involving licensed activities. This team collects, analyzes and documents the factual information sufficient to determine the probable causes, conditions, and circumstances relating to the event.

The scope of an IIT investigation is sufficient to ensure that the event is clearly understood, the relevant facts and circumstances are identified and collected, and the probable and contributing cause(s) are identified and substantiated by the evidence associated with the event. IIT's perform an important function when an event may involve an operation having potential generic safety implications.

While the cause of the Sequoyah incident was not complex, the involvement of multiple agencies in the response to the event, the onsite personnel health and safety concerns, the offsite protective actions taken, the heavy media and Congressional interest, as well as potential generic concerns support the LLG opinion that an IIT investigation of the Sequoyah Fuels Corporation facility incident might have been more appropriate than an AIT. It is also noted that the use of the AIT rather than an IIT, when the NRC responds to an incident, greatly increases the load on the resources of the affected NRC region.

5.2.2 Recommendations

The criteria of draft NRC Manual Chapter 0513 should be reexamined relative to clarification of the use of an IIT versus the use of an AIT following events involving offsite consequences or multi-agency response.

6.0 HEALTH EFFECTS REPORT

6.1 Discussion

Following the Sequoyah facility incident on January 4, 1986, a health effects report was prepared to evaluate the effects of the releases on people and on the local environment. The report was a joint effort of several agencies combined in an Ad-Hoc Interagency Public Health Assessment Task Force (Task Force). The Task Force was directed by NRC personnel from NMSS, and included personnel from other federal agencies and the State of Oklahoma. Several federal agencies provided personnel, who had expertise in areas of chemical effects and radiological assessment, to collate the data obtained from sampling at the site.

The first meeting of the full Task Force was on January 14, 1986. The NRC established a report completion date of February 28, 1986 and the report was issued in March 1986 as NUREG-1189, Volumes I and II. The data were sent to each task force agency for use in making assessments. The data were not well organized and, in some cases, were raw or handwritten because of the limited time allowed by the established deadline. NRC, with EG&G assistance, did establish a computerized data base during the later stages of data collection. A number of the task force agencies and the State of Oklahoma were not made aware, however, of the availability of this computerized data base.

The Task Force did not visit the impacted area nor did they have a dedicated liaison individual in the area to assist in the collection, collation or distribution of data to the Task Force. The lack of liaison had an impact on the NRC Site Team response efforts in several instances. Without an onsite liaison with the health effects task force, the Site Team or portions of the Site Team would appear to be directed from two sources, the Site Team Leader and the Task Force. A single point of direction is necessary. It should be noted that the Site Team description in the NRC Incident Response Plan and Regional Supplements, even for a fully augmented team to implement the Federal Radiological Emergency Response Plan (FRERP) and the Federal Radiological Monitoring and Assessment Plan (FRMAP), does not include provisions for interfacing with a group such as the health effects Task Force. It would therefore appear that either the Site Team composition should be modified to accommodate such task forces or that the health effects assessment should be done under the auspices of the FRMAP arrangement.

NRC established the Task Force to assess the health effects of the Sequoyah incident without regard to the fact that the federal government has in place the FRMAP and provisions for establishing the Federal Radiological Monitoring and Assessment Center (FRMAC) which has responsibility for coordinating the radiation monitoring and assessment activities of all federal agencies. In this case, FRMAC could have coordinated the activities for the Cognizant Federal Agency, here the NRC. Under FRMAP it would be possible to obtain federal expertise in sampling, analysis, evaluation and assessment of chemical

hazards so that a single federal group could coordinate all monitoring and assessment activities.

A number of concerns were voiced by involved state and federal agency personnel relative to the Task Force and the Report (NUREG-1189). These concerns are:

(1) An existing NRC Region IV contract for unrelated analytical work with the Oak Ridge National Laboratory was utilized to perform many of the analyses for the health effects assessment and the funding for this contract was exhausted in performing the requested analyses. Rather than provide additional funding to complete additional analyses thought to be important by some Site Team and Task Force members (for example, followup urinalyses samples from affected site employees and nearby residents), the analyses were halted. Had NRC entered an escalated response mode, such funding could have been made available through a designated Executive Team (see Section 3.2.1.1).

(2) The Site Team should have prompt access to NRC or outside expertise relative to medical concerns, exposure assessment, bioassay needs and evaluation, so that early opportunity is not wasted for obtaining appropriate samples, analysis and pertinent data for meaningful evaluation and followup most appropriate to the situation. In this event, the "window of opportunity" was lost for some analyses (see Section 3.2.1.1 relative to Executive Team Lead at the NRC Operations Center).

(3) The early sampling was not coordinated and consequently many of the early sample results could not be correlated. Not all agencies involved in the Task Force were asked to participate at an early enough stage to ensure that sampling, sample preparation and the analyses provided all the desired information (See Section 3.2.2.2).

(4) The short report deadline made it difficult to assemble and produce a comprehensive document to encompass both the onsite and offsite health assessments for affected individuals and the environment.

(5) NUREG-1189 was to be the one definitive health effects report covering the Sequoyah event; however, because of the limited time allotted to complete the report, only the short-term effects could be addressed. Potential longer range effects and concerns relative to the upcoming agricultural growing season could not be addressed based on the available data.

(6) Following the publication of NUREG-1189, the Task Force was disbanded. Concerns were expressed relative to the assessment of analyses and data generated and collected after the cutoff date for the report and relative to the longer term assessments.

(7) The report was not written or summarized to be understandable by local officials and individuals affected by the event. The assessment of the health effects of onsite employees was based on the analysis of data collected, whereas, the offsite health effects were projected through models. In addition, the report was not easily available to local and state health officials and to the affected general public.

6.2 Recommendations

(1) The Federal Radiological Monitoring and Assessment Plan (FRMAP) should be utilized to collect and assess data relative to the health effects of an incident. Current NRC response plans provide for interfacing with FRMAP and for providing direction to FRMAP agencies, therefore a separate health effects task force may not be necessary. If a task force is formed, however, it should be set up to utilize FRMAP-generated data and assessments without impacting on the response to the incident.

(2) Data should be entered into a computerized data base as early in the event as possible and the data base should be made available to the appropriate federal and state agencies to enable them to more easily assist in the evaluation of health effects.

(3) Recognizing the need to issue the report of the assessment of the short-term health effects promptly, a schedule should be established within that report to ensure the assessment and followup of the longer range effects. The latter should be included in a supplemental report.

(4) Additional consideration should be given to the intended audience for the reports. Because of the potential impact on plant employees and nearby residents, the report (or at least the Executive Summary) should be written in language understandable to the general population. Sufficient copies of the report should be made available in the local area to enable interested persons to obtain them.

7.0 Prior Events at UF_6 Conversion Facilities

7.1 Discussion

As with nuclear power reactors, certain events which may have safety significance have occurred at UF_6 conversion facilities. Such events have occurred at commercial, government and foreign facilities. To date, there have been at least three recorded instances of gross overfilling and heating that resulted in either rupture or deformation of a UF_6 cylinder because of the thermal expansion properties of UF_6. In 1960 an overfilled cylinder ruptured when heated and spilled liquid UF_6 at the Department of Energy's Gaseous Diffusion Plant in Paducah, Kentucky. In April 1985, an overfilled cylinder bulged when it was heated at a Canadian facility. In December 1984 an overfilled 14-ton cylinder was deformed when it was heated at the Allied Chemical plant in Metropolis, Illinois, a NRC licensee. Significantly, NRC was not aware of this event until late January 1986 because the licensee had concluded that this event was not reportable under 10 CFR Part 20.

In 1966, a report entitled "Uranium Hexafluoride: Handling Procedures and Container Criteria" (ORO-651) was issued by the U. S. Energy Research and Development Administration. This report was reissued in 1967, 1968, 1972 and, and again in 1977, as part of a continuing effort to present updated information on UF_6 shipping cylinders and handling procedures. The report contained procedures for the packaging, measuring and handling of UF_6, and it describes the probable consequences of heating overfilled shipping cylinders.

Except for the 1984 event at Allied Chemical, NRC was cognizant of UF_6 cylinder incidents and, in fact, summarized these incidents in a draft report NUREG-1140, "A Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radiological Materials Licenses," which was distributed for comment in June 1985. Although this information was available within NRC, there is no indication that consideration was given to information concerning hydraulic cylinder ruptures by either the licensing staff or the licensee until the later stages of the Sequoyah facility license renewal process (1984-1985). The LLG interviews with NMSS and licensee personnel indicated that the information available even at that time was incomplete and fragmented, and in some cases, limited to the receipt of oral information.

During the later stages of the license renewal process, there was, however, increased concern by NMSS staff and Sequoyah personnel regarding the potential for release of UF_6 from heated cylinders as a result of handling (dropping, puncturing). This concern resulted in NRC imposing license conditions in the September 1985 license renewal requiring the licensee to review methods and procedures for handling cylinders containing liquid UF_6. The results of this review were required to be submitted to NMSS by March 1986. Additionally, in a January 1985 revision to the licensee's Procedure N-280-1 for handling UF_6, a precaution was added that warned against the heating of an overfilled cylinder. The supervisor who added the precaution into the procedure reportedly did so because he had "informally heard" of the consequences of heating an overfilled cylinder during casual conversations with other individuals associated with the industry sometime during late 1984. While it was apparent that there was sufficient information available to identify the consequences of heating overfilled cylinders, both the NRC staff and the staff of Allied Chemical and

Sequoyah Fuels Corporation have expressed a need to have a better, more systematic and timely means to gather, analyze and communicate safety information gleaned from the review and analysis of incidents occurring at fuel facilities. It was emphasized that this type of information needs to be obtained not only from activities licensed by the NRC, but also from Department of Energy and foreign facilities. There are currently only limited reporting requirements for potentially significant safety incidents at fuel facilities. Title 10 CFR 20.403,. "Notification of Incidents," requires reporting of events involving radiological releases or exposures above specified limits, property damage exceeding specified monetary levels, or loss of use of the facility for a specified period of time. Title 10 CFR Part 40, "Domestic Licensing of Source Material," provides no requirements or guidance for reporting of incidents.

The establishment of (1) reporting requirements for defined potentially significant events at major fuel facilities and certain other materials licensees, (2) the subsequent analysis of the reports, and (3) dissemination of data with safety significance to licensees would enhance the ability of both the industry and NRC to identify potential incidents that should be considered during licensing and inspection by the NRC, and during plant operations by licensees.

7.2 Recommendations

(1) A formal system should be developed within the Office for Analysis and Evaluation of Operational Data (AEOD) for obtaining, evaluating and disseminating information and reports concerning incidents involving NRC licensed activities and for DOE and foreign facilities. This also would permit AEOD to establish a more complete data base of information for use in NRC licensing and inspection programs, and in the development of requirements for training and operational procedures.

(2) The requirements and guidance for reporting potentially significant events at fuel facilities and at certain other materials licensees should be reviewed to ensure that all potentially significant events are reported to NRC.

8.0 FUEL FACILITY LICENSING PROGRAM

8.1 Source Materials Licensing

In accordance with the provisions of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011, et. seq), Title II of the Energy Reorganization Act of 1974 (42 U.S.C. 5841, et. seq.) and The Uranium Tailings Radiation Control Act of 1978 (42 U.S.C. 7901), NRC is responsible for the licensing of source and byproduct materials. In NRC regulations, 10 CFR 40, "Domestic Licensing of Source Materials," procedures and criteria are established for the issuance of licenses to grant title to, possess, receive, use, transfer or deliver source and byproduct materials. Within the NRC, the Office of Nuclear Material Safety and Safeguards (NMSS) reviews license applications and issues licenses pursuant to 10 CFR 40. The possession and use of source material by Sequoyah Fuels Corporation are licensed under 10 CFR Part 40.

An evaluation of an application for license renewal is performed in the same manner as for a new license. To facilitate the renewal process, Regulatory Guide 3.55, "Standard Format and Content for the Health and Safety Sections of License Renewal Applications for Uranium Hexafluoride Production," was issued in April 1985 to provide specific guidance for the preparation of the health and safety sections of renewal applications. In such applications, the applicant must provide sufficient information to allow the NMSS licensing staff to perform independent analyses to confirm conclusions reached by the licensee in areas such as operations involving possible radiation exposures, releases to the environment, ALARA (as low as reasonably achievable) concepts, radiological contingency planning, operations involving hazardous chemicals, training, and prevention and control of fire and explosion.

The Sequoyah Fuels Corporation operates at Gore, Oklahoma, under Source Material License No. SUB-1010, Docket No. 40-8027. As originally issued on October 14, 1969, the license authorized only the storage of uranium ore concentrates. The license was amended on February 20, 1970 to authorize the use of the concentrates for production of UF_6. Subsequently, the license has been renewed and has remained continuously in effect. The last renewal application was submitted on September 24, 1982, and was subsequently revised October 17, 1983; May 24, 1984; August 13, 1984; September 18, 1984; December 6, 1984; and August 23, 1985. The renewed license was issued September 20, 1985, with an expiration date of September 30, 1990. As a matter of general agency policy, fuel facility licenses are issued for no more than a five-year term.

8.1.1 Discussion

Licenses issued pursuant to 10 CFR Part 40 (as well as to Parts 30 and 70) are considerably different in purpose and scope from licenses issued for commercial nuclear power reactors pursuant to 10 CFR 50, "Domestic Licensing of Production and Utilization Facilities." Under Part 50 the facility itself is licensed. whereas under Part 40, activities such as possession, transfer and use of

source material are authorized. Part 40 licenses do not typically cover operation of the facility in which the material is used, except to the extent that such operation may affect radiological safety.

Applications for source material licenses are filed in accordance with 10 CFR 40.31, "Application for Specific Licenses," and license renewal requests are filed in accordance with 10 CFR 40.43, "Renewal of Licenses." Further, 10 CFR 40.32, "General Requirements for Issuance of Specific Licenses," states, in part, that an application for a specific license will be approved if:

(a) The application is for a purpose authorized by the Act;

(b) The applicant is qualified by reason of training and experience to use the source material for the purpose requested in such a manner as to protect health and minimize danger to life or property; and

(c) The applicant's proposed equipment, facilities and procedures are adequate to protect health and minimize danger to life and property.

Given the purpose and scope of licenses issued under Part 40, the intent of item (c) is unclear as to what extent beyond the area of radiological safety the NRC must assess the licensee's operations, equipment and procedures.

The major emphasis during the Sequoyah license renewal was on radiological safety and the assessment of the potential for environmental impact. Less effort was directed toward operational aspects having indirect radiological implications (that is, areas such as systems and piping containing licensed materials, training, procedures and management audits). No effort was directed to those operational aspects not related to radiological safety, such as chemical hazards involving no NRC licensed materials. Chapters 1 through 8 of the 17-chapter license renewal application, which are incorporated into the license by reference, discuss licensee commitments in the area of environmental monitoring, as well as in areas directly related to radiological safety. The NRC emphasis on matters directly affecting radiological safety and environmental issues versus overall plant operating equipment and procedures is consistent with past and present NRC policy and practices in the review of fuel and other source and byproduct materials license applications. The thrust of the license review is on processes and procedures directly related to possession and use of licensed materials and their impact on radiological safety, and not on other hazardous materials or processes that may be associated with or used in conjunction with licensed material. In addition, current policy does not require that changes in plant systems, other than those affecting the NRC licensed process itself, be submitted to NRC for approval, nor is it required that licensees perform and document engineering evaluations prior to making changes in or to process equipment (see Section 2.3.1).

The NRC emphasis on radiological and environmental aspects may have the unintended effect of causing a licensee to expend a disproportionate amount of effort in areas related to radiological safety relative to those areas associated with the chemical and physical processes which sometimes have more serious existing hazards. Although the NMSS staff involved in the license renewal is well qualified in radiological safety and environmental issues, a more comprehensive review of the license application or renewal application with

regard to operations and procedures not directly related to radiological safety would require a commitment of NRC staff with more varied expertise and operational knowledge of major fuel facilities. It would also require clarification of the legal authority of NRC to regulate the nonradiological aspects of facility design, processes and operation (see Section 4.1.1).

Regardless of the resolution of this issue, a Standard Review Plan should be developed to define the criteria and scope of evaluations of license applications and, along with Regulatory Guide 3.55, serve to clearly identify the types of specific information and procedures required from the licensee. Licensees are currently required to develop procedures and have training programs for plant personnel and, in the case of the Sequoyah facility, commitments to develop these requirements were incorporated into the license by reference to Chapters 1 through 8 of the license renewal application. Little NRC guidance has been provided, however, as to required scope, format and content of these procedures and training programs.

Neither the licensee management, nor the NRC staff, perceived a difference in requirements set forth directly as license conditions versus those licensee commitments incorporated into the license by reference. However, both have indicated that the current format of the license may allow for different interpretations as to what constitutes a commitment and what has been incorporated into the license by reference as commitments. Since the license renewal application can be voluminous and contains numerous commitments along with descriptive materials, the licensee's commitments are not always easily identified. As a result, this has at times created difficulties in ensuring that licensee personnel know exactly what commitments were incorporated into the license.

8.1.2 Recommendations

(1) A Standard Review Plan for review of fuel facility license applications including those for UF_6 conversion facilities, should be established, implemented and maintained. Licensing guidance should also more definitively identify those areas of an applicant's operations which require the development and implementation of procedures and formalized training. This guidance should be in sufficient detail to permit the applicant to develop an acceptable program.

(2) NMSS should ensure that license reviewers have sufficient technical capability to more broadly evaluate the indirect effects of process equipment, facilities and procedures on radiological safety. Such assurance can be obtained by increasing the training and qualifications of individual reviewers, contracting for outside expertise, or increasing the use of other NRC personnel with the necessary expertise.

(3) The current license format used by NMSS should be evaluated to determine the need to more clearly identify licensee commitments incorporated into a license to ensure recognition of all applicable commitments, specifications, and requirements.

(4) NRC should review each of the recommendations in Chapter 2 of this report and determine whether specific changes should be made in license

requirements and licensing criteria. The need for any changes should be communicated to applicable NRC licensees and other fuel facilities.

8.2 Radiological Contingency Plans for Nonreactor Facilities

In late 1980, NRC evaluated existing emergency procedures and plans for fuel-fabrication plants and found some apparent weaknesses. For example, some licensees had no procedures for the prompt notification of state and local response organizations. Upon noting these weaknesses, the staff prepared orders to require certain licensees to submit radiological contingency plans (46 FR 12566). These orders, which were issued in February 1981, required some licensees, based on their licensed possession limits, to plan for actions that would be needed in the event of an accident. The orders were issued to operators of fuel-processing and fabrication plants, UF_6 conversion plants, and radioactive material users authorized to possess large quantities of radioactive materials in unsealed form.

On June 3, 1981, the Commission published in the Federal Register (46 FR 29712) an Advance Notice of Proposed Rulemaking on emergency preparedness for certain fuel and other radioactive material licensees. In the advance notice, the Commission proposed to codify, with some modification, the radiological emergency requirements set forth in the orders. The staff has submitted to the Commission proposed amendments to 10 CFR Parts 30, 40, and 70 that would formally require emergency plans for certain fuel facility and other radioactive material licensees. These proposed regulations would require about 30 licensees to have emergency plans, and an additional 30 licensees to either: (1) submit a plan, (2) submit an evaluation showing a significant release is not plausible, or (3) amend their licenses to reduce their possession limits. The staff estimates that of these latter 30 licensees, few plans are likely to be submitted. About half are likely to submit an evaluation and the other half are likely to reduce their possession limits.

8.2.1 Discussion

There is currently no organization in NRC dedicated to nonreactor radiological contingency plan review. Since early 1985, the reviews of licensee radiological contingency plan updates or amendments received from licensees have been the responsibility of the NMSS project manager for fuel facility plans or of NRC regional personnel for byproduct material licensee plans.

With regard to nuclear power plants, the review of emergency preparedness plans (the reactor counterpart of radiological contingency plans for fuel facility and material licensees) is performed by the Office of Inspection and Enforcement, not the Office of Nuclear Reactor Regulation. Having the review done by IE results in one Headquarters office having responsibility for review of plans and managing the headquarters Operations Center (which provides the headquarters support for the NRC emergency response).

Kerr-McGee submitted radiological contingency plans for the Sequoyah facility in conformance with the NRC orders on March 11, 1982 supplanting a submittal of September 30, 1981. These plans were updated in August 1984.

The LLG toured the Sequoyah facility and reviewed the licensee's response to the UF_6 cylinder rupture and made a number of observations about the event (see Section 3.1). Using these observations as a base, the LLG reviewed pertinent portions of: the licensee's Radiological Contingency Plan; NUREG-0762, Standard Format and Content for Radiological Contingency Plans for Fuel Cycle and Material Licensees; and NUREG-0810, Standard Review Plan for the Review of Radiological Contingency Plans for Fuel Cycle and Materials Licensees. Table 8.1 provides an assessment of portions of those documents relative to the recommendations discussed in Section 3.1. For those portions reviewed, the LLG believes that (1) the guidance to NRC reviewers in NUREG-0810 was generally adequate and; (2) the guidance provided to licensees in NUREG-0762 (Standard Format and Content...) is inadequate in several areas; and (3) the licensee's plan was generally inadequate in those areas.

8.2.2 Recommendations

(1) Consideration should be given to having the IE Emergency Preparedness Branch review radiological contingency plans for nonreactor facilities. The use of this group could make available the expertise developed in reviewing reactor plans, and could enhance communications with the NRC Operations Center personnel.

(2) The Standard Review Plan (NUREG-0810) and the Standard Format and Content document (NUREG-0762) should be reviewed to ensure that they are adequate or revised, if appropriate. The radiological contingency plans for fuel facility and materials licensees should then be reviewed against the revised guidance to ensure that they meet the acceptance criteria.

TABLE 8.1

ASSESSMENT OF PORTIONS OF THE SEQUOYAH RADIOLOGICAL CONTINGENCY PLAN, NUREG-0762 AND NUREG-0810, DERIVED FROM RECOMMENDATIONS MADE IN SECTION 3.1

Section	Item	Document RCP	NUREG-0762 SF&C	NUREG-0810 SRP
3.1.1.2	Plan Maintenance			
	. Overall responsibility for emergency plan	0	?	X
	. Audits of plan implementation	0	?	X
3.1.2.2	Training			
	. Systematic Training Program for Licensee (Site and Corporate)	0	?	X
	. Offsite Agency Training	0	0	X
3.1.3.2	Exercise and Drills			
	. Conduct of Exercises and Drills	0	X	X
	. Offsite Agency Participation	0	X	X
3.1.4.2	Facilities and Equipment			
	. EOC and Alternate/	0	X	X
	Adequate Available Communications	0	?	X
	. Locations of Equipment Caches	0	0	0
	. Air Capsule Escape Units	0	0	0
	. Communications Compatible with Offsite Agencies/	0	0	0
	Pre-identification of Responders	0	0	0

Key

X - Adequately described/acceptable
? - Marginally described/marginally acceptable
0 - Not described or not adequate

EOC - Emergency Operations Center
RCP - Radiological Contingency Plan
SF&C - NUREG-0762, Standard Format and Content
SRP - NUREG-0810, Standard Review Plan

9.0 FUEL FACILITY INSPECTION PROGRAM

9.1 Inspection Program and Procedures

IE Manual Chapter (MC) 2600, Fuel Cycle Facility Radiological Safety Inspection Program, issued May 23, 1984, establishes the radiological safety inspection program for spent-fuel storage, plutonium processing and fuel fabrication, uranium processing and fuel fabrication, UF_6 conversion, uranium recovery, and certain research and development activities associated with these facilities. The major facilities currently licensed and subject to inspection are listed in Appendix B. For UF_6 conversion facilities the inspection program specifies ten programmatic inspection procedures to be performed annually (see Table 9.1). From review of these inspection procedures it is apparent that the inspection program for fuel facilities is designed to emphasize the direct radiological safety aspects of facility operation.

Manual Chapter 2600 superseded the previously issued Manual Chapter 2655 which identified nineteen separate inspection modules. Discussion with Office of Inspection and Enforcement (IE) personnel indicated that Manual Chapter 2600 issued in 1984 consolidated many of the individual inspection procedures in an effort to streamline the inspection program documentation and guidance.

9.1.1 Discussion

As part of the budget process, the Program Support and Analysis Staff (PSAS), Office of Inspection and Enforcement, has in the past provided to the NRC regions a Planned Expenditure File (PEF). The PEF at that time provided inspection resource expenditures considered by IE to be reasonable for specifically identified facilities. For example, in 1984 Region IV was provided a PEF of about 30 onsite inspection-hours as reasonable to complete the inspection procedures at the Sequoyah Fuels Corporation facility at Gore for that year.

Specific resource expenditures per facility are no longer provided by IE in the PEF, but rather are provided as an overall collective resource figure for the number of similar type programs in the region (that is, byproduct materials, fuel facilities, etc.). For fiscal year 1986 Region IV was provided a collective resource figure of 1.47 staff years to be applied to all uranium mills plus the Sequoyah Fuels Corporation, Gore facility. From this collective budget and considering past resource expenditures at the Sequoyah Fuels Corporation, Region IV assigned 0.06 staff years or about 40 onsite inspection-hours for that facility.

Discussions with the Region IV staff indicated that determination of this inspection resource expenditure for the Sequoyah Fuel Corporation facility has been largely a function of what was previously expended to perform the program. The LLG determined that an average of about 35 inspection-hours per year was expended at the facility since 1975.

Since 1970, only a few items of noncompliance of a relatively minor nature were ever cited. The Region IV impression was that the facility, though not outstanding, was able to manage the operation to generally meet the regulatory requirements specified in the license. While it is apparent that Region IV's inspection effort at Sequoyah was limited, based on Region IV's perspective of the scope of the inspections and licensee's past performance, such level of effort may have seemed justified.

In comparison, the inspection resource expenditure of Region III at Allied Chemical's UF_6 conversion facility was generally about 80-96 inspection-hours per year. Further, discussions with IE Safeguards and Materials Programs Branch personnel indicate that a least 92 inspection-hours per year are appropriate to complete the inspection program for such facilities. As a result of discussions with the LLG, it appeared that the Region IV inspection staff was not aware of the resource allocation that IE assumed was appropriate for UF_6 facilities.

The inspections performed at the Sequoyah facility over the 10-year period concentrated on matters pertaining to inplant radiological safety, monitoring, and control of releases of radioactive material to the environment, waste management of radioactive material, and emergency preparedness. Aspects of facility operation such as engineering and design control, establishment and adequacy of administrative and operating procedures, the selection, training, and qualification of management and technical personnel associated with the facility, and the control of hazardous chemicals were not generally inspected during this period. While several different inspectors performed these inspections, all were radiation specialists (health physicists). Furthermore, there has been no apparent continuity of inspectors assigned to inspect the facility. While one inspector is shown to have performed more inspections than others in this period, the single inspection per year and the intermittent use of the same inspector do not indicate continuity in inspection program implementation.

Sequoyah inspection reports for this period indicated that the scope of the inspections was largely a function of individual inspector expertise. The Region IV inspectors had expertise in radiation safety but little operational experience in UF_6 conversion operations. Consequently, the inspection procedures were generally interpreted to apply predominantly to radiation protection aspects, even though some inspection guidance addressed operational aspects. Such interpretation of the inspection procedures is understandable since the license conditions and commitments are largely radiological in nature (See Section 8.1), and the inspection guidance for operations review tends to be overshadowed by the dominance of procedures and guidance for the direct radiological safety aspects. Although there may have been some deficiency in interpreting inspection guidance relative to operations review, Region IV's execution of the inspection program for the Sequoyah facility was generally in accordance with IE policy.

While workers at UF_6 conversion facilities are subjected to some radiological risk due to inhalation or ingestion of uranium, the chemical toxicity of the element in the soluble form is of more consequence. If any personnel are found to have injury caused by uranium exposure, it will likely be as a result of the chemical toxicity. However, additional risk may be attributed to other chemi-

cal hazards that are integral to the UF_6 conversion process. For example, both anhydrous and aqueous hydrofluoric acid are stored and used, as well as ammonia and 60% and 40% nitric acid. Associated with UF_6 conversion are chemical processes involving hydrogen fluoride (HF) gas, nitric acid vapors, nitrogen oxides, hexane and nitric acid. In fact, the unfortunate fatality in the January 4, 1986 accident was directly attributable to the HF produced by the reaction UF_6 with H_2O. Even in the worst-case accident scenario that the January 4, 1986 event represented, the radiological impact to both onsite workers and the public is considered to be insignificant, as reported in NUREG-1189, Vol. 1.

Although it was generally recognized even before the accident that worker health and safety were likely to be more affected by the chemical toxicity rather than the radiological nature of the UF_6 operation, the NRC licensing and inspection process focused on radiological risk control and mitigation. Such NRC focus is understandable in that NRC's traditional concern is with the receipt, possession and use of the licensed material as opposed to process or product-related attributes not having a direct bearing on radiological safety. What may be missed by this traditional perspective is the consideration of systems, processes, product-related attributes, procedures and operations which may indirectly affect radiological safety.

9.1.2 Recommendations

(1) The inspection program procedures contained in IE Manual Chapter 2600 should be revised to better emphasize inspection program aspects relative to procedures, hardware, and personnel training and qualifications that indirectly affect radiological safety and radioactive material control.

(2) Anticipated inspection resource expenditures allotted by IE for major fuel facilities should be clearly identified for each individual facility, rather than being identified collectively, and reassessed with consideration of variations in complexity of facility operations and associated hazards that directly or indirectly affect radiological safety.

(3) Efforts should be made by regional offices to assure continuity in the designation of inspectors assigned to inspect major fuel facilities.

9.2 Training and Qualification

9.2.1 Discussion

Interviews of NRC Region IV personnel associated with the inspection at the Sequoyah facility indicated that they generally were unaware of the specific thermal mechanical behavior of UF_6. Only a few of the personnel were aware of technical documents, such as ORO-651, that pertain to UF_6 handling.

Relative to inspector qualifications, IE Manual Chapter 1231, provides guidelines for the qualification of inspectors through regional, formal classroom, and on-the-job training. Except for safeguards inspectors, there are no qualification requirements for inspectors of fuel facilities beyond expertise in radiological safety. Inspectors are qualified only as fuel facility radiation specialists. Such qualification currently requires courses in

respiratory protection, wholebody counting and internal dosimetry. Fuel facility inspectors have qualifications in chemical engineering or fuel facility operations only if they had that experience before they were hired by the NRC or acquired it through extensive on-the-job training. Consequently, there are few inspectors within NRC who have expertise to comprehensively inspect fuel facility operations. However, there are inspection personnel with the necessary specialized expertise to inspect certain specific areas such as radiation safety, fire protection, and emergency (contingency) planning.

9.2.2 Recommendations

(1) Personnel associated with the establishment and implementation of inspection programs for major fuel facilities should be trained in aspects of the processing and handling of licensed material that directly or indirectly affect radiological safety and control of the material, as well as radiological contingency planning.

(2) The inspector qualification procedures contained in IE Manual Chapter 1231, Inspector Qualifications, should be amended to broaden the required qualification and formal training of fuel facility inspectors to develop overall expertise in the facility operations.

(3) Technical publications and information relevant to the technology, including standards and processes employed in fuel facility operations, should be referenced in IE inspection program procedures to provide guidance to inspection personnel.

(4) Since the current number of inspection personnel with fuel facility expertise and experience is limited, better utilization of these personnel appears necessary. This can be accomplished by interregional utilization of such personnel, consolidation of fuel facility inspection responsibility into fewer regions, or conduct of periodic team inspections by the region using appropriate specialists.

TABLE 9.1

IE MANUAL CHAPTER 2600
FUEL CYCLE INSPECTION PROCEDURES

Number	Title
30703	Management-Entrance/Exit Interviews
88005	Management Organization & Controls 1. Organizational Structure 2. Procedure Controls 3. Reviews and Audits 4. Safety Committees 5. Quality Assurance Programs
88010	Operator Training/Retraining 1. New Employee Indoctrination 2. Ongoing Training 3. Retraining
88020	Operations Review 1. Conduct of Operations, Facility Modifications and Changes, Safety Limits/LCOs 2. Housekeeping 3. Fuel Handling and Storage
88025	Maintenance/Surveillance Testing 1. Maintenance 2. Surveillance Testing 3. Calibrations
83822	Radiation Protection 1. Radiation Protection Procedures 2. Instruments and Equipment 3. Exposure Controls 4. Posting and Labeling 5. Surveys 6. Modification and Reports

TABLE 9.1 (Cont'd)

IE MANUAL CHAPTER 2600
FUEL CYCLE INSPECTION PROCEDURES

Number	Title
88035	Radioactive Waste Management 1. Liquid Effluents 2. Airborne Effluents 3. Records and Reports 4. Effluent Monitoring Instruments 5. Procedures 6. Radioactive Solid Waste 7. Waste Burial 8. Storage of High Level Liquid Waste
86740	Transportation of Radioactive Materials 1. Routine Maintenance of Reusable Packages 2. Packaging and Transportation Activities 3. Part 61 Requirements for Waste Generators (Waste Manifest)
88045	Environmental Protection 1. Management Controls 2. Quality Control/Analytical Measurements 3. Program Implementation
88050	Emergency Preparedness 1. Off-Site Support Agencies 2. Emergency Plans, Procedures, Facilities and Equipment 3. Tests and Drills 4. Fire Protection
84850	Inspection of Waste Generator Requirements of 10 CFR 20 and 10 CFR 61

TABLE 9.2

INSPECTION PROGRAM IMPLEMENTATION AT
SEQUOYAH FUELS CORPORATION
1975 - 1985

YEAR	INSPECTION NO.	HOURS ON-SITE	DESIGNATED INSPECTOR	DATE	INSPECTION TYPE
1985	85-01	74	A, B	3/11-15/85	Rad Safety
	85-02	3	C	8/29/85	Non-Program Split Sample
1984	84-01	24	D	7/17-19/84	Rad Safety
1983	83-01	56	A, E	2/14-18/83	Rad Safety
1982	82-01	54	D, F	2/22-25/82	Rad Safety
1981					No Inspection
1980	80-01	19	G	7/23-25/80	Rad Safety
1979	79-01	23	D	5/21-24/79	Rad Safety
1978	78-01	16	D, H	8/10-11/78	Rad Safety
	78-02	8*	I	12/04-05/78	Non-Program Investigation
1977	77-01	32	H, J	6/15-17/77	Rad Safety
1976	76-01	32*	K, J	7/28-30/76	Rad Safety
1975	75-01	16*	L	7/07-09/75	Rad Safety

*Assumed hours based on inspection dates and number of inspector participants.

APPENDIX A

PRIMARY INDIVIDUALS INTERVIEWED

NRC HEADQUARTERS

IE

W. Burton
L. Cobb
M. Hawkins
J. Himes
K. Perkins
D. Marksberry
J. Metzger
J. Partlow
R. Priebe
C. Sakenas
D. Sly
J. Taylor
R. Vollmer
B. Weiss
B. Zalcman

NMSS

D. Cool
W. Crow
R. Cunningham
J. Davis
M. Horn
J. Long
D. Mausshardt
E. Shum
V. Tharpe

REGION IV

R. Bangert
E. Bates
C. Cain
P. Check
R. Everett
C. Hackney
C. Jierree
R. Martin
B. Murray
G. Sanborn
D. Smith
B. Spitzberg
C. Wisner

OKLAHOMA DEPARTMENT OF PUBLIC HEALTH

M. Coleman
R. Craig
J. McHard
F. Walker

OKLAHOMA HIGHWAY PATROL

R. Banks

GORE, OKLAHOMA POLICE

J. Partain
J. Fields

SEQUOYAH COUNTY HEALTH DEPARTMENT

R. Barnett
M. Jones

SEQUOYAH MEMORIAL HOSPITAL

C. McClure
M. Herndon
R. Robbins
R. Roark
C. Wade

EG&G (DOE CONTRACTOR)

Z. Burson

MARTIN MARIETTA (DOE CONTRACTOR)

J. Dew
R. Donnelly
J. Grisham
C. Mason
K. Ross
W. Switzer
J. Thomas
R. Veasy
N. Windt

SEQUOYAH COUNTY CIVIL DEFENSE

A. Martin

ALLIED CHEMICAL CORPORATION

J. Bishop
R. Hahn
J. Honey
R. Yates

KERR-McGEE CORPORATION/SEQUOYAH FACILITY

C. Burdict
J. Carr
S. Clark
C. Grosclaude
S. Emerson
G. Jackson
L. Lacy
J. Marler
D. Martin
D. McCary
J. Stauter
L. Tharpe
W. Utnage

APPENDIX B

MAJOR FUEL FACILITIES LICENSED BY NRC

1. Combustion Engineering, Windsor Locks, Connecticut
2. United Nuclear Corporation, Montville, Connecticut
3. General Electric Company, Wilmington, North Carolina
4. Nuclear Fuel Services, Erwin, Tennessee
5. Westinghouse Corporation, Columbia, South Carolina
6. Combustion Engineering Corporation, Hematite, Missouri
7. Allied Chemical Corporation, Metropolis, Illinois
8. Sequoyah Fuels Corporation, Gore, Oklahoma
9. General Atomic, LaJolla, California
10. Exxon Corporation, Richland, Washington
11. Babcock and Wilcox, Lynchburg, Virginia

APPENDIX C

U.S. Department of Labor

Assistant Secretary for
Occupational Safety and Health
Washington, D.C. 20210

MAR 13 1986

The Honorable Nunzio J. Palladino
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Chairman:

This letter is in regard to the investigation conducted by the Occupational Safety and Health Administration (OSHA) of the January 4, 1986, accident at the Sequoyah Fuel Corporation uranium hexafluoride conversion plant near Gore, Oklahoma.

Before describing the actions taken by OSHA in response to the incident, I believe it will be helpful to explain OSHA's authority at nuclear facilities such as Sequoyah. The Occupational Safety and Health Act of 1970 (the OSH Act), covers nearly all the nation's employers. The Congress anticipated potential duplication by including in the Act a provision, section 4(b)(1), that takes into account other Federal laws which deal in varying degrees with employee safety and health. Under this section, the OSH Act's provisions do not apply to those working conditions of employees for which another Federal agency, or a State agency acting under section 274 of the Atomic Energy Act of 1954, as amended, exercises statutory authority to prescribe or enforce standards or regulations affecting occupational safety and health.

At nuclear facilities, the NRC has licensing authority for all non-military uses of source material such as uranium hexafluoride, byproduct material, and special nuclear materials. As part of its licensing authority, NRC has issued regulations to limit employee exposure to radiation from these licensed sources. Under NRC's regulations, licenses for the handling of such materials are issued only if the applicant's proposed equipment, facilities, and procedures are adequate to protect health and minimize danger to life and property. Thus, to the extent that the NRC license addresses working conditions, section 4(b)(1) of the OSH Act prohibits the application of OSHA regulations to the same hazards. Based on this limiting provision of our law, it is OSHA's position that we have no authority under the OSH Act to issue citations pertaining to the January 4 incident. The decision was not made lightly, but only after a careful onsite investigation, a review of the facts in the case, and in consultation with the Office of the Solicitor of Labor.

It may be instructive at this point to provide you with a brief description of OSHA's action regarding the Sequoyah incident.

On January 5, 1986, OSHA dispatched an investigation team to the site to commence an initial investigation. While it appeared to us that the events leading up to the accident were related to working conditions covered by NRC's licensing agreement with the company, it was impossible to make such a determination with any degree of certainty at that point. Under such circumstances, when it is not readily apparent which Federal agency is the appropriate enforcement authority, OSHA generally proceeds with an immediate investigation, while continuing to work with the other agency to clarify Federal coverage.

On Monday, January 6, discussions of the jurisdictional issues were held between officials at the regional and national offices of the two agencies. Based on these discussions, NRC indicated that it had the statutory authority to proceed in this case, and OSHA decided to defer to NRC in its investigation.

A week later, after NRC had further opportunity to consider the circumstances of the accident, NRC's Director of Inspection Programs requested that OSHA resume its investigation. NRC reasoned that employee exposure to hydrogen fluoride appeared to be the major issue at Sequoyah, rather than improper handling of radiological materials. While OSHA still had reservations about its statutory authority to proceed, the agency nonetheless affirmed on January 16 that it was reopening its investigation. The investigation proceeded and the onsite portion was completed in late January. The case file was then submitted to the OSHA National Office for a technical and legal review. As we have noted, this review has shown that OSHA may not issue citations pertaining to hazards subject to another agency's authority.

Because of our inability to issue any citation, we are forwarding a copy of our findings which you may wish to use in any enforcement action contemplated on your part. Please note that all of the proposed citations and penalties are drafts. They did not undergo the routine internal review which would have been completed prior to their issuance If such review had taken place, changes might have been made to the classification of the violations, the penalty amounts, or the standards cited.

Please be assured that OSHA will be available to assist in any way possible regarding your investigation of this case and other employee-related matters at NRC-licensed facilities.

Sincerely,

Patrick R. Tyson
Acting Assistant Secretary

Enclosures (5)

OSHA FILES

TABLE OF CONTENTS

Health -1 of 5:
- Health Inspection History
- Proposed draft citations
- OSHA-1 Form: Inspection worksheet
- OSHA-36 Fatality report
- OSHA 1A Inspection History- narrative
- Summary of incident

Health - 2 of 5:
- License Information
- OSHA 1Bs : Worksheets relative to alleged violations, with interviews, references, etc.

Health - 3 of 5:
- OSHA 1Bs : Worksheets relative to alleged violations, with interviews, references, etc.

Health - 4 of 5:
- References re: alarm systems
- Sequoyah SOPs re: Receiving and Handling Chemicals:
  - N-340-1-Rev 1
  - N-340-2-Rev 3
  - N-340-3-Rev 2
  - N-340-4-Rev 4
  - N-340-5-Rev 5
  - N-340-6-Rev 1
  - N-340-8A-Rev 2
  - N-340-8B-Rev 2
- Other references and interviews

Health - 5 of 5:
- Not sent. Contains NUREG 3.55, April 1985, Standard Format and Content of License Renewal Applications for Uranium Hexafluoride Production
- 1/16/86 letter Mr. Utnage to NRC, Dallas
- NRC Regulatory Guide -Occupational Health, Aug!78
- AEC draft of 8.15, July 1974
- NUREG 8.15, Acceptable Programs for Respiratory Equipment
- NUREG 0041, Manual Respiratory Protection Against Airborne Radioactive Materials

OSHA FILES

TABLE OF CONTENTS

Safety - 1 of 3: History of Inspection and Summary of Occurrence
References and interviews
Draft proposed citations
OSHA 1Bs - Worksheets relative to alleged violations, with interviews, references, etc.

Safety - 2 0f 3: Not sent. Contains the following:
Newspaper articles
NRC memo's relative to incident

Material forwarded from DOE: Uranium Hexafuoride Handling Procedures and Container Criteris, ORO-651

ANSI N-14.1-1982 (revised from 1971) ANSI standard for Packaging Uranium Hexafluoride for Transport

SOP's Martin Marietta (Oak Ridge Plant)

Summary of like accident - 1960

Safety - 3 of 3: Not sent. Sequoyah Fuel Corp. Contingency Plan for the Gore Plant

Also available on file: License Renewal-Safety Evaluation Report by NRC, Environmental Assessment (NUREG -1157)
License Renewal Application, Part 1
License Conditions (Chapters 1-8)
Part II: Safety Demonstration, (Chapters 9-17)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

October 10, 1984

MEMORANDUM FOR: Frank P. Gillespie, Director
Division of Risk Analysis and Operations
Office of Nuclear Regulatory Research

FROM: William J. Olmstead
Director and Chief Counsel, Regulations Division
Office of the Executive Legal Director

SUBJECT: CHEMICAL TOXICITY OF UF_6 AND EMERGENCY PREPAREDNESS

In your memorandum of August 23, 1984 you requested our opinion on whether NRC has the legal authority to base emergency preparedness regulations for a uranium hexaflouride (UF_6) release on the chemical toxicity of the compound. It is our conclusion that the chemical toxicity of uranium compounds may be taken into consideration in developing regulations to protect the public health and safety from the radiological effects of UF_6.

Although the predominant regulatory concern of the NRC for protection of public health and safety has been the radiological hazards associated with source, byproduct, and special nuclear material, under the Atomic Energy Act of 1954, as amended, Commission regulatory authority can be more extensive. The Atomic Energy Act confers broad authority to regulate the use and possession of the defined classes of nuclear materials, i.e., source, byproduct, and special nuclear, in order to protect public health, minimize danger to life or property from the hazards associated with these materials, and to prevent possession and use inimical to the common defense and security. Section 161i.(3) permits the Commission, by rule or order, to regulate any activity authorized by the Act including standards and restrictions governing the operation of facilities used in the activity. Section 161b authorizes the Commission to establish whatever regulations it deems necessary or desirable to protect health and to minimize danger to life or property with respect to the possession and use of source, byproduct, and special nuclear material. In the case of source material Section 63b(1) states that the physical characteristics of source material are to be considered in writing rules for its possession and use. The physical characteristics of source material would include both its chemical and radiological characteristics. Section 53b(1) states the same for special nuclear material. UF_6 can be either source material or special nuclear material depending on whether or not the uranium has been enriched. Under this broad authority the Commission has exercised regulatory authority over all integral parts of an activity for which an NRC license is required by the Atomic Energy Act. See legal opinions printed in the hearing, "Uranium Mill Tailings Control Act of 1978," before the Subcommittee on Energy and power, Committee on Interstate and Foreign Commerce, 95th Cong. 2d Sess., June 19, 20, and August 2, 1978, at pp. 204-207.

The chemical toxicity of uranium has already been considered in the Commission's regulations. It is our understanding that the values for soluble uranium in air in 10 CFR Part 20, Appendix B are based upon the chemical toxicity of uranium in the human kidney rather than its radiological hazard, even though the concentration limits are expressed in terms of radioactivity.[1/] See fn. 4 to Appendix B, 10 CFR Part 20, 39 F.R. 23990 (June 28, 1974). These values would apply to a release of UF_6 that on contact with air hydrolyzes to UO_2F_2, a compound very soluble in body fluids which would be absorbed into the blood via the lungs.[2/]

As a supplement to the Atomic Energy Act, the National Environmental Policy Act of 1969 (NEPA) also supports the establishment of regulations for protection of public health, safety and the environment from other hazardous materials produced in the course of using source, byproduct, or special nuclear material. Calvert Cliff's Coordinating Committee v. AEC, 449 F.2d 1109 (D.C. Cir 1971) imposed upon the Commission an obligation not only to consider environmental concerns, radiological and nonradiological, but also to take action to mitigate adverse impacts. Ibid p. 1128. See also, Public Service Co v. NRC, 582 F.2d 77 (1st Cir. 1978) (Commission has jurisdiction under Atomic Energy Act to order rerouting of transmission lines to minimize adverse environmental impacts). To implement NEPA objectives in individual licensing actions involving possession and use of UF_6 (both natural and enriched), NRC licenses are already routinely conditioned under Atomic Energy Act authority to require monitoring of emissions of other fluoride compounds such as HF, and the keeping of monitoring records. However, to avoid dual regulation of such other fluoride compounds, enforcement of violations of Clean Air Act health standards revealed by such monitoring is left to the States, or EPA, as appropriate.[3/]

1/ Personal communication from Ralph G. Page, Chief, Uranium Fuel Licensing Branch, Division of Fuel Cycle and Material Safety, ONMSS

2/ Chemical damage to the kidney sets the basis for bioassay (urinalysis) in uranium mills. See Regulatory Guide 8.22. It is also a factor in the general bioassay program in Regulatory Guide 8.11, in the health physics survey described in Regulatory Guide 8.24, and in the ALARA program for uranium mills in Regulatory Guide 8.31.

3/ 40 CFR 190, which was promulgated by EPA under Atomic Energy Act authority, sets the standard for environmental releases of uranium only with respect to radiological consequences. EPA authority under the Atomic Energy Act to establish generally applicable environmental protection standards for uranium does not limit the authority of the NRC to establish specific regulations for emergency preparedness by persons possessing and using UF_6. The latter is a matter of regulating directly the licensed activities of persons under the Atomic Energy Act.

It is clear from the preceding discussion that licenses are not infrequently conditioned under Atomic Energy Act authority to regulate non-radiological concerns related to the use of source, byproduct, and special nuclear materials. Because the Atomic Energy Act allows regulation by rule on an equal basis to regulation by license condition, it is our opinion that a rule under Atomic Energy Act authority for emergency preparedness for licensees possessing and using UF_6 may be based upon its chemical toxicity as well as its radiological characteristics.

William J. Olmstead
Director and Chief Counsel
Regulations Division
Office of the Executive
Legal Director

cc: R.G. Page, ONMSS

QUESTION 9. Does the Commission have the legal authority to regulate the handling of non-radiological hazardous chemicals at facilities it licenses? Are there any legal restrictions on NRC's authority to regulate such chemicals? Provide our Subcommittees with a legal analysis addressing this matter.

ANSWER.

Under the Atomic Energy Act of 1954, as amended, the Commission's primary responsibility is to regulate the use of source, byproduct, and special nuclear material in order to protect the health and safety of the public and of those who may be occupationally exposed. The National Environmental Policy Act requires the Commission, as it does all Federal agencies, to take into account environmental values and to mitigate environmental harm from the activities it regulates. In the regulation of source, byproduct and special nuclear material under these authorities it is frequently difficult to draw a clean line of authority between radioactive materials clearly subject to the Commission's authority and other chemicals used in the processing of the Atomic Energy Act materials.

The Commission believes that questions on Commission jurisdiction and authority over hazardous chemicals are best answered with respect to a set of facts where the chemical and chemical process can be analyzed in relation to the regulated nuclear activity and the radiation hazard involved.

In general, Atomic Energy Act radioactive materials are to be found in the form of chemical compounds, solutions, or alloys with other elements. No matter what chemical or physical form source, byproduct, or special nuclear material may take, it remains subject to the Commission's authority. (The only exceptions are those allowed by the Atomic Energy Act itself for the Department of Energy and certain military uses). Because of this fact, the Commission believes that its authority under the Atomic Energy Act is adequate to regulate radiological hazards regardless of the various chemical and physical forms in which source, byproduct, and special nuclear material occur.

More difficult questions are posed by the fact that many of the regulated uses of nuclear materials also present non-radiological health hazards and are accompanied by ancillary chemical processes that in themselves do not involve nuclear materials. For example, a plant for conversion of uranium oxide to uranium hexafluoride will have a separate operation for the production of fluorine to be used in the conversion process. Such a separate chemical process is not regulated by the Commission since it does not involve nuclear material. Only when the chemical is reacted with the nuclear material does the Commission exercise its authority over the process for the purpose of ensuring public health and safety. Sealed sources in gauges would present another example.

NRC FORM 335 (2-84) NRCM 1102, 3201, 3202

BIBLIOGRAPHIC DATA SHEET

SEE INSTRUCTIONS ON THE REVERSE.

NUREG-1198

2. TITLE AND SUBTITLE

RELEASE OF UF_6 FROM A RUPTURED MODEL 48Y CYLINDER AT SEQUOYAH FUELS CORPORATION FACILITY: LESSONS-LEARNED REPORT

3. LEAVE BLANK

4. DATE REPORT COMPLETED

MONTH: May | YEAR: 1986

5. AUTHOR(S)

LESSONS-LEARNED GROUP

6. DATE REPORT ISSUED

MONTH: June | YEAR: 1986

7. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)

U.S. Nuclear Regulatory Commission
Washington, DC 20555

8. PROJECT/TASK/WORK UNIT NUMBER

9. FIN OR GRANT NUMBER

Regulatory Topical

10. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)

Same as 7, above.

11a. TYPE OF REPORT

b. PERIOD COVERED (Inclusive dates)

12. SUPPLEMENTARY NOTES

13. ABSTRACT (200 words or less)

The uranium hexafluoride (UF_6) release of January 4, 1986, at the Sequoyah Fuels Corporation facility has been reviewed by a NRC Lessons-Learned Group. A Model 48Y cylinder containing UF_6 ruptured upon being heated after it was grossly overfilled. The UF_6 released upon rupture of the cylinder reacted with airborne moisture to produce hydrofluoric acid (HF) and uranyl fluoride (UO_2F_2). One individual died from exposure to airborne HF and several others were injured. There were no significant immediate effects from exposure to uranyl fluoride.

This report of the Lessons-Learned Group presents discussions and recommendations on the process, operation and design of the facility, as well as on the responses of the licensee, NRC, and other local, state and federal agencies to the incident. It also provides recommendations in the areas of NRC licensing and inspection of fuel facility and certain other NMSS licensees. The implementation of some recommendations will depend on decisions to be made regarding the scope of NRC responsibilities with respect to those aspects of the design and operation of such facilities that are not directly related to radiological safety.

14. DOCUMENT ANALYSIS - a. KEYWORDS/DESCRIPTORS

Uranium hexafluoride release, Sequoyah Fuels Corporation Facility, Kerr-McGee, cylinder rupture, lessons learned, licensing and inspection of fuel facilities, radiological safety, chemical hazards.

b. IDENTIFIERS/OPEN-ENDED TERMS

Radiological safety, chemical hazards, emergency preparedness, licensing, inspection

15. AVAILABILITY STATEMENT

Unlimited

16. SECURITY CLASSIFICATION

(This page) Unclassified

(This report) Unclassified

17. NUMBER OF PAGES

18. PRICE

These sources are subject to Commission regulation, but the Commission has never undertaken to exercise authority over the chemical processes monitored with these gauges. Put simply, in the area of nuclear materials regulation under the Atomic Energy Act, generally regulation by the Commission has been related in some reasonable manner to the radiological hazards of source, byproduct or special nuclear material and to the radiation hazard presented by these materials. Cf., New Hampshire, v. Atomic Energy Commission, 406 F.2d 170 (First Cir. 1969). (We do not address here the much more complex issues presented by the regulation of production and utilization facilities under the Atomic Energy Act.)

Mitigation of environmental impacts under the National Environmental Policy Act presents a separate issue. The Commission conditions licenses to monitor and reduce the environmental impacts of licensed activities. This frequently involves the application of EPA or State environmental standards covering hazardous chemical effluents under legislation such as the Clean Air Act or Safe Drinking Water Act. The Commission does not, however, under the limitations of Section 511(c)(2) of the Federal Water Pollution Control Act regulate non-radiological effluents in point discharges into watercourses covered by permits under that Act.

Hazardous chemical effluents from uranium mills may also be regulated by the Commission under the Uranium Mill Tailings Radiation Control Act and EPA regulations in 40 CFR 192.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

NUREG-1198

RELEASE OF UF_6 FROM A RUPTURED MODEL 48Y CYLINDER AT SEQUOYAH FUELS CORPORATION FACILITY: LESSONS-LEARNED REPORT

JUNE 1986