ACCIDENTAL RELEASE OF UF_6 AT THE SEQUOYAH FUELS CORPORATION FACILITY AT GORE, OKLAHOMA, U.S.A.

Edward Y. Shum
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission

INTRODUCTION

On January 4, 1986, a 14-ton UF_6 cylinder ruptured at the Sequoyah Fuels Corporation (SFC) site at Gore, Oklahoma, U.S.A., resulting in a massive release of uranium hexafluoride (UF_6). One SFC worker was killed and some workers were hospitalized. About 100 offsite individuals were admitted for medical "screening" in a local hospital.

Shortly after the accident, the Nuclear Regulatory Commission (NRC) gathered a group of experts (the Ad Hoc Interagency Task Force) to assess the potential health impact to the general public from this accident. In addition, the NRC formed a group on "Lessons Learned from the Accident" to review and improve the protection of the general public from future accidents.

A description of the accident, the public health impact, development of procedures for hospital "screening", suggestions for future improvements, and the requirement for emergency planning for this type of facility is discussed in the following sections.

DESCRIPTION OF THE ACCIDENT

On Saturday, January 4, 1986, at approximately 11:30 a.m., a cylinder containing about 29,500 pounds of uranium hexafluoride (UF_6) ruptured at the SFC site, releasing its contents into the atmosphere. According to statements from SFC officials, plant employees had inadvertently overfilled a 14-ton cylinder (maximum limit is 27,560 lbs.) and were in the process of heating the cylinder to facilitate removing the excess UF_6 when the rupture occurred.

As a result of overpressurization, the wall of the 12-foot long cylinder split over a length of about 52 inches parallel to the axis of the cylinder forming an opening about 8 inches wide at the midpoint of the split. Because of the high pressure in the cylinder, the large size of the opening, and because the cylinder rotated so that the split was on the lower side, much of the UF_6 came out of the cylinder rapidly.

Released UF_6 and its reaction products, UO_2F_2 and HF, made a dense white cloud which, pushed by the wind, quickly engulfed the process building (the Sequoyah Facility's principal structure) and formed a plume expanding to the south-southeast of the plant site. At the time of the incident, there were 42 workers at the plant site. One employee was in a scrubbing tower adjacent to the release point; his location was promptly enveloped in the initial plume from the release, and he died within a few hours of respiratory injuries. Approximately 37 people, mostly company employees, were hospitalized as a result

of the incident, but only a few were diagnosed as suffering from respiratory problems related to inhalation of hydrogen fluoride. About 100 offsite individuals reported to the local hospital for medical "screening".

PUBLIC HEALTH IMPACT

On January 14, 1986, the Nuclear Regulatory Commission (NRC) gathered a group of experts (the Ad Hoc Interagency Task Force) to assess the potential health impact to the general public from this accident. A report was published in March 1987 (NUREG-1189).[1] Based on the available data at that time, the Ad Hoc Interagency Task Force made the following conclusions and recommendations:

SFC Workers

The workers involved in this incident encountered exceptionally high uranium exposures and intakes (as estimated by urine uranium levels). These exposures were at levels at which one would expect from past experience at least some temporary renal (kidney) injury in a significant number of those exposed. No conclusions could be drawn with regard to more permanent and serious injury to some of the more highly exposed workers because they were exposed to levels at which there are no reliable data relating to human exposures.

The Ad Hoc Interagency Task Force recommended that workers exposed during the incident should be monitored carefully for evidence of pulmonary and renal injury. Medical surveillance of these individuals should be performed for a period of 1 to 2 years or until such time that renal and/or pulmonary function is determined by physicians to be acceptable in their professional opinion. These individuals should receive periodic evaluations, preferably every 6 months.

The maximum uranium intake among onsite workers was approximately 28 mg. The estimated effective whole-body equivalent dose for this maximally exposed worker was about 0.46 mSv (46 mrem).

Offsite Individuals

Around 100 offsite individuals submitted urine samples; of these, most showed no evidence of exposure, while 7 received low-level uranium exposure. The intakes for these individuals ranged from 0.1 to 0.9 mg uranium. The effective whole body equivalent for the maximally exposed offsite individual was about 0.014 mSv (1.4 mrem). This is insignificant compared with background radiation of 1.06 mSv/yr (106 mrem/yr) in the area. The population dose for the affected population sector to 80 km (50 miles) from the site was about 0.0048 person-Sv (0.48 person-rem) which was insignificant compared with the annual natural background radiation of 8.4 person-Sv (840 person-rem) received by the same affected population.

Offsite Contamination

A comprehensive survey was conducted after the accident covering affected areas up to 10 miles from the site. The survey included soil, vegetation, and surface water sampling, and aerial and in-situ radiological surveys. The results indicated that no significant uranium or fluoride deposited offsite. Most of the contamination was found onsite within the site boundary.

LESSONS LEARNED FROM THE ACCIDENT

After the accident, the NRC formed a Lessons Learned Group to review and improve the protection of the general public from future accidents. A report (NUREG-1198)[2] titled "Release of UF_6 from a Ruptured Model 48Y Cylinder at Sequoyah Fuels Corporation Facility, Lessons-Learned Report" was published in August 1986. Some of the major recommendations have been reflected in the following topics.

EMERGENCY PLANNING FOR FUEL CYCLE AND OTHER RADIOACTIVE MATERIAL LICENSEES

In the NRC's current proposed rules for emergency preparedness for fuel cycle and other radioactive material facilities (nuclear power plants are not in the same category)[3], the proposed requirements for emergency planning if it is needed, should include the following items:

1. Facility description: A brief description of the licensee's facility and area near the site.

2. Types and classification of accident: An identification of each type of accident for which protective action might be needed.

3. Detection of accident: Identification of the means of detecting each type of accident.

4. Mitigation of consequences: A brief description of the means and equipment for mitigating the consequences of each type of accident.

5. Assessment of releases: A brief description of the methods and equipment to assess releases of radioactive materials.

6. Responsibilities: A brief description of the responsibilities of licensee personnel should an accident occur.

7. Notification and coordination: A commitment to and a brief description of the means to promptly notify offsite response organizations and request offsite assistance, including medical assistance for the treatment of contaminated and/or injured onsite workers when appropriate.

8. Information to be communicated: A brief description of the types of information on facility status radioactive releases and recommended actions, if necessary, to be given to offsite response organizations and to the NRC.

9. Training: A brief description of the training the licensee will provide workers on how to respond to an emergency and any special instructions and orientation tours the licensee would offer to fire, police, medical, and other emergency personnel.

10. Recovery: A brief description of the means of restoring the facility to a safe condition after an accident.

11. Exercises and audits: Provisions for conducting quarterly communication checks with offsite response organizations and annual onsite exercises to test responses to simulated emergencies.

PROCEDURES FOR MEDICAL SCREENING FOR ACCIDENTAL EXPOSURES

After the SFC accident, it was determined that emergency chemical and radiological bioassay procedures to evaluate the exposure of individuals to these materials under accident conditions need to be developed. The NRC has contracted the Brookhaven National Laboratory (BNL) to develop emergency bioassay procedures for medical "screening" for accidental exposures to alpha-emitters. A table is to be developed for each radionuclide, (UF_6, Am-242, Pu, Cm, and Po-210,) showing the recommended bioassays. The table will outline the bioassay program and follow-up action recommended for three groups of people by level of exposures: (1) people with exposures believed to be far above 10 CFR Part 20 limits; (2) people believed to have significant exposures, but not greatly above Part 20 limits; and (3) people believed to have low or no exposure. Guidance will be provided for determining assignment to these groups. For each exposure group, the recommended bioassay schedule should be presented for the following time periods: (1) the first day; (2) day 2 and 3; and (3) day 4 through 7. Beyond 7 days, it is anticipated that the NRC and the licensee will be able to assemble whatever resources are necessary to deal with the specific accident. Instructions concerning proper specimen submittal, prevention of specimen contamination, and specimen preservation will be included so that appropriate measurements can be performed either promptly or later. The work will be published as an NRC NUREG report.

CONCLUSION

After the SFC accident, the NRC has made additional requirements on the emergency planning for fuel cycle and other radioactive material licensees. Guidelines are being prepared to provide procedures for medical "screening" to further improve the protection of the general public from future accidents.

REFERENCES:

1. NUREG-1189. Assessment of the Public Health Impact from the Accidental Release of UF_6 at the Sequoyah Fuels Corporation Facility at Gore, Oklahoma, March 1986, U. S. Nuclear Regulatory Commission.

2. NUREG-1198. Release of UF_6 from a Ruptured Model 48Y Cylinder at Sequoyah Fuels Corporation Facility: Lessons-Learned Report, August 1986. U. S. Nuclear Regulatory Commission.

3. Federal Register. (52 F.R. 12921, April 20, 1987.) Proposed Rule for Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licensees.