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OFFICE OF STANDARDS DEVELOPMENT
DRAFT REGULATORY GUIDE AND VALUE/IMPACT STATEMENT

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Division 8
Task OH 941-4

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INFORMATION RELEVANT TO ENSURING THAT OCCUPATIONAL RADIATION EXPOSURES AT URANIUM MILLS WILL BE AS LOW AS IS REASONABLY ACHIEVABLE

A. INTRODUCTION

Paragraph 20.1(c) of 10 CFR Part 20, "Standards for Protection Against Radiation," states that licensees should make every reasonable effort to keep radiation exposures, as well as releases of radioactive material to unrestricted areas, as far below the limits specified in Part 20 as is reasonably achievable. Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable," sets forth the philosophy and general management policies and programs that licensees should follow to achieve this objective of maintaining radiation exposures to employees "as low as is reasonably achievable" (ALARA).

This guide is directed specifically toward uranium mill licensees and recommends design criteria and administrative practices acceptable to the NRC staff for maintaining occupational exposures ALARA in uranium mills. However, since the basic processes at other types of uranium recovery facilities have a similar potential for exposing workers to uranium and its daughters, the guidance provided in this guide can be applied to those facilities as well. An existing NRC report, NUREG-0511, "Draft Generic Environmental Impact Statement on Uranium Milling" (Ref. 1), also provides detailed information for controlling the radiation hazard and chemical toxicity of airborne uranium and its daughter products in uranium mills.

This guide is generally directed toward occupational health protection from radiologic and toxic hazards from airborne particulates of uranium and its daughters; however, it is also recognized that uranium mill workers will

This regulatory guide and the associated value/impact statement are being issued in draft form to involve the public in the early stages of the development of a regulatory position in this area. They have not received complete staff review and do not represent an official NRC staff position.

Public comments are being solicited on both drafts, the guide (including any implementation schedule) and the value/impact statement. Comments on the value/impact statement should be accompanied by supporting data. Comments on both drafts should be sent to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch, by OCT

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be exposed to external radiation in addition to inhaled particulates. Therefore, the need to ensure protection of mill workers from external radiation hazards is also advised.

Specific guidance regarding protection from radiologic and toxic hazards caused by materials in effluents to unrestricted areas is beyond the scope of this guide. This topic is mentioned only in connection with actions that influence both occupational exposure and effluent control. However, the same controls that have been shown to keep occupational exposures to airborne uranium and its daughters ALARA also tend to keep releases of these materials from the mill ALARA.

B. DISCUSSION

The principle of maintaining occupational radiation exposures as low as is reasonably achievable is an extension of an original recommendation of the National Committee on Radiation Protection (NCRP) (now the National Council on Radiation Protection and Measurements) in its 1949 report (published in 1954 as Report No. 17 (Ref. 2)). In this early report, the NCRP introduced the philosophy of assuming that any radiation exposure may carry some risk and recommended that radiation exposure be kept at a level "as low as practicable" (currently referred to as ALARA) below the recommended maximum permissible dose equivalent. Similar recommendations to keep exposures ALARA have been included in NCRP reports up to the present time (Ref. 3), as well as in recommendations of the National Academy of Sciences--National Research Council (Ref. 4), the Federal Radiation Council (Ref. 5), and other independent scientific and professional organizations (Ref. 6). The basic radiation protection philosophy of these recommendations has been incorporated in regulations and guides of the Nuclear Regulatory Commission.

This guide provides a very detailed supplement for uranium mill licensees of the basic philosophy of Regulatory Guide 8.10, which lists for all specific licensees the types of management commitments and radiation protection programs that would help to achieve the objective of maintaining occupational exposures ALARA.

Regulatory Guide 3.5, "Standard Format and Content of License Applications for Uranium Mills," outlines the information that applicants should include in

their application for a uranium mill license; however, it does not outline the detailed information that would be required to establish acceptable health physics and ALARA programs. This regulatory guide describes the details of an acceptable health physics and ALARA program that an applicant would describe as recommended in Section C.5, "Operations," of Regulatory Guide 3.5.

This guide; Regulatory Guide 3.5; Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection"; Regulatory Guide 8.22, "Bioassay at Uranium Mills"; and Draft Regulatory Guide OH 710-4, "Health Physics Surveys in Uranium Mills," will be used as the bases for evaluating license applications and radiation safety programs of NRC-licensed uranium mills.

C. REGULATORY POSITION

The principles and practices presented in this guide should be used as guidance in developing the health physics and ALARA programs for a uranium mill for appropriate sections of an application* for a new or renewal license. The recommendations of this guide are intended to assist the applicants in preparing license applications that are acceptable to the NRC licensing staff and are consistent with the philosophy of ALARA. Unique features not addressed here will require specific review by the NRC licensing staff.

A licensee's program for occupational protection against uranium and its daughters will be considered consistent with the ALARA philosophy if the uranium mill's operating policies and programs satisfy the following major principles and practices.

1. ALARA PHILOSOPHY

The purpose of the radiation protection program at a uranium mill is to maintain radiation exposure ALARA for all employees, contractors, visitors,

*An application and a suggested format for its completion may be obtained from the licensing staff of the Division of Waste Management, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

and members of the general public. Thus, the implementation of a successful ALARA program becomes the responsibility of everyone incidental to the processing of uranium ores. Responsibilities for conducting an ALARA program are shared by licensee management,* the radiation safety officer (RSO),** and all mill workers.

1.1 Licensee Management

Licensee management should provide the following:

1. Information and policy statements to employees, contractors, and visitors;
2. Periodic management audits of procedural and operational efforts to maintain exposures ALARA;
3. Continuing management evaluation of the health physics program, its staff, and its allocation of adequate space and money;
4. Appropriate briefings and training in radiation safety, including ALARA concepts for all uranium mill employees and, when appropriate, for contractors and visitors.

1.2 Radiation Safety Officer

The Radiation Safety Officer (RSO) should be delegated the following:

1. Sufficient authority to enforce regulations and administrative policies that affect any aspect of the radiological safety program;
2. Responsibility to develop and administer the ALARA program;
3. Authority to review and approve plans for new equipment, process changes, or changes in operating procedures to ensure that the plans do not adversely affect the protection program against uranium and its daughters.

*"Management" is defined here as those persons authorized by the licensee of record to make policies and to direct activities of the recovery facility.

**The title "Radiation Safety Officer" is used synonymously with radiation protection manager by many licensees and will be used in this guide to designate the qualified individual who is responsible for developing and supervising the radiation safety program; other titles are equally acceptable.

1.3 Mill Workers

All workers at the mill should be responsible for the following:

1. Adhering to all rules, notices, and operating procedures for radiation safety established by licensee management and the RSO;

2. Reporting promptly to the RSO and licensee management the witness of equipment malfunction or the violation of standard practices or procedures that could result in increased radiological hazard to any individual;

3. Suggesting improvements for the ALARA program.

2. HEALTH PHYSICS ORGANIZATION AND ADMINISTRATIVE PROCEDURES

2.1 Health Physics Authorities and Responsibilities

The radiation safety officer at the mill site should be responsible for conducting the health physics program and for assisting the resident manager in ensuring compliance with NRC's regulations and the license conditions applicable to worker health protection.

Generally, the RSO should report directly to the resident manager on matters of safety. The RSO should be directly responsible for supervising the health physics technicians, for overseeing the day-to-day operation of the health physics program, and for ensuring that records required by the NRC are maintained. The RSO should have both the responsibility and the authority to suspend, postpone, or modify any work activity that is potentially hazardous to workers or a violation of the Commission's regulations or license conditions. The RSO may have other safety-related duties, such as responsibility for programs of industrial hygiene and fire safety, but should have no direct production-related responsibility.

2.2 Operating Procedures

Standard written operating procedures should be established for all operational activities involving radioactive materials that are handled, processed, or stored. Standard operating procedures for operational activities should include a consideration of pertinent radiation safety practices. Additionally, written procedures should also be established for nonoperational activities,

to include health physics and environmental monitoring, sampling, analysis, and instrument calibration. An up-to-date copy of each written procedure should be kept in each area where it is used.

All written procedures for both operational and nonoperational activities should be reviewed and approved in writing by the RSO before being implemented and whenever a change in a procedure is proposed to ensure that proper radiation protection principles are being applied. In addition, the RSO should review all existing operating procedures at least annually to ensure the procedures do not violate any newly established radiation protection practices.

For work or nonroutine maintenance jobs where the potential for exposure to radioactive material exists and for which no standard written operating procedure already exists, a radiation work permit (RWP)* should be used. Such permits should describe the following:

1. The details of the job to be performed.
2. Any precautions necessary to reduce exposure to uranium and its daughters.
3. The radiological monitoring and sampling necessary during and following completion of the job.

The RSO should indicate by signature the review of each RWP prior to the initiation of work, and the work should be carried out in strict adherence to the conditions of the RWP. When the RSO is not available, e.g., during off-shifts, the RSO should designate a member of the radiation safety office staff or a supervisory member of the production staff who has received specialized radiation protection training to review and sign RWPs in the RSO's absence.

2.3 Surveillance: Audits and Inspections

It has been observed repeatedly that where sufficient management interest exists, exposure to hazardous materials is reduced. Frequent management audit and inspection of worker health protection practices at a uranium mill can serve to provide management with the information necessary to conduct an appropriate ALARA program.

*The term, "radiation work permit" is used by many licensees and will be used throughout this guide; other terms, such as special work permit, are equally acceptable.

2.3.1 Daily and Weekly Inspections

The RSO or designated health physics technician and the mill foreman should conduct a daily walk-through (visual) inspection of all areas of the mill to ensure proper implementation of good safety practices, including good housekeeping and cleanup practices that would minimize unnecessary contamination and ensure adherence to standard operating procedures. Problems observed should be noted in writing in a daily inspections' logbook. The entries should be dated, signed, and maintained on file for at least 1 year. The RSO should review each day's findings of violations of radiation safety procedures or other potentially hazardous problems with the resident manager and other mill employees who have authority to correct the problem. Also, the RSO should review the daily work-order and shift logs on a regular basis to determine that all jobs and operations having a potential for exposing personnel to uranium, especially those jobs that would require a radiation survey and monitoring, were approved in writing by the RSO or his staff prior to initiation of work.

A weekly inspection should be made by the health physics technician of all work and storage areas and a report submitted to the RSO on any items of non-compliance with operating procedures, license requirements, or safety practices affecting radiological safety.

2.3.2 Monthly Inspections

At least monthly, the RSO should conduct an inspection of all work and storage areas and should review all monitoring and exposure data for the month. The RSO should provide to the resident manager and all department heads for their review a written summary of the month's significant worker protection activities containing (1) a summary of personnel exposure data, including bioassays and time-weighted calculations, and (2) a summary of all pertinent radiation survey records.

In addition, the monthly inspection summary should specifically address any trends or deviations from the ALARA program, including an evaluation of the adequacy of the implementation of license conditions regarding ALARA. The summary should provide a description of unresolved problems and the proposed corrective measures. Monthly summary inspection reports should be maintained on file and readily accessible for at least 5 years.

2.3.3 ALARA Program Audit

The RSO should perform a formal semiannual audit of the ALARA program and submit a detailed written report on the audit to the resident manager. The primary purpose of the audit is to evaluate the overall effectiveness of the mill ALARA program. The audit report should summarize the results of the following data:

1. Employee exposure records (external and time-weighted calculations)
2. Bioassay results
3. Inspection log entries and summary reports of daily, weekly, and monthly inspections
4. Documented training program activities
5. Safety meeting reports
6. Radiological survey and sampling data
7. Radioactive effluent and environmental monitoring data
8. Reports on overexposure of workers submitted to NRC, MSHA, or States
9. Operating procedures that were reviewed during this time period.

The report on the semiannual ALARA audit should specifically discuss the following:

1. Trends in personnel exposures for identifiable categories of workers and types of operational activities
2. Trends in effluent releases
3. Whether equipment for exposure control and effluent control is being properly used, maintained, and inspected
4. Recommendations on ways to further reduce personnel exposures and effluent releases of uranium and its daughters.

2.4 Technical Qualifications of Health Physics Staff

2.4.1 Radiation Safety Officer

The RSO should have the following education, training, and experience:

1. Education: A bachelor's degree in the physical sciences or engineering from an accredited college or university.

2. General experience: One year of supervisory experience and one year of experience in a uranium mill or related industry.

3. Health physics experience: One year of work experience in applied health physics, radiation protection, industrial hygiene, or similar work. This experience should involve actually working with radiation detection and measurement equipment rather than only administrative or "desk" work.

4. Specialized training: A formalized intensive course in health physics of at least 4 weeks' duration. At least 1 week of the course should be specifically applicable to health physics for uranium milling and mining, if both are applicable. In addition, the RSO should attend a refresher course on uranium mill health physics every 2 years.

5. Specialized knowledge: A thorough knowledge of the proper application and use of all health physics equipment used in the mill, the chemical and analytical procedures used for radiological sampling and monitoring, and methodologies used to calculate personnel exposure to uranium and its daughters.

2.4.2 Health Physics Technicians

In addition to the RSO, there should be a minimum of one full time health physics technician at every uranium mill. The health physics technician should have the following education, training, and experience:

1. Education: An associate degree in the phycical sciences, engineering, or a health-related field. Alternatively, a high school diploma plus 2 years of relevant work experience in applied radiation protection are acceptable.

2. General experience: One year of previous work experience in a uranium mill or related industry involving radiation protection.

3. Health physics experience: One year of work experience using sampling and analytical laboratory procedures that involve health physics, industrial hygiene, or industrial safety measures to be applied in a uranium mill.

4. Specialized training: At least 4 weeks of formalized training in radiation health protection for uranium mills.

5. Specialized knowledge: A working knowledge of the proper operation of health physics instruments used in the mill, surveying and sampling techniques, and personnel dosimetry requirements.

2.5 Radiation Safety Training

All new employees should be instructed by means of an established course in the inherent risks of exposure to radiation and the fundamentals of protection against exposure to uranium and its daughters before beginning their jobs. Other guidance pertinent to this course is found in Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure," and Draft Regulatory Guide OH 902-1, "Instruction Concerning Risk from Occupational Radiation Exposure." This course of instruction should include the following topics:

1. Fundamentals of Health Protection
   a. What are the radiologic and toxic hazards of exposure to uranium and its daughters
   b. How uranium and its daughters enter the body (inhalation and ingestion)
   c. Why exposures to uranium and its daughters should be kept as low as is reasonably achievable (ALARA)
2. Personal Hygiene at Uranium Mills
   a. Wearing protective clothing
   b. Using respirators, when appropriate
   c. Eating, drinking, and smoking only in designated areas
   d. Using proper methods for decontamination (i.e., showers).
3. Facility-Provided Protection
   a. Cleanliness of the work place
   b. Safety-designed features for process equipment
   c. Ventilation systems and effluent controls
   d. Standard operating procedures
   e. Security and access control to designated areas.
4. Health Protection Measurements
   a. Measurement of airborne radioactive materials
   b. Bioassays to detect uranium (urinalysis and *in vivo* counting)
   c. Surveys to detect contamination of personnel and equipment
   d. Personnel dosimetry
5. Radiation Protection Regulations
   a. Regulatory authority of NRC, MSHA, and State
   b. Employee rights in 10 CFR Part 19
6. Mill Emergency Procedures.

A written test with questions directly relevant to the principles of radiation safety and health protection in uranium milling covered in the training course should be given to each worker. The instructor should review the test results with each worker. The instructor should discuss any wrong answers to test questions with the worker until the worker understands the correct answer. Workers who fail the test should be retested. These tests and results should be maintained on file. Each permanent worker should be provided an abbreviated retraining course annually. Documented successful completion of the retraining course should also be maintained on file. Retraining should include relevant information that has become available during the past year, a review of safety problems that have arisen during the year, changes in regulations and license conditions, exposure trends, and other current topics.

In addition, all new workers, including supervisors, should be given specialized instruction on the health and safety aspects of the specific jobs they will perform. This instruction should be in the form of individualized on-the-job training. Supervisors should be provided additional specialized training on their supervisory responsibilities in the area of worker radiation protection. Retraining should be conducted annually and documented. All employees should sign a statement that they received job-specific safety training. The statement should indicate the dates the training was received and it should be cosigned by the instructor. Also, every 2 months all workers should attend a general mill safety meeting with at least 30 minutes of the meeting devoted to radiation safety matters.

All visitors who have not received training should be escorted by someone properly trained and knowledgeable about the hazards of the mill. As a minimum, visitors should be instructed specifically on what they should do to avoid possible hazards in the areas of the mill they will be visiting.

Contractors having work assignments in the mill should also be given appropriate training and safety instruction. Contract workers who will perform work on heavily contaminated equipment should receive the same training and safety instruction normally required of all permanent workers. Only job-specific safety instruction is necessary for contract workers who have previously received full training on prior work assignments at the mill.

2.6 Surveys

The RSO and radiation safety office staff are responsible for performing all routine and special radiation surveys as required by license conditions and 10 CFR Part 20. Acceptable survey methods are specified in Section C.1 of Draft Regulatory Guide OH 710-4, "Health Physics Surveys in Uranium Mills."

2.7 Respiratory Protection

The RSO and the radiation safety office staff are responsible for the implementation of a respiratory protection program. There should be adequate supplies of respiratory devices to enable assignment of a device to each individual who may routinely enter airborne radioactivity areas. Additional respiratory protection devices should be located near access points of airborne radioactivity areas. All airborne radioactivity areas should have controlled access. Routine physical (medical) evaluation should be required of those individuals who will use respirators. As a minimum, the respiratory protection program should meet the recommendations in Regulatory Guide 8.15 and as supported in NUREG-0041, "Manual of Respiratory Protection Against Airborne Radioactive Materials" (Ref. 7).

2.8 Bioassay Procedures

The RSO is responsible for implementing a bioassay program. The frequency adopted and the type of analysis should meet the recommendations in Regulatory Guide 8.22.

3. FACILITY AND EQUIPMENT DESIGN

General considerations for the design of uranium mills and uranium ore processing equipment should not be based solely on chemical process efficiency, but should also be based on the relative potential for radiologic and toxic hazards resulting from exposure of personnel to uranium and its daughters. Major aspects of planning and design that should be considered are discussed below.

3.1 Space Layout

Facility layout should be designed to maintain employee exposures ALARA while at the same time ensuring that exposure to other persons is not thereby increased. General provisions of the mill layout should include the following considerations:

1. The need for access to process equipment and the need to perform routine maintenance.
2. The need to maintain adequate ventilation in all mill areas in which radioactive materials might be spilled, suspended, or volatilized;
3. Provisions to enable isolation of yellowcake drying, packaging, and shipping areas from other mill process areas;
4. Provisions for controlling access to the uranium mill proper and the ability to secure or restrict entry to any airborne radioactivity area; and
5. The need to locate emergency personnel decontamination equipment (e.g., shower facilities) adjacent to mill equipment that, in the advent of an accident, a spill, or equipment malfunction, could cause gross contamination of a worker.

3.2 Access Control

Access to airborne radioactivity areas should be controlled or restricted by the use of caution signs, operational procedures, or security locks.

3.3 Ventilation Systems

To the extent practicable, accomplish the following:

1. Provide local exhaust ventilation (such as chemical hoods) or general area ventilation where concentrations of natural uranium may be present in excess of 10% of the values given in Table 1 of Appendix B to 10 CFR Part 20. The design ventilation rate (air exchange rate) should be sufficient to maintain airborne concentrations of natural uranium to less than 10% of the maximum permissible concentration (MPC) given in Table 1 of Appendix B to 10 CFR Part 20.
2. Design exhaust stacks so that exhausted air will not enter air intakes that service other mill areas.

3. Locate exhaust vents in a way that ensures compliance with the requirements of § 20.106 of 10 CFR Part 20 and 40 CFR Part 190 for effluents to unrestricted areas, as well as ALARA exposure considerations for the worker and the general public.

4. Where approriate, include specific types of filters or air scrubbers for the exhaust air to minimize the release of uranium to the environs.

3.4 Fire Control and Chemical Hazard Protection Systems

The mill design should provide for the isolation of mill areas where there is a high potential for fire and where uranium could be dispersed as the result of a fire. Provisions should be made for fire alarms, fire extinguishers, sprinkler systems, fire hydrants, water tanks, and other general fire fighting equipment. Emergency procedures and training should include immediate fire control as a priority item. Design features should include automatic fire suppression and detection equipment in high fire-potential areas (i.e., solvent extraction area). In the event of fire, there should be provision for drainage of solvent to sumps or to outside lined ponds. Appropriate caution signs should be posted in areas of fire hazard. Fire detection systems should be checked weekly. Fire drills should be performed at least semiannually.

Facility design should provide for the construction of dikes and curbs around process and storage tanks to confine hazardous chemicals in the event of a spill or leak. Tanks containing hazardous chemicals should be equipped with high-level alarms to minimize the possibility of spillage caused by a malfunction of the process circuit.

3.5 Laboratory Design Features

Consideration should be given to providing different laboratory facilities for metalurgical and bioassay analyses, if they are both performed at mill site. Owing to the sensitivity required in performing bioassay analyses, provisions should be made to ensure against cross-contamination of uranium from mill ore samples. Laboratory equipment and surfaces should be constructed of materials that are easily decontaminated. Laboratory surfaces used for the preparation of bioassay samples should be decontaminated daily to less than 200 dpm $\alpha/100cm^2$ of total surface contamination. All mill laboratories should provide adequate

general ventilation and exhaust fume hoods when appropriate. Special attention should be directed to the design of air exhaust systems that service ore sample pulverizing and grinding equipment. The design of the laboratory should provide for the safe handling, storage, and disposal of radioactive wastes resulting from sample analyses.

3.6 Ore and Product Storage

Uranium mill plans should include the following areas:

1. Provide for raw ore storage, fine ore bins, and yellowcake storage in areas such that they do not cause unnecessary exposure to mill personnel.

2. Provide adequate space in the yellowcake packaging area to conduct an initial survey and smear test of each yellowcake package and to enable decontamination of drums to avoid transporting a contaminated package through other mill areas.

3. Locate yellowcake storage and shipping areas so as to minimize the handling time required prior to shipment.

3.7 General Equipment Considerations

General features applicable to equipment that will be used for handling, containing, or contacting uranium and its daughters are as follows:

1. Equipment that contains large volumes of uranium-bearing liquids should be designed with sumps or dikes to contain the liquids in the advent of leaks or spills.

2. Equipment should be designed to optimize the ease of carrying out procedures, especially routine maintenance, thereby minimizing working time where personnel are exposed to radiation and maximizing distances of personnel from the source of radiation with which they are working, consistent with the purposes of the procedures.

3. Appropriate caution signs and symbols should be provided to meet the requirement of § 20.203 of 10 CFR Part 20.

4. CONTROL OF AIRBORNE URANIUM AND ITS DAUGHTERS

One of the major inhalation hazards associated with uranium milling facilities results from the resuspension in air of uranium and its daughters. Therefore, properly designed ventilation and dust control systems are needed to ensure that exposure of workers is maintained ALARA. There are, in general, four areas that present radiologic and toxic hazards caused by airborne materials at a typical mill. These areas encompass (1) ore storage, handling, and crushing, (2) ore grinding, leaching, and concentrating processes, (3) ore precipitation, drying, and packaging, and (4) miscellaneous mill locations. Appropriate design objectives for ventilation and dust control systems recommended for each of these generalized mill areas are given below.

4.1 Ore Storage, Handling, and Crushing Areas

Where ore is handled in the open, the objective should be to minimize blowing of dust. Water sprinkling systems are recommended for use on ore piles when the ore moisture content is less than 10%. If ore is crushed and transported in the dry state, (i.e., moisture content less than 25%) the use of ventilation systems and dust collectors are recommended. As ore travels along conveyor belts to the grinder, all drop points should have either hooded dust collectors or dust supressant systems, such as sprinklers or foam ejectors. When crushers are used prior to grinding, it is recommended that a hooded ventilation system be installed over all external openings to the crusher. The use of wet scrubbers or dust collectors is recommended for ventilation systems that service ore storage, handling, and crushing areas of the mill.

4.2 Grinding, Leaching, and Concentrating Process Areas

Although many methods of ore grinding exist, a preferred method is the semiautogenous method. Effectively, the semiautogenous grinding method is a one-step process that eliminates the need for crushers. Thus, the need for most dust collectors normally required at mills using crushers and rod or ball grinders would be negated. However, general ventilation systems are recommended to service mill areas where any grinding method is performed to ensure against the buildup of radon and its daughters normally released in the grinding process.

The ventilation rate should be adequate to maintain the concentration of natural uranium to less than 10% of the concentration values specified in paragraph 4.a of the note to Appendix B to 10 CFR Part 20, (i.e., 7.5 $\mu gm/m^3$ of air or 5×10^{-12} $\mu Ci/cm^3$). It is recommended that all leaching and thickening tanks located in enclosed structures be covered and vented directly to the outside atmosphere. General ventilation systems for mill areas where leaching and thickening tanks are located should be designed to maintain natural uranium ore dust concentrations in air at less than 7.5 $\mu gm/m^3$. If the mill is so designed that the solvent extraction (SX) concentration process equipment is in enclosed structures, a general ventilation system is recommended and should be designed to maintain the airborne uranium concentration in air to less than 20 $\mu gm/m^3$ or 1×10^{-11} $\mu Ci/cm^3$, (i.e., 10% of the MPC for uranium other than natural ore dust). The use of wet scrubbers on general ventilation systems that service areas of the mill where grinding and leaching equipment are located is recommended. Scrubbers are not necessary on ventilation systems that service areas of the mill where the clarification or solvent extraction equipment is located.

4.3 Precipitation, Drying, and Packaging Areas

During the precipitation step of the uranium recovery process, the uranium-bearing solution is neutralized with ammonia to produce ammonium diuranate, (yellowcake) which is then thickened by dewatering. Some yellowcake and ammonia gas may be released into the air because of the agitation of this solution. General ventilation systems are required and should be designed to maintain the concentration in air of yellowcake near precipitation tanks, yellowcake thickeners, yellowcake filters, and yellowcake repulp equipment to less than 20 $\mu gm/m^3$ or 1×10^{-11} $\mu Ci/cm^3$ (10% of the MPC). The next step of the recovery process involves the drying and packaging of yellowcake. Since the potential for the release of airborne yellowcake is much greater in dry form, it is recommended that drying and packaging of yellowcake should be performed in an enclosure that is separated from other areas of the mill. Also, the drying and packaging enclosure should be maintained under negative pressure. A separate air suction ring system should also be used at each yellowcake drumming station. Individual suction ring systems need only be operated during periods when the

drum at that location is being filled. The exhausts for the drying and packaging enclosure and the suction ring should be vented through a wet scrubber. To ensure proper operation, scrubber circuits from the concentrate drying and packaging areas should be checked every hour and documented. Manometer readings should be recorded once per shift and subsequently documented.

4.4 Miscellaneous Locations

Other important areas of the mill that have the potential for containing hazardous levels of uranium and its daughters in air include maintenance shops, rubber shops, metallurgical and bioassay laboratories, and general laundries, if they exist. Each of the above mill areas should be serviced by ventilation systems designed to maintain air concentration of uranium to less than 20 $\mu gm/m^3$ or 1×10^{-11} $\mu Ci/cm^3$. Wet scrubbers are not necessary on these systems, however, bag filters are recommended.

REFERENCES

1. "Draft Generic Environmental Impact Statement on Uranium Milling," NRC report NUREG-0511, April 1979.

2. National Bureau of Standards, "Permissible Dose from External Sources of Ionizing Radiation," Handbook 59, Recommendations of the National Council on Radiation Protection (NCRP Report No. 17), Washington, D.C., September 24, 1954.

3. National Council on Radiation Protection and Measurements, "Review of the Current State of Radiation Protection Philosophy," Report No. 43, Washington, D.C., January 15, 1975.

4. National Academy of Sciences - National Research Council, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation," Washington, D.C., 1972.

5. Federal Radiation Council, "Background Material for the Development of Radiation Protection Standards," Report No. 1, Washington, D.C., 1960.

6. International Commission on Radiological Protection, "Implications of Commission Recommendations That Doses Be Kept As Low As Readily Achievable," Report No. 22, Pergamon Press, Elmsford, New York, 1974.

7. "Manual of Respiratory Protection Against Airborne Radioactive Materials," NRC report NUREG-0041, October 1976.

DRAFT VALUE/IMPACT STATEMENT

1. PROPOSED ACTION

1.1 Description

Applicants for a uranium milling license must submit a license application containing the information specified in Regulatory Guide 3.5, "Standard Format and Content of License Applications for Uranium Mills." The purpose of this proposed action is to describe both administrative health physics programs and methods to achieve ALARA occupational exposure to workers that are acceptable to the NRC staff. Health physics programs are covered in Section C.5, "Operations," in Regulatory Guide 3.5.

1.2 Need

Now, licensees are uncertain what the NRC staff will accept in the way of a health physics program or procedures and design features needed to achieve ALARA exposures in a uranium mill. As a consequence, a wide variety of programs are submitted. In order to meet minimum standards, much correspondence between the applicant and NRC is required. A guide will reduce the amount of correspondence needed, save manpower for both NRC and the applicant, show clearly how NRC regulations apply to uranium mills, and establish a uniform standard for an acceptable health physics and ALARA program for worker protection.

1.3 Value/Impact

1.3.1 NRC

The impact of the proposed guidance will be primarily to reduce licensing staff effort in reviewing applications and in corresponding with applicants about areas where the application does not meet NRC licensing practice. An estimated 0.75 man-year is required to develop the guide.

1.3.2 Other Government Agencies

The proposed guidance will impact on the Mine Safety and Health Administration (MSHA) because they also regulate occupational health protection at uranium mills and on Agreement State regulatory agencies that regulate mills, primarily New Mexico, Colorado, Texas, Washington, and Florida. A Memorandum of Understanding (MOU) signed by NRC and MSHA states that each agency will coordinate the development of standards with the other agency. The MOU was published in the Federal Register (45 FR 1315) on January 4, 1980.

1.3.3 Industry

Industry will benefit from having clear guidance on what constitutes NRC licensing policy. Some minor expense may be involved, however, in upgrading current health physics programs and in establishing an effective ALARA program where one does not currently exist to meet the recommendations in the guidance.

1.3.4 Workers

Workers' protection should improve from having clearly stated and consistent standards for health physics and ALARA programs. Workers and their representatives will now have access to a clearly defined standard ALARA program for uranium mills. This will help them understand whether their employer has an adequate program and why some things are done as they are.

1.3.5 Public

The guidance pertains to worker protection programs. It will not directly affect the public.

1.4 Decision

The NRC should develop guidance on a standard administrative health physics and ALARA program for worker protection that is acceptable to the NRC licensing staff.

2. TECHNICAL APPROACH

The technical approach in the guidance will be based on (1) NRC licensing policy as expressed in Safety Evaluation Reports (SER) written by the NRC

licensing staff, especially the recent SER for Minerals Exploration Company Sweetwater Uranium Project and (2) other references to be cited in the guidance.

3. PROCEDURAL APPROACH

3.1 Procedural Alternatives

There are three reasonable procedural alternatives: (1) put the guidance directly in the regulations, (2) put the guidance in a regulatory guide, and (3) continue to handle on a case-by-case basis for each licensing application.

3.2 Value/Impact of Procedural Alternatives

Putting the guidance in the regulations is not really suitable for the type of guidance envisioned because some of the program must be tailored to the design and needs of the individual mill.

The guidance envisioned seems best suited for a regulatory guide. A guide provides the best mix of flexibility and clear statement of a uniform and consistent licensing policy.

3.3 Decision on Procedural Approach

Developing a regulatory guide is the favored procedural approach.

4. CONCLUSION

In summary, it is proposed that a regulatory guide on health physics and ALARA programs in uranium mills for worker protection be developed.

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