DRAFT REGULATORY GUIDE DG-8XXX

HEALTH PHYSICS SURVEYS DURING ENRICHED URANIUM-235 PROCESSING AND FUEL FABRICATION

A. INTRODUCTION

Paragraph 20.1501(a) of Title 10, Part 20, "Standards for Protection Against Radiation," of the *Code of Federal Regulations* (10 CFR Part 20) requires that each licensee make or cause to be made such surveys as may be necessary for it to comply with the regulations in that part. As used in 10 CFR Part 20, the term "survey" is defined as an evaluation of the radiation hazards incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation under a specific set of conditions. This guide specifies the types and frequencies of surveys that are acceptable to the staff of the U.S. Nuclear Regulatory Commission (NRC) for the protection of workers in plants licensed by the NRC to process enriched uranium and fabricate uranium fuel.

This guide does not relate to the processing of uranium-233, nor does it deal specifically with the following aspects of an acceptable occupational health physics program that are closely related to surveys: (1) the number and qualification of the health physics staff, (2) instrumentation, including types, numbers of instruments, limitations of use, accuracy, and calibration, (3) personnel dosimetry, and (4) bioassay. Guidance on bioassay for uranium appears in Regulatory Guide 8.11, "Applications of Bioassay for Uranium."

The NRC issues regulatory guides to describe to the public methods that the staff considers acceptable for use in implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations and compliance with them is not required.

This regulatory guide is being issued in draft form to involve the public in the early stages of the development of a regulatory position in this area. It has not received final staff review or approval and does not represent an official NRC final staff position.

Public comments are being solicited on this draft guide (including any implementation schedule) and its associated regulatory analysis or value/impact statement. Comments should be accompanied by appropriate supporting data. Written comments may be submitted to the Rulemaking, Directives, and Editing Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; e-mailed to nrcrep.resource@nrc.gov; submitted through the NRC's interactive rulemaking Web page at http://www.nrc.gov; faxed to (301) 415-5144; or hand-delivered to the Rulemaking, Directives, and Editing Branch, Office of Administration, U.S. Nuclear Regulatory Commission, 11555 Rockville Pike, Rockville, MD 20852, between 7:30 a.m. and 4:15 p.m. on Federal workdays. Copies of comments received may be examined at the NRC's Public Document Room, 11555 Rockville Pike, Rockville, MD. Comments will be most helpful if received by [60 days from issuance].

Electronic copies of this draft regulatory guide are available through the NRC's interactive rulemaking Web page (see above); the NRC's public Web site under Draft Regulatory Guides in the Regulatory Guides document collection of the NRC's Electronic Reading Room at http://www.nrc.gov/reading-rm/doc collections/; and the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading rm/adams.html, under Accession No. ML08XXXX.

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B. DISCUSSION

Surveys are considered part of a comprehensive protection program established by the licensee according to the philosophy and principles of Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures as Low as Is Reasonably Achievable." Principles, methods, and instrumentation for carrying out radiation and contamination surveys were developed early in the atomic energy program and have been discussed in reports of the National Council on Radiation Protection and Measurements (NCRP), the International Atomic Energy Agency, and the International Commission on Radiological Protection. More recent standards (Ref. 1) contain additional information for use in establishing radiation survey programs and selecting methods and equipment for their implementation. Surveys are necessary supplements to personnel monitoring, in which devices worn by the workers measure individual external radiation exposures, and to various forms of bioassay to determine intake of radioactive material by the workers.

Some enriched uranium processing and fuel fabrication plants conduct operations with Clearance Class D (transportable, rapid clearance from the lung) uranium compounds for which considerations of chemical toxicity to the kidney are limiting. (This guide does not address other chemical hazards such as HF.) Other plants conduct operations with Clearance Class W or Y (nontransportable, with longer 50- or 500- day biological half-life in the lung) compounds only. In the latter case, considerations of dose equivalent to the lung are limiting (Ref. 2). In the development of this guide, the staff considered such differences in plant operation.

C. REGULATORY POSITION

Methods, procedures, and criteria in this guide are acceptable to the NRC staff and may be incorporated into appropriate sections of a license application. This guide is intended to assist applicants in preparing license applications and to assist licensees in establishing acceptable survey programs in accordance with the "as low as reasonably achievable" (ALARA) philosophy.

1. Types of Surveys

1.1 General Description

a. Section 20.1502 of 10 CFR Part 20 specifies that surveys be performed to demonstrate compliance with the other radiation safety requirements of that part. Some of these surveys are necessary to evaluate external exposure to personnel and concentrations of airborne uranium in the facility and in effluents from the facility. Monitoring of effluents is beyond the scope of this guide.[1] Applicable guides of Divisions 4 and 10 should be consulted for such guidance.

b. Occupational radiation protection programs at enriched uranium processing and fuel fabrication plants should include the types of surveys discussed below. Acceptable survey frequencies are discussed in Regulatory Position C.2.

1.2 Surveys of External Radiation Dose Rates

a. NRC licensees are required by 10 CFR 20.1502(a)(1) to supply appropriate personnel monitoring equipment to each individual who enters a restricted area under circumstances that make it likely that the individual will receive a dose in any year in excess of 10 percent of the values specified in 10 CFR 20.1201, "Occupational Dose Limits for Adults," and to require the individual to use the equipment. Health physics or radiological control personnel should conduct initial surveys to identify all areas and operations where personnel monitoring and periodic surveys may be required to detect any changes. The survey instruments used should be operable and capable of measuring, at or below the required level, the types of radiation that personnel will encounter. Periodic surveys should be made for beta-gamma radiation levels to ensure that personnel exposure limits are observed. In a large part of an enriched uranium processing or fuel fabrication plant, radiation levels may exist that could result in limits being exceeded unless care is taken to minimize exposures. Beta-gamma radiation levels of 1 to 2 millirem per hour (mRem/hr) usually exist at a distance of 1 foot or more from the surfaces of uranium dioxide (UO_2) pellet trays or boats or fuel rods or bundles and in areas where fuel bundles are stored.

[1] However, the radiation safety program should include surveys or records that indicate control of the quantities or radioactive material released in air and water to unrestricted areas as required by 10 CFR Part 20.

Radiation levels of 5 to 10 mRem/hr may be found at the surfaces of fuel rods and bundles, and levels of 50 to 100 mRem/hr may be found near the surface of pellet trays and boats. Care should be taken to survey and assess doses to hands and lenses of eyes received by workers handling process materials (with gloves or short tools). Levels of gamma radiation may be much higher around used uranium hexafluoride (UF_6) cylinders due to thorium and protactinium daughters of uranium in heels, scale, or residue. The radiation levels near such sources should be surveyed. Although most of the radiation levels in operating areas are low, a reasonable effort should be made to minimize individual and collective (man-rem) doses.

b. The health physics staff should perform preoperational, routine, and special radiation surveys of the plant areas as described in Regulatory Position C.2. The staff should record the results of these surveys as described in Regulatory Position C.3.

c. Where operating personnel can potentially receive more than 10 percent of the dose limits, surveys are not normally acceptable for compliance with the personnel monitoring requirements of 10 CFR 20.1502(a)(1). However, in the absence of personnel dosimetry data (for example, because of loss or chemical or physical damage to the dosimeter), an alternative means of estimating the exposure is to use survey data in conjunction with appropriate occupancy factors. In such a case, the estimate, including the survey data used, must be documented and retained indefinitely along with personnel monitoring records pursuant to 10 CFR 20.2103(b)(1). The health physics staff should promptly review survey results in conjunction with personnel monitoring records (1) to identify potentially hazardous situations and unfavorable trends, and; (2) to ensure that all personnel are adequately monitored and that exposures are maintained ALARA. Surveys for alpha radiation in enriched uranium processing and fuel fabrication areas are conducted primarily to assess the extent of contamination of personnel, equipment, and premises and to detect the loss of confinement. The following sections discuss such surveys in more detail.

1.3 Measurements of Uranium Concentrations in Air

a. It is essential to establish a comprehensive program for assessing concentrations of uranium in air, at frequencies specified in Regulatory Position C.2, for each area where operations could expose workers to the intake of quantities of uranium exceeding those specified in 10 CFR 20.1201(e). Special requirements for such assessments may also be made a condition of the NRC license. Air samples should be collected in such a way that the concentrations of uranium are representative of the air to which workers are exposed (Ref. 3).

b. Air sampling may be accomplished using fixed-location samplers for basic evaluation of the exposure of workers, personal (lapel) samplers for supportive measurements and special studies, and air monitors for early warning of unexpected releases.

c. When radiometric measurements of the quantity of uranium deposited on or in an air sample filter are being taken, appropriate corrections should be included for geometry and alpha (or beta) absorption by the filter media and by material collected on the filter. The filter media used should retain collected material on the filter surface, and correction should be made for filter efficiency considering the particle sizes and flow rates involved. Overestimates of the volume of air that has passed through the filter should be avoided by accurate calibration of the flow rate and by prevention of or correction for loss of flow rate resulting from the accumulation of material on the filter. A means for measuring flow rate at air sampling heads should be available.

d. Any air samples that are suspected of reflecting releases and high concentrations, such as samples taken during glovebox glove changes, should be counted promptly to identify any samples with quantities of uranium greater than expected for the sampling location and volume. The procedures used should

ensure prompt evaluation and correction of the circumstances or operation that led to the release and the high sample. Air samples should be counted again for record purposes after a routine period of time (24 hours is often used) for decay of the "background" radon and thoron. The samples should be counted for a sufficiently long period of time or until a sufficiently large number of counts has been observed to establish the sample counting rate error within ±20 percent (Ref 4).

e. Filters from personal (lapel) samplers should be counted and the data related to the uranium intake of the wearer by application of factors for sampling time, breathing rate, wearing time, and total working time. Filters from general air samplers should be changed each working shift or more often in the event of rapid buildup of material on the filter media, which reduces the air flow. Consideration may be given to running samplers over weekends when no work is in progress or to changing part of the samplers each day of a weekend.

f. The regulation in 10 CFR 20.1003, "Definitions," defines "airborne radioactivity area," and 10 CFR 20.1902(d) prescribes posting requirements. In presenting the standards for limiting intake of uranium, 10 CFR 20.1701, "Use of Process or Other Engineering Controls," requires licensees to use process and other engineering controls to the extent practicable to limit concentrations of radioactive material in air to levels below those that delimit an airborne radioactivity area. In 10 CFR 20.1702, "Use of Other Controls," the regulation allows the use of other precautionary procedures, such as increased surveillance, limitation of working times, or provision of respiratory protective equipment to maintain intake of radioactive material ALARA. Health physics surveys of air concentration are essential in evaluating the changes obtained under process and engineering controls, in conducting increased surveillance and limiting working times, and in supporting a program for the use of respiratory protective equipment. An air monitor[2] may be used to provide a warning signal that the concentration of airborne uranium has become unexpectedly high. An air monitor should be considered if conditions make it likely that an intake of uranium exceeding the limits in 10 CFR 20.1201(e) may occur.

g. The principal function of the air monitor is to alert personnel to take immediate action to protect themselves from unexpected airborne uranium. Inhalation exposures occur during the time between the release of the uranium and the sounding of the alarm. Thus, every reasonable effort should be taken to reduce this time period. In particular, the air inlet of the monitor should be located near the potential source of airborne uranium, preferably between the source and the workers. The use of excessively long tubing or piping leading to the inlet should be avoided because of the high probability of alarm delay resulting from uranium deposition on the interior walls of the tube or pipe. The intake by personnel should be reduced by the choice of setpoint. However, the setpoint should not cause false alarms that weaken the workers' confidence in the air monitor. The intake by personnel may also be reduced by providing a high flow rate of air through the filter. It is important to maximize this flow rate, thus reducing the time of exposure before the alarm.

1.4 Surface Contamination Surveys

a. For contamination control inside the restricted area of a plant, there are controlled areas where uncontained uranium is handled and uncontrolled areas where uranium is in the form of sealed sources or is not handled at all. Routine monitoring for uranium contamination that could be present on surfaces of floors, walls, plant equipment, or furniture in controlled areas is a necessary part of the survey program. The failure to control surface contamination may result in unnecessary external or internal exposure of personnel to radiation. Although surface contamination contributes to the external radiation dose of

[2] The term "air monitor" as used here refers to a device providing a particle collection system, a radiometric measurement system, a continuous recorder, a meter with preset alarm capability, and an audible alarm.

workers, the primary concern is to avoid internal deposition resulting from the intake of loose uranium by inhalation, ingestion, or penetration of the skin.

b. This guide considers removable contamination to be that uranium contamination present on a surface that can be transferred to a dry smear test paper or fabric smear by rubbing with moderate pressure. Methods and instruments used in surveys of removable surface contamination should be capable of detecting the alpha radiations from uranium at and below the levels specified in Table 2. For example, smear counting may be performed with proportional counters, alpha scintillation counters, or thin-window Geiger-Mueller tubes.

c. Uniform methods for collecting and analyzing smear samples should be used. These standardized methods should be employed over extended periods of time to aid in cross-comparison of contamination at different times and places and to evaluate trends. A dry smear taken from an area of about 100 square centimeters (cm^2) is acceptable to indicate levels of removable contamination. A diagram of each routinely surveyed area should be used for recording survey results. This procedure will provide radiation safety personnel with a record that will assist in the identification of trends. The surveyor will find it helpful to identify on the survey diagram the locations that are smear tested.

d. Quantitative measuring instruments used to monitor the adequacy of confinement and contamination control, such as those used for measuring air samples, and measurements to evaluate uranium contamination of personnel (bioassays), work areas (smear tests), and equipment should be calibrated and checked before use each day. The accuracy of the calibration standard should be ±2 percent of the stated value and traceable to a primary standard such as that maintained by the National Institute of Standards and Technology (NIST).

e. The regulations in 10 CFR Part 20 do not specify limits for surface contamination. Each applicant may propose and justify surface contamination limits allowable before decontamination is required in each work area. These limits should be based on the need to avoid transfer of contamination to uncontrolled areas and to maintain exposures ALARA. The contamination limits for controlled areas presented in Table 2 are acceptable to the NRC staff and need not be justified by the applicant.

1.5 Protective Equipment and Clothing Contamination Surveys

a. When it is impracticable to apply process or other engineering controls to limit concentrations of uranium in air below those defined in 10 CFR 20.1201(e), other precautionary procedures such as increased surveillance, limitation of working times, or provision of respiratory protective equipment must be used to keep intake of uranium by any individual within the limits. When respiratory protective equipment is used to limit the inhalation of airborne uranium pursuant to 10 CFR 20.1702, the licensee may make allowance for such use in estimating exposures of individuals to uranium, provided that use of such equipment follows the stipulations in Regulatory Guide 8.15.

b. Individuals working in areas where a potential for skin or clothing contamination exists should wear suitable protective clothing. Radioactive material on contaminated protective clothing may again become airborne while the clothing is being removed. Monitors should be available in areas where workers change clothing to survey the clothing before removal and the workers' bodies (particularly their heads, hands, and other exposed portions) after the workers remove the protective clothing and before they leave the controlled area. Potentially contaminated clothing should not be sent to a laundry that is not specifically authorized to process clothing. Clothing surveyed and found to have less than 200 disintegrations per minute (dpm) per 100 cm^2 ($9x10^{-7}$ picoCuries per square centimeter (pCi/cm^2)) of uranium contamination is acceptable outside restricted areas.

c. Individual workers' surveys of themselves need not be recorded unless the values exceed those in Table 2. However, the health physics staff and/or radiological control personnel should maintain regular surveillance to ensure that the workers continue their own personal contamination surveys. Observations during radiation safety surveillance should be recorded.

d. Any personal clothing worn beneath protective clothing should be surveyed before the person leaves the controlled area. If personal clothing contamination levels exceed preselected limits, the health physics office should be contacted to provide direction for the survey and to supervise any necessary decontamination or clothing disposal. The applicant may propose and justify personal clothing contamination limits; the level of 200 dpm per 100 cm^2 ($9x10^{-7}$ pCi/cm^2) is acceptable to the NRC staff and need not be justified by the applicant. Records should be maintained in the manner described above for instances of protective clothing contamination.

e. For individuals whose work is conducted in controlled areas with a potential for high surface contamination levels, complete clothing changes are normally provided. In this case, personal clothing should be stored outside the controlled area. Surveys of personal clothing are not necessary in this case if the area in which the clothing is stored is surveyed in accordance with Regulatory Position C.1.4 of this guide and if survey results are below the limits adopted for in-plant uncontrolled areas. After workers remove protective clothing and wash, and before they don personal clothing and leave the change areas, particular attention should be paid to surveying the hair, bottoms of the shoes or feet, and the hands.

1.6 Personal Surveys

a. Individuals whose duties involve work in controlled areas where there is potential for uranium contamination of body surfaces should survey all exposed areas of the body after washing and before donning personal clothing and leaving the controlled area. Workers should be required to report to the health physics office if, following attempts to remove the contamination by washing with soap and water, contamination remains on the body that exceeds preselected levels. Decontamination attempts under the direction of the radiation safety staff or the licensee's medical consultant should be repeated until (1) such attempts cease to effect significant reductions or (2) such attempts threaten to damage the skin.[3] If the residual contamination does not exceed preselected levels when the decontamination attempts are terminated, there should be no further concern because the contamination would not then present a significant ingestion or inhalation hazard. If residual contamination exceeds the selected limits, the affected individual should be released, but periodic surveys should be made until the levels of activity have sufficiently decreased (Ref 5). There are no restrictions of personnel in this situation. However, consultation with the Health Physics Staff should be made available as needed. Complete records should be maintained of each incident of this nature.

b. Because of the potential for intake of uranium in various chemical and physical forms, screening by means of nasal swabs and bioassay by means of urinalysis, fecal analysis, and in vivo counting should be performed if, on the basis of air sampling data, accident, equipment failure, etc., there is reason to believe that an individual might have an intake of uranium. There is broad direction on minimum acceptable criteria, including numerical guidance on the initiation, selection, frequency, and interpretation of results for such programs (Refs. 6 & 7).

1.7 Surveys of Equipment, Premises, or Scrap before Release for Uncontrolled Use

[3] Decontamination attempts without a medical consultant present should be restricted to approved decontamination procedures agreed to by the licensee and the licensee's medical consultant. If such attempts do not reduce the contamination levels, the aid of a physician should be obtained.

a. Surface contamination surveys should be conducted for both removable and total contamination before the release of potentially contaminated premises, equipment, or scrap from controlled to uncontrolled areas and use. If contamination is detected or is known to have been covered, reasonable efforts should be made to eliminate the contamination, i.e., decontamination procedures should be repeated until additional efforts do not significantly reduce contamination levels. The limits of Table 2 apply. If the value of the items involved does not justify this level of effort, the items should be disposed of as radioactive waste or limited to use inside the controlled area. The applicant may propose and justify total and removable contamination levels higher than those specified in the license for uncontrolled use. Such proposals should ensure that reasonable efforts will be made to eliminate the residual contamination.

1.8 Surveys of Packages Received and Packages Prepared for Shipment

a. External radiation surveys and smear tests of external surfaces of packages should be performed both at the packaging point before the packages are sent to the shipping point and at the receiving point to avoid unwarranted radiation exposure and inadvertent contamination of personnel or the facility. Surveys and labeling must comply with regulatory requirements in 10 CFR 20.1904, "Labeling Containers," and 10 CFR 20.1906, "Procedures for Receiving and Opening Packages," and any specific license conditions. Packages transported within the plant should also be surveyed and labeled. When practicable, materials should be transferred by carts, conveyors, or other mechanical equipment rather than by hand-carrying. Packages (particularly pails or other containers containing powder or other finely divided material) should not be opened until the packages have been placed in an appropriately exhausted facility such as a hood or glove box. Packages should not be released for shipment or transfer unless external radiation and contamination levels are within the limits of the U.S. Department of Transportation regulations (Ref. 8).

1.9 Checks on Posting of Caution Signs, Labels, Signals, Controls, and Notices to Employees

a. The health physics staff should survey to ensure that signs, labels, signals, other access controls, required notices to employees, copies of licenses, and other items are properly posted, legible, and operative as required by 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," and 10 CFR Part 20 or specific license conditions. Air monitor alarms should be tested monthly unless the licensee provides justification for testing at less frequent intervals. Any failure of such devices to perform as intended should be promptly corrected.

1.10 Leak-Tests of Sources

a. Leak-testing of sources such as those used in instrument calibration and quality control procedures must be carried out in accordance with the terms and conditions of the applicable specific license. See appendix A-1.

1.11 Calibration of Radiation Safety Instruments

a. Portable survey instruments should be placed on a routine maintenance and calibration program that will ensure that properly calibrated and operable survey instruments are available at all times for use by the health physics staff (Refs. 9 & 10).

b. An adequate calibration of survey instruments cannot be performed solely with built-in check sources. Electronic calibrations should be evaluated to ensure the proper functioning and response of all components of an instrument. However, an initial calibration with a radiation source and periodic tests using electronic input signals may be considered adequate for high ranges that are not used routinely.

c. Daily or other frequent checks of survey instruments should be supplemented annually with a calibration of each instrument at two points at 20 percent and 80 percent (Ref. 9) of each linear scale that is used routinely or with a calibration at one point near the midpoint of each decade on logarithmic scales that are used routinely. Digital readout instruments with either manual or automatic scale switching should be calibrated in the same manner as used for linear readout instruments. Digital readout instruments without scale switching should be calibrated in the same manner as used for logarithmic readout instruments. Survey instruments should also be calibrated following repair. A survey instrument may be considered properly calibrated when the instrument readings are within +10 percent of the calculated or known values for each point checked. Readings within +20 percent are considered acceptable if a calibration chart or graph is prepared and attached to the instrument.

1.12 Ventilation Surveys

a. Health physics personnel should conduct surveys monthly to determine that the velocity of air flow at the entrance of all hoods or other exhausted enclosures and close-capture points is adequate to preclude escape of airborne uranium (considering density and particle size of the materials present) and to minimize the potential for intake by workers. Such measurements should be made using a properly calibrated thermoanemometer or velometer to determine whether the air flow has been reduced to unacceptable levels by filter loading, malfunction of exhaust fans, or some other factor. The average face velocity for a hood used for special nuclear material with the sash in the operating position and an opening in a special enclosure should be 150 feet per minute (ft/min) (45 meters per minute (m/min)), as determined from at least five different measurement points. In addition to these surveys, each enclosure should be equipped with manometers or other indicators of the pressure drop across filters to provide early indication of a reduction in air flow; the readings of such devices should be checked during each shift or more frequently for operations where high loading rates may occur. Corrective action should be taken as soon as possible when the air flow is found to be deficient. Work should be terminated if the average face velocity falls below 100 ft/min (30 m/min).

b. Surveys should be made of the negative pressure maintained inside glove boxes or other closed systems. Additional surveys for airborne uranium, contamination of personnel and equipment, and other sources should be made during and after glove changes and any other operations during which the integrity of the system may be lost. In addition to these surveys, each enclosure should be equipped with a device that indicates the flow rate, pressure drop, or negative pressure in the enclosure. Workers should be instructed to check these devices and to notify the health physics staff promptly upon indication of flow rates below preset levels.

1.13 Surveys of In-Plant Uncontrolled Areas

a. Uncontrolled areas inside the plant should be surveyed periodically to ensure that uranium is adequately confined in the controlled areas. Procedures should be established for the movement through corridors or other uncontrolled areas of the plant of uranium in any form capable of contaminating surfaces or of dispersing in air. Regulatory Position C.2 discusses acceptable survey frequencies; Position C.3 describes how the results should be recorded. With the exception of lunch rooms, cafeterias, snack bars, and vending machine areas, random smear testing of floors alone is adequate for most uncontrolled areas. In lunch rooms, cafeterias, snack bars, and vending machine areas, furniture and vending equipment as well as floors should be surveyed. If such surveys reveal that contamination has been transferred out of the controlled areas, immediate corrective action should be taken to eliminate such transfers and to decontaminate the uncontrolled areas. Also, the uncontrolled areas should be surveyed more frequently (e.g., daily or weekly) after contamination has been found until a trend of negative results is again established. The applicant may propose and justify permissible contamination levels for in-plant

uncontrolled areas. The limits given in Table 2 are acceptable to the NRC staff and need not be justified by the applicant.

1.14 Surveillance

a. This guide uses the term "surveillance" to refer to observations of working conditions in and around the plant made by the health physics staff performing routine radiation and contamination surveys. The NRC staff considers such surveillance to be one of the most important aspects of a protection program. Licensees should have a preconceived surveillance plan through which health physics personnel acquire and maintain detailed knowledge of each operation as necessary to permit (1) the identification of ways to prevent or minimize occupational exposures, (2) the selection of appropriate times for making health physics measurements, and; (3) adequate preparation for action to be taken in the event of breakdown of process equipment or other emergency conditions. Health physics personnel responsible for performing surveys should be sufficiently familiar with each activity to recognize potential hazards so that precautions can be taken to minimize exposures. Knowledge of procedures within each activity is essential to the selection of appropriate times for performing health physics measurements.

2. Frequency of Surveys

a. The frequency of routine surveys should be commensurate with the nature of the work being conducted, the quantities of material being processed, and the specific protective facilities, equipment, and procedures used to protect the workers from external radiation and the intake of uranium. For example, the nature and frequency of surveys appropriate for a plant in which all or a large portion of the work is conducted entirely within closed systems are quite different from those conducted in plants having only hoods, exhausted enclosures, or close-capture exhaust systems.

b. Generally, surveys should be performed before the plant begins operation to establish a baseline of background radiation levels and radioactivity from natural sources. These baseline surveys should be performed under various conditions expected during routine plant operation. Surveys should be conducted during test operation of any new process or protective equipment, during significant changes in input materials or workload, and during routine plant operations with all potentially involved persons present and carrying out their functions. Routine and repetitive surveys are necessary to control the location of material within process equipment and handling systems and to ensure the continued integrity of protective equipment and the adequacy of procedures. The survey program should be capable of monitoring the continuing adequacy of containment and control of the materials involved in the entire plant operation. Although the frequencies of routine surveys depend on many factors and should be designed for the specific operations and facilities involved, Table 1 presents minimum frequencies acceptable to the NRC staff as meeting the requirements of 10 CFR 20.1501, "General."

3. Records of Surveys

a. Recordkeeping requirements for surveys appear in 10 CFR 20.2103, "Records of Surveys." The regulation in 10 CFR 20.2103 requires that the licensee maintain records in the same units used in 10 CFR Part 20. Thus, external exposure rates should be recorded in estimated maximum dose equivalent units, rem or millirem, to relevant organs or tissues as specified in 10 CFR 20.1201. Air concentrations should be recorded in terms of disintegrations per unit time per milliliter or microcuries per milliliter. Surface contamination measurement results should be recorded in disintegrations per unit time per 100 cm^2 or in microcuries per square centimeter. Uptakes of radioactive material should be recorded in terms of microcuries (micrograms may be used for uranium-234, -235, and -238) and percentage of the

applicable limit. The exposed individual's record should specifically reference or document the methods used to calculate intake quantities from bioassay data. If specific information on the uranium compounds involved and their behavior in an individual is known, such information may be used and documented in the exposed individual's record.

b. The regulations cited above give records retention requirements. The regulation in 10 CFR 20.2103(a) requires that survey records be preserved for 3 years, except for (1) records of air monitoring, bioassay by urinalysis, fecal analysis, whole body or in vivo counting, and others used to determine the intake of an individual in compliance with 10 CFR 20.2103(b), (2) records of surveys to determine external radiation dose (in the absence of personnel monitoring data), and (3) results of surveys used to evaluate the release of radioactive effluents to the environment (not treated in this regulatory guide), which are to be maintained until the NRC terminates the license. Note that additional information such as occupancy time may be essential to the estimation of dose from survey data or the estimation of intake from data on air concentrations.

c. Records may be maintained in logbooks or on special forms if they are clear, legible, understandable, authenticated by authorized personnel, and contain all of the information required. The signature of the person making the record and the data should be on the same page immediately following each record entry. Either the original or a reproduced copy or microform (duly authenticated) may be maintained to meet the storage requirements of 10 CFR 20.2110, "Form of Records."

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC's plans for using this draft regulatory guide. The NRC does not intend or approve any imposition or backfit in connection with its issuance.

The NRC has issued this draft guide to encourage public participation in its development. The NRC will consider all public comments received in development of the final guidance document. In some cases, applicants or licensees may propose an alternative or use a previously established acceptable alternative method for complying with specified portions of the NRC's regulations. Otherwise, the methods described in this guide will be used in evaluating compliance with the applicable regulations for license applications, license amendment applications, and amendment requests.

REGULATORY ANALYSIS

Statement of the Problem

The NRC published Regulatory Guide 8.24, "Health Physics Survey During Enriched Uranium-235 Processing and Fuel Fabrication," in October 1979 to identify the types and frequencies of surveys that are acceptable to the NRC staff for the protection of workers in plants licensed by the NRC for processing enriched uranium and for fabricating uranium fuel.

With the recent surge in new applications for fuel cycle facilities, the NRC recognizes the need for significant revision of these guides, to include changes to Title 10 of the *Code of Federal Regulations* and the addition of American National Standards Institute (ANSI) guidance and other updated references.

Objective

The objective of this regulatory action is to provide a more useful and up-to-date version of the guidance for the conduct of appropriate health physics surveys for fuel cycle facilities. Not only has additional guidance been published since the original guide, but calibration frequencies and criteria have been revised.

Alternative Approaches

The NRC staff considered the following alternative approaches:

Do not revise Regulatory Guide 8.24.
Issue a new regulatory guide.
Revise Regulatory Guide 8.24.

Alternative 1: Do Not Revise Regulatory Guide 8.24

Under this alternative, the NRC would not revise this guidance, and the original version of this regulatory guide would continue to be available. If the NRC does not take action, there would be no changes in costs or benefits to the public or licensees. However, the "no-action" alternative would not address identified concerns and regulatory changes and would fail to provide licensees a regulatory standard that could be cited as part of an application and save time in the completion of the document review.

Alternative 2: Issue a New Regulatory Guide

Under this alternative, the NRC would delete Regulatory Guide 8.24 and replace it with a new guide. In this action, the NRC would revise the guidance and include regulatory changes, which would be beneficial to licensees. The impact to the NRC would be resource commitment in preparing and issuing an entirely new guide and properly notifying licensees of guidance to replace that which has been standing for nearly 30 years.

Alternative 3: Revise Regulatory Guide 8.24

Under this alternative, the NRC would revise Regulatory Guide 8.24. This action would address important aspects of regulatory changes to fuel cycle facility surveys, to include ANSI standard and NCRP guidance. Much of the guidance remains unchanged, which justifies the revision of a guide that applicants are familiar with and offers continuity for the NRC staff without a major change. The cost to the NRC of issuing the revised regulatory guide in a timely manner would be relatively small.

Conclusion

Based on this regulatory analysis, the staff recommends that the NRC revise Regulatory Guide 8.24. The staff concludes that the proposed action will enhance licensing practices of fuel cycle licensees, as well as providing practical and up-to-date guidance for conducting surveys.

TABLE 1. SURVEY FREQUENCIES

Plant Areas	External Radiation Surveys	Air Sampling	Removable Surface Contamination Surveys
Uranium receiving, warehousing, shipping	Monthly	Continuous air sampling; samples changed weekly and following any indication of release leading to airborne concentration of uranium	Monthly and following any indication of release
Active processing areas UF_6 vaporization, UF_6-UO_2 conversion, chemical processing, scrap recovery, powder processing, rod loading, decontamination, waste processing, change rooms	Monthly	Continuous air sampling;* samples changed each shift, following any change in equipment or process control, and following detection of any event that may have released uranium (i.e., leakage from valves, pipes, tanks, or trays; spillage; or blockage of process equipment such as conveyors, elevators, or hoppers).	Weekly and following any indication of release
Chemical-metallurgical laboratory	Monthly	Continuous air sampling; samples changed each shift	Weekly
Fuel assembly, inspection storage	Monthly	Continuous sampling; samples changed weekly	Monthly
Lunch rooms, cafeterias, snack bars, vending machine areas	Quarterly	-	Daily

*See Regulatory Position C.1.3.

TABLE 2 ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDES [a]	AVERAGE [b c f]	MAXIMUM [b d f]	REMOVABLE [b c f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranic's, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, 1-125, 1-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, 1-126, 1-131, 1-133	1000dpm / 100 cm^2	3000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5000 dpm $\beta\gamma$/100 cm^2	15,000 dpm $\beta\gamma$/100 cm^2	1000 dpm $\beta\gamma$/100 cm^2

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

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

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

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

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

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

APPENDIX A-1

Leak Test Requirements

A. Each source shall be tested for leakage at intervals not to exceed 6 months. In the absence of a certificate from a transferor indicating that a test has been made within 6 months prior to transfer, the sealed source shall not be put into use until tested.

B. The test shall be capable of detecting the presence of 0.005 microcuries of contamination on the test sample. The test sample shall be taken from the source or from appropriate accessible surfaces of the device in which the sealed source is permanently or semipermanently mounted or stored. Records of leak test results shall be kept in units of microcuries and maintained for inspection by the Commission.

C. It the test reveals the presence of 0.005 microcuries or more of removable contamination, the licensee shall immediately withdraw the sealed source from use and shall cause it to be decontaminated and repaired by a person appropriately licensed to make such repairs or to be disposed of in accordance with the Commission's regulations. Within 5 days after determining that any source has leaked, the licensee shall file a report with the Director, Division of Fuel Cycle Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555, describing the source, test results, extent of contamination, apparent or suspected cause of source failure, and corrective action taken. A copy of the report shall be sent to the Administrator of the nearest NRC Regional Office listed in Appendix D of Title 10, Code of Federal Regulations, Part 20.

D. The periodic leak test required by this condition does not apply to sealed sources that are stored and not being used. The sources excepted from this test shall be tested for leakage prior to any use or transfer to another person unless they have been leak tested within 6 months prior to the date of use or transfer.

REFERENCES

1. ANSI/HPS N13.49-2001, "Performance and Documentation of Radiological Surveys," American National Standards Institute/Health Physics Society, August 6, 2001.

2. ICRP Publication 30, "Limits for the Intake of Radionuclides by Workers," International Commission on Radiological Protection, 1982.

3. Regulatory Guide 8.25, "Air Sampling in the Workplace," U.S. Nuclear Regulatory Commission, Washington, DC, June 1992.

4. ANSI N42.18-2004, "Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents," December 2004.

5. NCRP Report No. 65, "Management of Persons Accidentally Contaminated with Radionuclides," National Council on Radiation Protection and Measurements, 1989.

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7. Regulatory Guide 8.11, "Applications of Bioassay for Uranium," U.S. Nuclear Regulatory Commission, Washington, DC, June 1974.

8. Title 49, *Code of Federal Regulations*, "Transportation," U.S. Department of Transportation, Washington, DC.

9. ANSI/HPS N323-1978, "Radiation Protection Instrumentation Test and Calibration," American National Standards Institute/Health Physics Society, March 11, 1991.

10. NCRP Report No. 112, "Calibration of Survey Instruments Used in Radiation Protection for the Assessment of Ionizing Radiation Fields and Radioactive Surface Contamination, National Council on Radiation Protection and Measurements, December 13, 1991.