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EXPRESS MAIL

21G-04-0146
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September 20, 2004

Director
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

References: 1) Docket No. 70-143; SNM License 124
2) Letter from NRC to B.M. Moore, Nuclear Fuel Services, - License Amendment 40 – Request to Use ICRP 68 Values (TAC NO. L31730), dated August 31, 2003

Subject: Administrative Changes to NFS' Air Sampling and Bioassay Programs

Dear Sir:

Nuclear Fuel Services, Inc. (NFS) hereby submits a request to amend the referenced license authorizing changes to the requirements for assessing airborne radioactivity and to the frequency for collecting bioassay samples. Authorization for other minor administrative changes related to the design-basis of ventilation systems is also requested herein. The requested changes pertain to Chapters 3 and 12 of the referenced license.

NFS requests authorization to change provisions in Section 3.2.3 *Work-Area Air Sampling* in a manner commensurate with information contained in Regulatory Guide 8.25 entitled *Air Sampling in the Workplace.* Continuous sampling of airborne radioactivity in work areas is currently required in this section of the referenced license without regard to the potential concentration of airborne radioactivity that may actually be present. NFS requests a change to allow stationary air sampling to be used in a manner that accomplishes monitoring of individual workers that may receive doses in excess of 10% of the Derived Air Concentration (DAC) or Annual Limit on Intake (ALI) as required under Title 10, Code of Federal Regulation (CFR), Part 20.1502, *Conditions Requiring Individual Monitoring of External and Internal Occupational Doses.* These proposed changes serve to clarify the manner in which compliance is achieved for ensuring occupational workers are adequately monitored in accordance with the aforementioned regulations and Regulatory Guide 8.25. As such, these changes are administrative and procedural in nature.

Public per
John Lubinski NMSS01

NFS also requests authorization to amend commitments related to the frequency in which bioassay samples are collected from workers that could be potentially exposed to highly soluble forms of uranium (Class D/F). Bioassay samples are currently required to be collected from individuals potentially exposed to highly soluble forms of uranium enriched in the isotope ^{235}U at a weight percentage of less than 5% at a sampling interval not to exceed 20 days, as specified in Section 3.2.5.1 *Internal Exposure Assessment* of SNM-124. This requirement is intended to ensure that occupational workers are properly monitored in airborne environments where chemical toxicity of uranium may be the predominant health effect. However, since the isotopic composition of uranium isotopes typically associated with downblending operations differ substantially from the uranium composition of typical uranium feedstock, NFS requests to protect workers from the chemical toxicity hazards of uranium based on its specific activity instead of ^{235}U enrichment. Since the same level of protection will be afforded to workers using the proposed method, this request is administrative and procedural in nature.

The last of these proposed changes is related to Section 3.2 *Ventilation* of SNM-124, which makes reference to the DACs in 10 CFR 20, Appendix B, Table 1, Column 3. The Nuclear Regulatory Commission (NRC) recently authorized NFS to use information contained in the International Commission on Radiological Protection (ICRP) Report 68 to adjust the DAC/ALI values used for assigning occupational radiation doses (Reference 2). As such, changes to Section 3.2 *Ventilation* are proposed to remove reference to 10 CFR 20, Appendix B, Table 1, Column 3 as a design-basis for ventilation systems. If these proposed changes are approved, the adjusted DAC values, based on the ICRP 68 methodology, will be used as the design-basis for said ventilation systems.

Since each of these proposed changes are administrative and procedural in nature or have already been authorized and supported by an environmental review (Reference 2), such changes are commensurate with a Categorical Exclusion as specified in 10 CFR 51.22, *Criterion for Categorical Exclusion; Identification of Licensing and Regulatory Action Eligible for Categorical or Otherwise not Requiring Environmental Review.*

To support your review of this license amendment request, Attachment I contains additional information to address the rationale and technical basis for assessing the workplace hazards associated with highly soluble forms of uranium. Revised pages of the referenced license associated with these proposed changes are contained in Attachment II.

The Safety and Safeguards Review Council has reviewed and approved these changes. For your convenience, vertical lines in the right-hand margin of affected license pages denote changes.

If you or your staff have any questions, require additional information, or wish to discuss this, please contact me, or Mr. Rik Droke, Licensing and Compliance Director at (423) 743-1741. Please reference our unique document identification number (21G-04-0146) in any correspondence concerning this letter.

Sincerely,

NUCLEAR FUEL SERVICES, INC.

B. Marie Moore
Vice President
Safety and Regulatory

JSK/lsn
Enclosures

cc:
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Attachment I

Justification for Change to Soluble Uranium Urine Sampling
(2 pages to follow)

Justification for Change to Soluble Uranium Urine Sampling

Amendment Request: Urine samples are collected and analyzed when required to show compliance with the 10 mg soluble U per week limit for workers (10 CFR Part 20). Under its existing license (SNM-124), NFS must increase its routine urine sample frequency to twice monthly for individuals working with low enriched uranium (< 5 wt.% U-235). NFS requests a modification to this license requirement by proposing that the criterion be based on specific activity of the uranium rather than enrichment (as allowed under 10 CFR 20, Appendix B) by increasing the sampling frequency when the specific activity is less than or equal to 2.4 uCi/gram U.

Justification: Individuals at NFS routinely work with uranium that has been blended by mixing highly enriched uranium with natural and/or depleted uranium. For this type of uranium, the specific activity (uCi/gU) is generally higher than that experienced with (non-blended) uranium enriched from natural form using the traditional gaseous diffusion process. For example, the blended uranium that is expected to be produced at the NFS BLEU Prep Facility (BPF) (nominal U-235 weight percent of 4.95%) will have a nominal specific activity of around 8.4 uCi/gU. This value is about 3.5 times higher than the value seen for traditional non-blended uranium enriched to the same level by gaseous diffusion (~2.4 uCi/gU based on Footnote 3 to Appendix B of 10 CFR Part 20).

The table below shows that the significance of the chemical hazard (relative to the radiological hazard) is more directly linked to the specific activity of the mixture than the U-235 weight enrichment. As shown, the radiological and chemical hazards are approximately equivalent for a specific activity of 2.4 uCi/gU (this corresponds to ~5% U-235 weight enrichment for traditional, non-blended uranium). At a specific activity of 2.4 uCi/gU an individual exposed to 100% of the radiological DAC (Derived Air Concentration) would receive a 10 mg/week U intake by inhalation (assuming 20 liters/minute reference breathing rate). For blended uranium at the NFS BPF (nominal enrichment = 4.95% U-235; 8.4 uCi/gU), the weekly average air concentration must exceed 350% of the radiological DAC in order to result in a 10 mg/week intake. By license requirements, NFS is committed to operating at average levels below the DAC and typically operates considerably lower than this in practice. Therefore, for blended material, radiological exposure (vs. chemical exposure) is the overriding concern. In conclusion, specific activity is a more appropriate metric than U-235 enrichment for instigating increased urine sampling due to chemical toxicity concerns.

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Material Type	U-235 Wt%	Ci/gU*	Activity (uCi) in 10 mg U	Avgerage Concentration (uCi/ml) --> 10 mg/week	Avg. %DAC to give 10 mg/week at 20 l/min
Depleted U	< 0.72%	3.60E-07	3.60E-03	7.50E-11	15%
Natural U	0.72%	6.77E-07	6.77E-03	1.41E-10	28%
Nonblended LEU-1%	1%	7.83E-07	7.83E-03	1.63E-10	33%
Nonblended LEU-2%	2%	1.17E-06	1.17E-02	2.45E-10	49%
Nonblended LEU-3%	3%	1.57E-06	1.57E-02	3.27E-10	65%
Nonblended LEU-4%	4%	1.97E-06	1.97E-02	4.11E-10	82%
Nonblended LEU-5%	5%	2.39E-06	2.39E-02	4.97E-10	99%
Nonblended LEU-18.12%	18.12%	8.40E-06	8.40E-02	1.75E-09	350%
Blended Recycled LEU-4.95%**	4.95%	8.40E-06	8.40E-02	1.75E-09	350%
Recycled HEU-55%**	55%	9.90E-05	9.90E-01	2.06E-08	4125%

*Value in Column 3 is based on Footnote 3 to 10CFR Part 20, unless specified otherwise.
**Specific activity based on site-specific data for NFS/TVA uranium materials (U-Al, U-metal buttons).

Column 4 = # of uCi in 10 mg U = (10 mg U)*(1g / 1000 mg)*(Column 3, Ci/gU)*(1E6 uCi/Ci)

Column 5 = uCi in 10 mg U / Volume of air (ml) breathed in a 40-hr workweek by reference man @ 20 L/min (ml)
= {Column 4, uCi} / {40 hr x 60 min/hr x 20 L/min x 1000 ml/L}

Column 6 = {Column 5 / DAC} x 100%
DAC = 5E-10 uCi/ml (10 CFR 20, Class D soluble uranium)

Attachment II

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Replacement Pages

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- Ventilation for occupied areas shall be designed to maintain average work station concentrations of airborne radioactive materials, during normal conditions, below the DAC (Derived Air Concentration) value.

- In special circumstances where personnel occupation is limited, or during maintenance, decommissioning, equipment modification, etc., where installation of such engineering controls is impracticable and/or infeasible, alternatives such as the use of portable containment or respiratory protection devices shall be used to control exposure to radioactive materials.

3.2.2.2 **Process Enclosure and Exhaust Ventilation**

Process containment, enclosure, and/or exhaust ventilation designed to maintain average concentrations of airborne radioactive materials, under normal conditions, below the DAC shall be provided. Should failure or degradation of process ventilation occur whereby average

concentrations greater than the DAC are experienced for seven days or more, investigation and corrective action shall be initiated.

3.2.2.2.1 **Hoods and Glove Boxes**

The design criteria for inward air flow through the open face of a new hood or similar enclosure, used to contain radioactive material which has a propensity to suspend in air, shall be at least 125 linear feet per minute (LFM).

The inward air flow through the open face of an existing hood, open box, or similar open face enclosure, used to contain radioactive material which has a propensity to suspend in air, shall be at least 100 LFM, except for the following. The minimum rate of flow into these hoods shall be at least 50 LFM.

- The large secondary hoods enclosing the primary hoods over the dissolver trays,

- The spectrographic and standard products laboratories hoods and dryboxes,

(both primary and secondary) in the exhaust system are equipped with a device for measuring differential pressure.

HEPA filter integrity is evaluated when the differential pressure across the filter exceeds four inches of water. A HEPA filter is replaced following evidence of the inability of the filter or the exhaust system to perform its function properly. In no case will filters continue to be operated at delta P values which exceed the manufacturer's rating for the filter. These pressures are checked weekly.

3.2.3 Work-Area Air Sampling

3.2.3.1 Stationary Air Samplers

Stationary air sampling of work areas for airborne alpha radioactivity shall be based on guidance provided in Regulatory Guide 8.25, dated June, 1992. If it is likely that a worker intake could exceed 0.1 times the ALI (Annual Limit of Intake) value and stationary air sampling is used as the primary means to assign the intake of record, then such sampling shall be shown to be representative.

Demonstration that stationary samples are representative shall be performed in accordance with written procedures that are based on Regulatory Guide 8.25 (June 1992). When, for various reasons, the stationary air samplers cannot be made representative, other appropriate forms of work-area monitoring shall be provided. Stationary air sample collection frequencies shall be established in written procedures. Each air sampler consists of a particulate filter and a rotometer so that the volume of air sampled can be determined. These rotometers are calibrated or replaced annually.

The airborne concentration of radioactivity at each sampling location shall be estimated in a timely manner after each sampling period in order to detect an unexpected release of radioactive materials.

If a single sample from a permanent air sampling station exceeds the applicable DAC, an investigation as to the cause shall be conducted, and necessary corrective action shall be taken and documented. If the 7-day average result for a work station exceeds the level which delimits an airborne radioactivity area (10 CFR 20.1003), an investigation as to the cause shall be conducted, and necessary corrective action shall be taken and documented.

The stationary air sampling analytical system shall have a detection limit of at least 0.3 DAC.

The routine survey data and individual personnel exposure assignments are monitored to evaluate the effectiveness of the radiation controls.

3.2.3.2 **Special Air Sampling**

Breathing Zone Air Samplers (BZA) are used in the verification program of the stationary air samplers and to monitor personnel exposure to airborne radioactivity. BZAs are worn by operators while working at a station. The results are then used to assure adequate representation is provided by the stationary air samplers. BZAs may also be used to augment the stationary air sampling program or for personnel monitoring purposes. When BZAs are used to monitor personal internal exposure to airborne radioactivity, the filters of the BZAs shall be collected each shift and analyzed for radioactivity.

Continuous Air Monitors may be positioned in various Plant areas, as deemed necessary by the Safety function, to identify airborne problems as they occur. These instruments are equipped with a

The routine frequency for the collection and analysis of urine samples to measure intakes of uranium by individuals who could be exposed to highly soluble compounds of uranium with specific activity less than or equal to 2.4 μCi/gU shall be at least twice a month, with a maximum interval between sampling not to exceed 20 days. In addition, the action level for investigation, intake assessment, and follow-up sampling shall not exceed 20 micrograms uranium per liter of urine.

Actions based on results will be at a minimum those specified in Regulatory Guide 8.9.

A quality assurance program for in vitro and in vivo measurements performed by vendor and by NFS shall be in place.

Bioassay result interpretation and internal dose assessments will be conducted in accordance with written procedures. The methods employed will be consistent with requirements in 10 CFR Part 20.1204 and NRC Regulatory Guides 8.9 and 8.34.

The concentrations of airborne radioactivity may be assessed, for the purpose of assigning effective doses to workers, using DAC/ALI values for an aerosol particle size of 5 microns specified in ICRP 68 in lieu of those contained in 10 CFR 20, Appendix B. In addition, use of the DAC/ALI values specified in ICRP 68 may be used independent from methods to adjust the DAC/ALI values based on the aerosol particle studies.

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CHAPTER 12

D. EXPOSURE MONITORING

12.10 OCCUPATIONAL EXPOSURE ANALYSIS

As an appendix to this chapter, NFS provides an analysis of occupational exposures (external and internal). The analysis includes data from at least the past two years of Plant operation for each Plant area and type of operation performed. It has been developed utilizing the guidance provided in Regulatory Guide 3.52 (Rev. 1, November 1986) "Standard Format and Content for the Health and Safety Sections of License Renewal Applications for Uranium Processing and Fuel Fabrication."

12.11 MEASURES TAKEN TO IMPLEMENT ALARA

Nuclear Fuel Services, Inc., is committed to the philosophy of ALARA. That commitment is manifested in:

- A published Radiation Safety policy, signed by the President of NFS, declares, to all employees, the policy and intent of NFS to maintain exposure as low as reasonably achievable.

- NFS has developed a formal written ALARA Plan, approved by senior level managers, which implements the NFS policy by:

  (a) Requiring training in ALARA philosophy for all radiation workers

  (b) Requiring the development, approval, and implementation of specific ALARA goals for selected operating units and the designation of an ALARA Coordinator as appropriate for each group to review the progress toward the attainment of specific ALARA goals

  (c) Requiring the measurement and monitoring of progress toward goal achievement and the issuance of regular progress reports to all levels of management and supervision

  (d) Requiring the performance of specific ALARA reviews during the design phase of engineering projects for new facilities or facility and/or equipment modification

(e) Defining, as appropriate, specific long-term ALARA goals

(f) Establishing an ALARA technical review committee composed of the SSRC (Safety and Safeguards Review Committee) to review all proposed facility modifications and their ALARA evaluations, operating procedures, and ALARA reports.

(g) Requiring the issuance of a semiannual report of all radiation and other safety-related monitoring and audits to appropriate levels of management together with recommendations on methods for lowering exposures, both occupational and environmental

(h) Requiring the analysis of monitoring data for trends which might indicate an increase in radiation exposures

(i) Establishing a plan for auditing the conduct of the ALARA program and,

(j) Requiring routine inspections of operating areas focused on implementation of radiological controls.

- NFS has appointed an ALARA Health Physicist, within the Radiation Protection organization, with responsibility for overseeing and coordinating the ALARA Program.

12.12 INTERNAL EXPOSURE MONITORING

12.12.1 General

The primary objective of the internal radiation monitoring program is to assure that significant internal radiation exposures are detected, properly evaluated, and recorded. The internal radiation monitoring program, including bioassay procedures, is designed to ultimately express measurements in terms of estimated dose (e.g., DAC-hrs, CEDE).

To accomplish this objective, monitoring of both the working environment and workers is required. Breathing zone air samplers and representative fixed air sampling are used as the primary means of determining intakes for workers. Bioassay measurements, when they possess the necessary sensitivity, may be used as an overcheck of the air sampling program and may be used to make adjustments or additions to an individual worker's dose record.

The sensitivity of a particular bioassay procedure is a function of body metabolism of the radionuclide, its route of entry into the body, and the exposing conditions (i.e., acute versus chronic exposure). Directly related factors are lung solubility of the material, particle size, the overall sensitivity of the laboratory used to analyze bioassay samples, and the time(s) after exposure the bioassay sample is collected and analyzed.

These variables disallow the establishment of internal action guides for exposure control based on bioassay results per se. Rather, action guides are based on an interpretation of each bioassay result.

The NFS internal exposure monitoring program currently utilizes the IMBA Expert Computer Program developed by the UK National Radiological Protection Board and ACS and Associates, Inc. However, NFS reserves the right to modify these programs or adopt alternate programs that have equivalent or superior capabilities upon industry development.

The computer program relies on International Commission on Radiological Protection (ICRP) models which estimate intakes from the interpretation of bioassay results. The estimated intake can then be compared to internal action levels and to the ALI. Also, the dose to the worker is estimated.

The model structure is based upon Reference Man models summarized in ICRP Publications. Intake pathways considered include inhalation, ingestion, instantaneous uptake, and delayed uptake through a wound.

Intake retention functions based on ICRP Publication 68 dose models are used in the design and operation of the NFS bioassay program including:

- the identification of those bioassay procedures that have sufficient sensitivity and accuracy for the detection of appropriate internal action levels,
- the determination of derived investigation levels (DILs),
- the determination of the frequency of monitoring required to ensure the detection of an internal action level, and
- in cases involving accidents, the determination of special bioassay procedures that can be used to confirm or make better estimates of the intake and other dose estimates over time intervals appropriate to the specific case.

12.12.2 **Capabilities**

On-site capability exists in dedicated facilities for the analysis of urine samples, nasal smears, and work place particle size determinations. An on-site in vivo chest counter was installed and operational in 1987. Contract laboratories are currently utilized, where appropriate, for urine and fecal isotopic analysis, lung solubility determinations on samples from the NFS work place, and quality assurance sample checks on the NFS urinalysis laboratory.

Typical minimum detectable amounts are listed:

	U-233	U-235	Plutonium (1)
Urinalysis	0.04 µg/l	0.04 µg/l(2)	0.5 DPM/l
Fecal Analysis	0.1 DPM/g	0.5 DPM/g	0.1 DPM/g
In-Vivo Lung Count	N/A (3)	0.2 nCi	0.5 nCi

(1) MDA is specific to the radionuclide in the mixture, or as in the case of lung counting, the daughter Am-241.

(2) Based on Kinetic phosphorescence analysis of total uranium, analysis performed on-site. (0.4 µg/l based on natural dietary intake.)

(3) Dosimetry based on the more sensitive urine or fecal analysis.

12.12.3 **Bioassay Frequencies**

Routine bioassay frequencies are determined as outlined in Table 1 of Regulatory Guide 8.34 and guidance given in Regulatory Guide 8.9. When measurement capability is a limiting factor, frequencies are increased. Participants and types of bioassays are determined by the radiation safety and protection function based on work assignments and review of exposure history.

Urinalysis is the preferred technique for soluble (Class D/F) radioactive material work areas, while in vivo and fecal analyses are relied upon more heavily for insoluble (Classes W/M and Y/S) radioactive material work areas. Lung solubility determinations at work stations are based on either actual measurement or the classification in Appendix B to 10 CFR 20. These classifications are based on the theoretical reaction products at a particular work station and are used for planning purposes in the routine bioassay program. For significant exposure evaluations, solubility is determined from a series of

bioassay measurements, when feasible.

Operational bioassay measurements are required as outlined in Section 12.4.2.2. Special bioassays are collected or in vivo measurements made to adequately assess intakes as outlined in Sections 12.4.2.3, 12.8.1, and 12.8.2.

12.12.4 **Quality Control of Other Programs**

A secondary objective of the bioassay program is to provide a quality control check to assure adequate protection of workers from internal radiation exposure. As such, bioassay results are periodically used to verify the validity of the work place air monitoring program and the effectiveness of the respiratory protection program. When bioassay- based exposure estimates indicate exposures are approximately equal to or less than those generated from the air monitoring program, then the air monitoring program is considered adequate. Respirator use protection factors are applied as appropriate. This program is separate from the other validity checks on the air sampling program discussed later in this chapter.

12.12.5 **Work Restrictions**

When significant exposures occur or are suspected, in addition to other actions required by this license and NRC regulations, work restrictions are imposed. Two types of restrictions are utilized:

- Diagnostic restriction means a reassignment of an individual to a position or work area to minimize the potential for additional exposure which would complicate the exposure evaluation process. Once the radiation safety and protection function has adequate samples/information to assign an estimate of the exposure to an individual, he/she may be allowed to return to a normal work assignment.

- Regulatory restriction means a reassignment of an individual to a position or work area with significantly lower exposure potential for the remainder of the reporting period in which the exposure occurred. This type of restriction usually follows a diagnostic restriction and is provided to allow adequate control of individual exposures below the NRC reporting limit in 10 CFR 20.1201.

An indication from any of the safety monitoring programs that an exposure of 200 DAC-hrs may have occurred after applying decay and respiratory protection factors, if applicable, is the action guide for diagnostic restriction. An assigned

exposure greater than or equal to the limits set forth in 10 CFR 20.1201 results in a regulatory restriction. In the event a measurement indicates an intake of an individual is equal to or exceeds 10 milligrams of Class D/F uranium (≤2.4 μCi/gU specific activity) in a week, a medical restriction is imposed.

Internal exposures are assigned to the calendar year in which the exposure event occurred.

12.13 AIR SAMPLING

12.13.1 Airborne Radioactivity in Work Areas

The control of radioactive materials in restricted areas is effected by means of equipment design, containment, and associated ventilation.

Processing of radioactive materials in which significant potential for release of airborne contaminants exists is conducted in a ventilated drybox or hood with sufficient ventilation to minimize the release of radioactivity. When a system fails to perform in such a way as to maintain applicable specifications, prompt corrective action is instituted to minimize exposure of personnel to the lowest practicable levels.

In general, the limits set forth in 10 CFR 20 will be reached or exceeded only under abnormal circumstances. Design objectives, corrective actions, management responses, etc., are made within the framework of the "as low as reasonably achievable" concept.

12.13.2 Air Monitoring Systems

To verify the effectiveness of the containment capabilities, surface smear and airborne radioactivity surveys are conducted on a routine basis, the frequency of which is dependent on the potential for radioactivity release. A number of air monitoring systems exist at the NFS Erwin facility to monitor work area exposures/ concentrations and to detect unsafe concentrations.

12.13.2.1 Stationary Air Samplers (SAS)

Continuous air sampling of process work areas for airborne alpha and/or beta radioactivity is performed by drawing air through a particulate filtering or collection media with a known collection efficiency and measured periodically by counting the filter media with a gas-flow proportional counter. Each air sampler is coupled to an air-flow-rate meter so that the volume of air sampled can be

accurately determined.

Stationary air samples in areas where annual intakes are likely to exceed 10% of the ALI are collected every operating work shift. Other active air samples are collected, at a lower frequency in accordance with written procedures, based on the potential for exposure to occur.

12.13.2.2 **Continuous Air Monitors (CAMs)**

A number of airborne alpha and/or beta monitors may be positioned in various Plant areas to identify airborne problems as they occur, if deemed necessary by the radiation safety and protection function. These instruments are equipped with a particulate filter and solid state detector. Whenever airborne activity could result in the exposure of an individual to greater than 40 DAC-hrs in a day, the monitor activates an alarm.

When such an alarm occurs, workers in the area are required to evacuate or wear respiratory protection equipment until the high level alarm is investigated and resolved.

12.13.2.3 **Lapel Samplers (BZAs)**

The primary purpose of lapel air sampling (BZA) is to monitor personnel exposure to airborne radioactivity. They are also used to determine the representativeness of the SASs. When used to monitor personnel exposure, the sample filters are routinely counted prior to the individual's next scheduled work shift.

All wearers are instructed in the proper use of lapel samplers. Depending upon the analytical results of the lapel sampler filter, the wearer may be required to complete a questionnaire, submit a bioassay sample, and in some cases have nasal smears performed (see Section 12.8 for action limits).

12.13.2.4 **High-Volume Sampling**

Immediate assessment of airborne radioactivity levels are made with high-volume air samplers using filter media or impactor heads. The samples are promptly counted for gross alpha activity. The resulting information is important for recommending respiratory protection or other necessary measures.

12.13.3 **Quality Assurance/Quality Control (QA/QC) Considerations**

In the event stationary air samplers are used for assigning exposure, the following QA/QC steps will be taken to verify the representativeness of work area air sampling. This is accomplished by comparing data generated from the SASs to data generated by lapel samplers worn by operators performing work in the area under consideration.

If the lapel or stationary sampler result does not exceed the value excluded by Table 1 of Regulatory Guide 8.25, dated June 1992, no further test is performed and the stationary air samplers are ruled representative. If this excluded level is exceeded by the lapel or stationary sampler, the ratio of the stationary air sample result to the lapel sample result must exceed the value of 0.5 for the stationary air sample(s) to be ruled representative. The results from more than one shift may be averaged to make this determination.

Other QA/QC methods are used, including periodic equipment calibrations, daily source and background checks, to assure proper operating characteristics. These practices are documented and audited to assure that all duties are performed according to procedures.

12.13.4 **Action Guidelines**

Action points for various air sampling systems are provided in Section 12.8. Reports are also part of the actions initiated by elevated sampling station data.

Because airborne radioactivity can be a significant source of radiation exposure at the NFS Erwin facility, a summary report of all individual Plant air samples which exceeds the DAC, corrected for decay, is prepared and circulated to Plant management at least monthly. Problem areas are identified and, if known, the cause of increased airborne radioactivity is given.

Weekly averages of airborne radioactivity levels by work station and area

are maintained and reported to the President on a semiannual basis. Problem areas are identified and recommendations for reduction of airborne radioactivity levels are made with this report.

The design objective of process equipment and confinement is to maintain the average airborne radioactivity concentrations at less than 25% of the appropriate DAC value. Whenever airborne concentrations at any work station exceed 25% of the appropriate DAC value as averaged over a work week, and no cause has been identified, the work station is investigated, including the equipment in use, operator work habits, ventilation effectiveness, etc. Such investigations and the corrective action taken, or initiated, are documented.

Confirmation that any work station average airborne radioactivity concentration as averaged over a work shift (or over the sampling period, in areas where less frequent samples are collected), is in excess of the DAC initiates the following actions:

- Confirmation of the continued existence of airborne radioactivity in the area through short-term high-volume air sampling. Determine the number and identity of personnel who may have been exposed.

- If confirmed, posting of the room, area, or building with signs indicating the need for respiratory equipment (including type and instructions to all occupants to use it).

- Investigate to determine the sources of airborne radioactivity.

- Initiate appropriate corrective action to control further releases of radioactivity.

- Suspend routine operations if the airborne radioactivity concentration exceeds 100 times the DAC. Corrective action is initiated and documented for routine operations. Non-routine operations performed under an RWP requiring respiratory protection could continue if adequate measures are in place and approved by the areas health physicist on a case-by-case basis.

12.13.5 **Particle Size Adjustment**

For inhalation exposures, NFS may elect to adjust Derived Air Concentrations (DACs), Annual Limits of Intake (ALIs), and Committed Dose Equivalents

(CDEs to specific organs) which are based on 1-micron AMAD (Activity Median Aerodynamic Diameter) particles using the results of particle activity-size distribution measurements. The method of obtaining such measurements, analyzing data, and applying results is described below.

Particle (activity) size distribution measurements will be taken using an Anderson Marple Model 296 Personal Cascade Impactor (or equivalent). Typically this impactor is operated at a flow rate of 2 liters/minute and consists of 6 impactor stages and a back-up filter. The typical particle size range collected by each stage in micrometers (um) is as follows: >9.8 um; 6.0 to 9.8 um; 3.5 to 6.0 um; 1.55 to 3.5 um; 0.93 to 1.55 um; 0.52 to 0.93 um. The size range for the back-up filter is 0 to 0.52 um.

If NFS chooses to adjust DACs, ALIs, and CDEs, at least three particle size samples will be collected and analyzed for radioactivity for each grouping of locations. The locations for which particle sizing data analysis will be performed will be limited to Inhalation Class W/M or Class Y/S process areas. The analytical results will be averaged for each impactor stage and for the back-up filter to determine a single average measured activity-size distribution to use in subsequent analyses described below. Particle size analysis will be performed at least semi-annually in each group of locations for which particle size credit is taken. After one year, the frequency may be relaxed to annually if data for a group of locations does not differ significantly from previous measurements. Particle size will be reassessed following significant process changes deemed likely to change the particle size distribution. Using the results of particle size measurements and knowledge of the process, a Health Physicist will decide whether specific operations or specific locations can be grouped together for characterization purposes.

The method of analysis used to determine the particle size consists first of specifying the parameters (i.e., a weight, geometric mean, and geometric standard deviation) for up to four underlying lognormal sub-distributions. Then by changing parameters of each underlying lognormal distribution (i.e., weight, geometric mean, and geometric standard deviation), a numerical iteration technique is employed to minimize the sum of the squared differences between the predicted and measured activity on each stage. In this numerical technique, the geometric mean will be constrained to values <20 μm; and the geometric standard deviation (GSD) will be constrained to values between $1.1 < GSD < 2.5$. As an indication of the goodness-of-fit for the final predicted (hypothesized) distribution as compared to the measured distribution, the chi-square statistic is used. The chi-square test statistic is calculated assuming n-2 degrees of freedom, where n is the number of stages including the back-up filter

(i.e., n=7). If a statistically good fit exists (as indicated by the p-value), the fractional activities represented by each underlying distribution and their associated AMADs (equivalent to the geometric mean for a lognormal distribution) are used to determine an appropriate adjustment factor to apply to the associated 1-micron based DAC, ALI, and CDE values in accordance with equations in Appendix B to this chapter. The level of confidence required to demonstrate goodness-of-fit will be "p" greater than or equal to 0.8, where "p" is the probability of obtaining a value equal to or less than the calculated chi-square statistic when the hypothesized distribution is true. If this level cannot be achieved, the data will be discarded and additional data taken. However, if additional data cannot be fitted (i.e., "p" is also less than 0.8), then a conservative analysis will be used to determine a particle size distribution and the analysis will be documented.

CHAPTER 12

E. EXPOSURE CONTROL

12.14 SURFACE CONTAMINATION CONTROL PROGRAM

12.14.1 General

The NFS surface contamination control program requires that administrative action guidelines be established to assure that contamination levels and employee exposures are kept as low as reasonably achievable (ALARA) and within the limits established by internal action guides.

To comply with these limits, NFS has a protective clothing program and a program for monitoring area contamination levels and personnel contamination.

12.14.2 Area Classification

Classification of the areas and the limits applied to areas within the Plant protected area is based on the use to which the specific area is committed and the potential hazard presented by the presence of surface contamination, particularly with regard to inhalation and resuspension propensity. The area designations are "uncontrolled" and "controlled", and are defined in Chapter 1. Controlled areas may be further subdivided into contamination areas, buffer zones, step off pads, etc., where appropriate. Typical areas within buildings where "controlled areas" are frequently established are presented in Figure 12.2.

12.14.3 Action Guide Levels

Action guides are established to ensure appropriate corrective actions are taken for contamination control. The guideline levels are designed to be conservative in nature and are not to be regarded as the borderline between "safe" and "unsafe."

If contamination in excess of the action guide levels occurs, the necessary remedial action (decontamination, stabilization, excavation, disposal, etc.) is based upon the particular circumstances and the behavior of the material involved.

Action levels are given in Table 12.6. Response is based on the need to avoid transfer of contamination to uncontrolled areas and to maintain exposures as low as is reasonably achievable. Timeliness of the response is based on the above considerations and is set by internal guidelines.

Figure 12.2 - Plant Areas Designated

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(Figure Contains Official Use Only Information)

All areas are required to be surveyed for total and removable alpha and/or beta contamination on routine frequencies. Areas in which the potential for surface contamination is high, or the probability for human uptake is high, are surveyed more frequently.

Table 12.6
CONTAMINATION SURVEY ACTION POINTS

Location	Transferable Alpha Contamination (dpm/100 sq cm)	Transferable Beta Contamination (dpm/100 sq cm)
Uncontrolled Area	200	1,000
Uranium Controlled Area	5,000	50,000
Plutonium Controlled Area	1,000	N/A

Surface contamination on offsite shipments of radioactive materials complies with Department of Transportation (or other regulatory agency) requirements.

12.14.4 **Survey Practices**

Removable radioactive contamination is determined by taking a smear from a known surface area (normally 100 cm^2) by applying moderate pressure and assessing the amount of radioactive material on the smear with an appropriate instrument of known efficiency. Wet smears may be taken as necessary and dried appropriately for analysis. In determining removable contamination on objects of lesser surface area, the pertinent levels are reduced proportionally; and the entire surface is wiped. Large area wipes may also be used for onsite release or gross indicators of contamination on an object or in an area.

Measurements of total alpha/beta contamination may be made as a part of the contamination control program. Actions are taken based on the results of the transferrable contamination levels.

The interior surfaces of containment systems such as ventilated hoods, gloveboxes, cells, etc., are excluded from the limits for removable contamination in controlled areas and, therefore, are not routinely surveyed. Special diked areas, drip pans, and the like, although open to room air, are limited to traffic access and, therefore, create less potential for transfer or resuspension.

These areas are surveyed routinely for removable contamination with acceptable levels, and decontamination actions and survey frequencies are set by internal guidelines.

Only alpha contamination surveys are performed routinely. Beta contamination surveys are performed only under special circumstances when the conditions warrant such surveys. Removable and total contamination surveys are performed on the basis of process operations and the contamination trends. Decontamination is performed in accordance with the action points designated in Table 12.6. Measurements are recorded in units of dpm per area of surface surveyed or dpm per wipe for large area wipes.

12.14.5 **Control Practices**

The contamination buildup within controlled areas is primarily controlled by physical containment of materials in station enclosures. Frequent mopping of floors and wiping down of equipment, ducts, pipes, etc., are used as an additional control measure.

During or at the conclusion of each contamination survey, the foreman or supervisor is advised by the surveyor of all areas which exceed the action limits. The foreman then initiates action to assure timely decontamination. Such action is documented on the survey form.

Each day (Monday through Friday, except holidays) a qualified member of the radiation safety and protection function reviews the contamination surveys for trends, problem areas, timely decontamination, etc. He/she identifies to the area manager those locations considered to be a problem.

A monthly summary of surface contamination results is prepared, reviewed by the manager of the radiation safety and protection function and distributed to Plant management.

12.14.6 **Personnel Contamination Control Guidance**

To prevent the spread of contamination from the controlled areas and to minimize exposure to employees, the following requirements are enforced:

- All personnel wear anti-contamination clothing while in controlled areas. This may include coveralls, gloves, hoods, shoe covers, or booties, as appropriate.

- All personnel remove protective clothing at the designated boundary and deposit them in the dirty laundry or disposal receptacles.

- All personnel survey for contamination at designated locations after exiting the controlled areas. If the levels in Table 12.7 are exceeded, decontamination is performed. If protective clothing is suspected of being contaminated, the affected areas are also monitored. Actions specified in Table 12.7 are taken.

- Hands and feet are surveyed at a minimum. Additional body or clothing locations are surveyed based on initiating actions (e.g., area contacted liquid or contaminated equipment). Guidance for determining initiating actions and necessary survey(s) are specified in Health and Safety Procedures.

- Periodic overcheck surveys are performed at various locations and documented to assure that, upon leaving the Plant protected area, contamination of personnel does not exceed instrument detection levels.

12.14.7 **Contamination Control for Release of Material or Equipment and for Shipping**

Surface contamination surveys are conducted for contamination prior to release of potentially contaminated packages, equipment, scrap, or waste from controlled to uncontrolled areas and use. No equipment or package brought from a controlled area is removed from the NFS Erwin facility unless radioactivity contamination levels are at or below the guidelines given in Chapter 1, Appendix A.

Shipments of radioactive materials meet Department of Transportation regulations regarding radiation and contamination levels.

If contamination is detected or is known to have been covered, a reasonable effort is made to eliminate the contamination; i.e., decontamination procedures are repeated until additional effort does not significantly reduce the contamination levels. If the value of the item does not justify this level of effort, it is disposed of as radioactive waste or limited to use within the controlled area. If the value of the item or the need to remove the item from the controlled area is very great, then a conditional release is granted under very strict control conditions designed to prevent the spread of contamination or the exposure of personnel. These conditions are set by internal guidelines.

Table 12.7

PERSONNEL SURVEY ACTIONS/LIMITS

Range/Limit* (dpm/100 cm^2)	Skin	Personal Clothing	Personal Shoes	Protective Clothing
0 - MDA	No action	No action	No action	No action
>MDA - 2500	Decontaminate and resurvey. Notify foreman if decontamination is not successful	Decontaminate and resurvey. Notify Safety Department if decontamination is not successful and change into clean clothing	Decontaminate and resurvey. Notify Safety Department if decontamination is not successful and change into clean shoes	Deposit in dirty laundry container.
>2500	Notify area foreman. Decontaminate and resurvey. Notify Safety Department if decontamination is not successful	Decontaminate and resurvey. Notify Safety Department if decontamination is not successful and change into clean clothing	Notify Safety Department. Decontaminate and resurvey. Notify Safety Department if decontamination is not successful and change into clean shoes	Notify Safety Department. Deposit in dirty laundry container.

*Corrected for background. This measurement is for total alpha contamination. A correction will be made for active surface area of the probe used. MDA is defined in Part 1, Chapter 3, Table 3.1.

12.15 URANIUM CHEMICAL TOXICITY

When individuals may have been exposed to soluble compounds (Class D/F) of uranium with specific activity less than 2.4 μCi/gU, the chemical toxicity limit of 10 milligrams inhaled in any 40-hour period may be more restrictive than the radiological limit. If this type of exposure is possible, the action levels in Table 12.3 are modified as follows:

Internal Exposure	Action
Airborne - Any result which shows a potential exposure > 0.2 mg U/m^3 averaged over a calendar week	Initiate confirmatory bioassay; determine individuals potentially exposed and evaluate work history for total intake; and investigate as to cause and recommend corrective actions. Establish work restriction pending intake assessment; perform detailed exposure evaluation utilizing urinalysis.
URINALYSIS - Any result which shows a potential exposure > 10 mg U in a calendar week	Initiate confirmatory bioassay; determine individuals potentially exposed and evaluate work history for total intake; and investigate as to cause and recommend corrective actions. Establish work restriction pending intake assessment; perform detailed exposure evaluation.

NOTE: 0.2 mg U/m^3 (Class D/F) = 14% DAC (0.36 μCi/gU)
= 27% DAC (0.677 μCi/gU)
= 40% DAC (1.0 μCi/gU)
= 80% DAC (2.0 μCi/gU)
= 95% DAC (2.4 μCi/gU)

10 mg U (Class D/F) = 6 DAC-hr (0.36 μCi/gU)
= 11 DAC-hr (0.677 μCi/gU)
= 17 DAC-hr (1.0 μCi/gU)
= 33 DAC-hr (2.0 μCi/gU)
= 40 DAC-hr (2.4 μCi/gU)