MODULE 9.0: REGULATIONS

Introduction

Welcome to Module 9.0 of the Fuel Cycle Processes Directed Self-Study Course! This is the ninth of nine modules available in this self-study course. The purpose of this module is to provide an understanding of nuclear energy and its role in nuclear power, an overview of NRC regulations of enrichment facilities, gaseous diffusion plant and other enrichment facility NRC regulations, export-import regulations of enrichment technologies, and an overview of other NRC regulations important for enrichment facilities. This self-study module is designed to assist you in accomplishing the learning objectives listed at the beginning of the module. There are six learning objectives in this module. The module has self-check questions and activities to help you assess your understanding of the concepts presented in the module.

Before you Begin

It is recommended that you have access to the following materials:

- Trainee Guide
- 10 CFR Part 76, Certification of Gaseous Diffusion Plants
- 10 CFR Part 70, Domestic Licensing of Special Nuclear Material
- 10 CFR Part 110, Export and Import of Nuclear Equipment and Material

Complete the following prerequisite(s):

- Module 1.0: Overview of the Nuclear Fuel Cycle

How to Complete this Module

1. Review the learning objectives.
2. Read each section within the module in sequential order.
3. Complete the self-check questions and activities within this module.
4. Check off the tracking form as you complete the self-check questions and/or activity within the module.
5. Contact your administrator as prompted for a progress review meeting.
6. Contact your administrator as prompted for any additional materials and/or specific assignments.
7. Complete all assignments related to this module. If no other materials or assignments are given to you by your administrator, you have completed this module.
8. Ensure that you and your administrator have dated and initialed your progress on the tracking form.
9. Go to the next assigned module

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LEARNING OBJECTIVES

9.1 Upon completion of this module, you will be able to understand nuclear energy and its role in nuclear power.

9.1.1 Explain an overview of NRC regulations of enrichment facilities.

9.1.2 Identify NRC regulations of gaseous diffusion plants (Part 76).

9.1.3 Identify NRC regulations for other enrichment facilities (Part 70).

9.1.4 Identify export-import regulations of enrichment technologies (Part 110).

9.1.5 Explain an overview of other NRC regulations important for enrichment facilities.

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Learning Objective

When you finish this section, you will be able to:

9.1 Explain an overview of NRC regulations of enrichment facilities.

NRC REGULATION

Regulatory Objectives

The NRC is the principal regulator of commercial activities involving radioactive materials, with the following two overall objectives:

1. protect the health and safety of the public and workers, and to protect the environment, from radiological and certain chemical hazards.

2. Safeguard nuclear facilities and materials from loss, theft, or diversion.

NRC requires most of its regulated facilities and activities to obtain a license prior to commencing operations with radioactive materials. The license is based upon a written submission, an application, that is reviewed by the NRC prior to the use of nuclear materials, or, in some cases, prior to construction of the facility itself. The license specifies operations, isotopes, and quantities for the facility.

The NRC regulates the facilities so that the risks are as low as reasonably achievable (ALARA). This means the radiological risks from the NRC licensed activities are to pose negligible additional risk to the workers, the public, and the environment, as compared to similar activities not involving radiological materials. Negligible is normally defined as 0.1% and, thus, worker and public risks from the nuclear operations usually translate to very low risk values of 10-5 to 10-6 per year or lower (See, for example, NRC statements on safety goals.).

NRC regulations are contained within Title 10, “Energy,” of the Code of Federal Regulations (CFR). There are many sections (referred to as “Parts”) in Title 10 applicable to specific NRC regulations for certain areas and types of activities involving radioactive materials. Enriched uranium is special nuclear material (SNM) and the applicable regulation is 10 CFR 70, or simply, Part 70, entitled “Domestic Licensing of Special Nuclear Material.” This regulation applies to the handling and processing of SNM, such as at enrichment and fuel fabrication facilities, at all levels of enrichment. (It also applies to facilities handling plutonium and uranium-233.) The regulation was revised in 2001 to include risk-informed, performance based measures. A separate regulation designated Part 76 was derived from Part 70 and developed for the gaseous diffusion plants (GDPs).

Relationships with Other Regulators

The NRC is the lead regulator at facilities it licenses. Other Federal and State Agencies may also have regulatory roles; for example, the Occupational Safety and Health Administration (OSHA) oversees normal workplace safety (including onsite hazardous chemicals) while the Environmental Protection Agency (EPA) regulates the offsite effects of hazardous chemicals. State Agencies may oversee water use and discharge permits. Local Agencies may oversee emergency plans (EPs). The NRC may interface with these other Agencies as part of its licensing and inspection processes, and develop Memoranda Of Understanding (MOU), as appropriate.

The NRC has established an MOU with OSHA covering the four areas of chemical safety at its licensees:

1. Hazardous chemical effects from licensed radioactive materials; an example is the chemical effects of UF_6. This is codified in 70.61, 70.62, and 70.64. There is no dose requirement and the effect may be entirely chemical.

2. Hazardous chemicals and their effects, produced from licensed radioactive materials; examples are hydrogen fluoride released by the UF_6 reactions or NOx released from nitric acid reacting with UO_2 or uranium metal. This is codified in 70.61, 70.62, and 70.64. There is no dose requirement and the effect may be entirely chemical.

3. Hazardous chemicals and their effects that affect the safe handling of licensed radioactive materials; examples are nitric acid fumes corroding or adversely impacting the operation of safety equipment (or electronics), inerting gases depressing operator reaction times (or even operator asphyxiation), or hazardous gases incapacitating or hindering operator egress from radiological areas. In general, there is some increase in radiation risk or dose although the principal hazard is chemical in origin. This is codified in the 70.62 and 70.64 regulations and while the guidance is non-specific, the increase in radiation risk is usually associated with very small doses of “mrem.”

4. Hazardous chemicals and their effects which do not affect the safe handling of licensed radioactive materials; an example is a chemical release from bulk storage tanks. Note, however, if the bulk storage tanks are sufficiently close to the areas handling licensed radioactive materials they may affect the safe handling or safeguards of these materials, and, thus, be regulated by the NRC.

The NRC regulates the first three areas of chemical safety, while OSHA regulates the fourth area. In addition, NRC and OSHA agree to inform each other if their respective inspections identify potential findings in the other Agency’s jurisdiction and if imminent safety concerns are found.

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Learning Objective

When you finish this section, you will be familiar with:

9.1.2 Identify NRC regulations of gaseous diffusion plants (Part 76).

10 CFR Part 76

The NRC oversees the operation of two gaseous diffusion plants, the Honeywell facility located at Paducah, Kentucky, and the Portsmouth Plant located in Piketon, Ohio. The plants are operated by the United States Enrichment Corporation (USEC) under lease with the U.S. Department of Energy. The Portsmouth GDP was in full operation until June 2001. It is now in “cold standby,” although some sampling and transferring functions continue. The NRC also has regulatory authority for the two GC facilities under construction.

The Energy Policy Act of 1992 established USEC and authorized NRC to regulate the radiological and operational health and safety aspects of the gaseous diffusion plants. In accordance with that Act, NRC promulgated regulations for the gaseous diffusion plants in 10 CFR Part 76 in September 1994. Part 76 was largely derived from the Part 70 regulation existing at that time. This applies to portions of GDPs at Paducah and Portsmouth that are leased by USEC. NRC certified that the plants met the requirements of Part 76 in late 1996. After certification, the two plants came under NRC regulation on March 3, 1997.

New provisions for gaseous diffusion are in Subsection B, Part 76.45, and Subsection C, Part 76.68. Part 76.45 permits amendments to certificates. Recent amendments processed under Part 76.45 include HAUP for the Paducah Plant and Cold Trap for the Portsmouth facility. Part 76.68 covers plant changes and requires safety analysis to show there is no undue risk or decrease in safety, safeguards or security.

Table 9-1, 10 CFR Part 76, “Certification of Gaseous Diffusion Plants,” provides a brief description of each subpart in Part 76.

Table 9-1. 10 CFR Part 76 - Certification of Gaseous Diffusion Plants

Subpart	Description
A - General Provisions	Provides the purpose, scope, and general approach to managing the regulatory environment and communication of the gaseous diffusion plants.
B - Application Part 76.45	Sets the certification application procedure and contents as well as setting the annual renewal requirements. Permits amendments to certificates, establishing a formal process for proposed new or modified activities. The amendment application should contain sufficient information for the NRC to make findings of compliance or acceptability in same manner as required for original certificate.
C - Certification Part 76.68	Sets the additional regulatory requirements from other Parts; describes the issuance, denial, expiration, and termination of certificates; describes the procedure for plant changes and post issuance procedures. Covers plant changes. Requires safety analysis, SAR update that demonstrates no undue risk to public. The changes may not decrease the effectiveness of the plant's safety, safeguards, and security programs or may not involve a change in certificate of compliance or approved compliance plan.
D - Safety	Describes the use and transfer of radioactive materials, sets the scope of accident assessment, technical safety requirements, criticality accident requirements, emergency planning, quality assurance, and training.
E - Safeguards and Security	Sets the specific requirements for physical security, special nuclear material accountability and control, and protection of certain information.
F - Reports and Inspections	Describes the event reporting and NRC inspection processes.
G - Enforcement	Sets the scope of violations and penalties allowed under law for enforcement of GDP regulations purposes.

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Learning Objective

When you finish this section, you will be able to:

9.1.3 Identify NRC regulations of other enrichment facilities (Part 70).

10 CFR Part 70

Several revisions have been made to 10 CFR Part 70, “Domestic Licensing of Special Nuclear Material.” Part 70 applies to fabrication, enrichment, and MOX, including any new enrichment or fabrication facility that possesses a critical mass of special nuclear material (SNM). The regulation was revised in 2001 to include a risk-informed, performance-based approach that requires an integrated safety analysis (ISA). The ISA takes into consideration consequences, likelihoods, and integration of hazards. The revision contains unlikely and highly unlikely probability bins and allows for a qualitative risk management approach. The revision is incorporated into Subpart H.

Applicants for new licenses must perform an ISA and submit a summary (an ISA Summary) to the NRC for approval. The ISA Summary differs from the ISA itself by focusing on higher risk accident sequences with consequences that could exceed the performance criteria of 10 CFR 70.61. The ISA Summary is a synopsis of the results of the ISA and contains information specified in 10 CFR 70.65(b).

The NRC determines the acceptability of the applicant’s ISA by reviewing a portion of the ISA documentation and any supporting documentation maintained onsite, and by reviewing and approving the applicant’s ISA Summary. Reviewers must confirm that an ISA Summary meets the regulatory requirements of 10 CRF 70.65 and, specifically, that Items Relied On for Safety (IROFS) and management measures are designated for higher-risk accident sequences and that programmatic commitments to maintain the ISA and ISA Summary are acceptable.

The purpose of the review of commitments related to the safety program, including the ISA, as presented in the license application, renewal, or amendment, is to determine with reasonable assurance that the applicant will accomplish the requirements of 10 CFR 70.61; 70.62(a)(1), (2) and (3); 70.62(c)(1) and (2); 70.62(d); 70.64 for new facilities; and 70.72 for changes requiring updates of the ISA. (NUREG-1520)

New provisions in the revised 10 CFR Part 70 are included in Table 9-2 and discussed in the sections that follow.

Table 9-2. 10 CFR Part 70 - Domestic Licensing of Special Nuclear Material–New Provisions from the 2001 Revision

Subpart	Description
E - Licenses	Sets forth terms and conditions for licenses.
Part 70.34, Amendment of Licenses	Applications for amendment of a license shall be filed in accordance with Part 70.21(a) and must specify what the licensee wants amended and the grounds for such amendment. Full documentation and updates are required by the licensee/facility.
H- Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material	Sets forth performance requirements that require an Integrated Safety Analysis (ISA); establishes safety program and the ISA; establishes content and approval requirements for license applications.
Part 70.61, Performance Requirements	Each applicant or licensee must evaluate its compliance with the performance requirements using an integrated safety analysis (ISA). Consequence and likelihood must be considered. ◙ Risk of a credible high-consequence event must be limited and engineered controls, or administrative controls, shall be applied to reduce likelihood of occurrence. High consequence accidents are chemical or radiological affecting the worker and public. ◙ Risk of each credible intermediate-consequence event must be limited and engineered controls, administrative controls, shall be applied to reduce likelihood of occurrence. Intermediate consequence accidents include chemical and radiological affecting the worker, public, and the environment. ◙ Risk of a nuclear criticality accident must be limited by assuring under normal or abnormal conditions nuclear processes are subcritical. Preventive measures and controls are primary means of protection. Controls are Items Relied On for Safety (IROFS).

Table 9-2. 10 CFR Part 70 - Domestic Licensing of Special Nuclear Material–New Provisions from the 2001 Revision

Subpart	Description
	Each engineered or administrative control used for compliance shall be designated as an Item to be Relied On for Safety. Each licensee must establish a controlled area over which control and access/egress can be maintained for any reason.
Part 70.62, Safety Program and ISA	Each licensee or applicant must establish and maintain a safety program to comply with requirements of Part 70.61. The three elements of the safety program are: 1. maintaining Process Safety Information 2. performing ISA - Integrated Safety Analysis 3. establishing Management Measures for IROFS
Part 70.64, Requirements for New Facilities	Licensees must address Baseline Design Criteria (BDC), including Quality Standards, NPH, Fire, Environmental, Chemical, Emergency Capability, Utilities, Inspections, Criticality Control, and Instrumentation (I & C). Design and layout must be based on Defense-in-Depth practices with preference given to Engineering Controls over Administrative Controls. Safety can be enhanced by reducing challenges to IROFS.
Part 70.65, Additional Content of Applications	Each application must include a description of applicant's safety program established under Part 70.62. The integrated safety analysis summary (ISA Summary) must be submitted with the license or renewal application (or amendment application). Full documentation and updates are required by the licensee/facility.
Part 70.72, Facility Changes and Change Process	The licensee must establish a configuration management system to evaluate, implement, and track each change. This system must be documented in written procedures. Any change to the site, structures, or processes must be evaluated in accordance with the system. Amendment is dependent on the ISA. If changes are made that affect the ISA summary, a revised summary must be submitted. Full documentation and updates are required by the licensee/facility.

In response to USEC's proposal for a new GC enrichment facility at a GDP, the NRC has determined that applications for a new enrichment facility must be made under 10 CFR Part 70, even if the new facility is located at a GDP.

Recently issued Part 70 Standard Review Plans that can apply or provide guidance to enrichment facilities are:

- NUREG-1513, "Integrated Safety Analysis Guidance Document," May 2001
- NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility" (non-MOX), June 2003
- NUREG-1701, "Standard Review Plan for the Review of a License Application for the Atomic Vapor Laser Isotope (AVLIS) Facility," March 1999 (Draft)
- NUREG-1702, "Standard Review Plan for the Review of a License Application for the Tank Waste Remediation System. Privatization (TWRS-P) Project," March 2000
- NUREG-1718, "Standard Review Plan for the Review of a License Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," October 2002

Performance Requirements

Part 70.61 contains the performance requirements. These link acceptable consequences and likelihoods, and, thus, acceptable risks, for potential radiological and chemical accidents at the facility. The requirements identify three receptors, three consequence levels, and three likelihood ranges (Tables 9-3 and 9-4).

The three receptors are:

1. The worker, who is defined as an individual who receives an occupational radiation dose; i.e., the dose received by an individual in the course of employment, in which the individual's assigned duties involve exposure to radiation or to radioactive material from licensed and unlicensed sources of radiation, whether in possession of the licensee or another person. Note that this definition does not include personnel if their assigned employment duties do not include exposure to radiation or to radioactive materials, such as support and administrative staff. Part 19 also lists requirements for workers (e.g., 19.12).

2. Individual outside the controlled area boundary (CAB), the CAB is defined as the boundary of the area outside of the restricted area but inside the site boundary, access to which can be limited by the licensee for any reason. In practical terms, this is normally the fence line. The individual outside the CAB (IOC) is essentially treated as a member of the public for regulatory purposes. Individuals who work at the facility within the CAB but whose activities and assigned duties do not meet the definition of worker (e.g., administrative and support staff) must meet the performance requirements for an IOC at the normal location of their work. Alternatively, the licensee must train these individuals as workers (i.e., to meet Part 19.12(a)(1)-(5)), at which point they may be treated as workers for regulatory purposes.

3. The environment, this is evaluated at the restricted area boundary. The restricted area is the area the licensee restricts access for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

The consequence levels are:

1. High Consequence: this level approximately corresponds to endangering the life of the worker; or irreversible or serious, long-lasting health effects to the IOC.

2. Intermediate Consequence: this level approximately equates to irreversible or serious, long-lasting effects to the worker, or mild, transient effects to the IOC. For the environment, this consequence level is represented by a 24-hour averaged release of 5,000 times the values in Table 2, Appendix B to Part 20.

3. Low Consequence: Low consequence events are not explicitly mentioned in the 70.61 regulation but are de facto defined as below intermediate consequences.

Table 9-3. 10 CFR Part 70 Performance Requirements

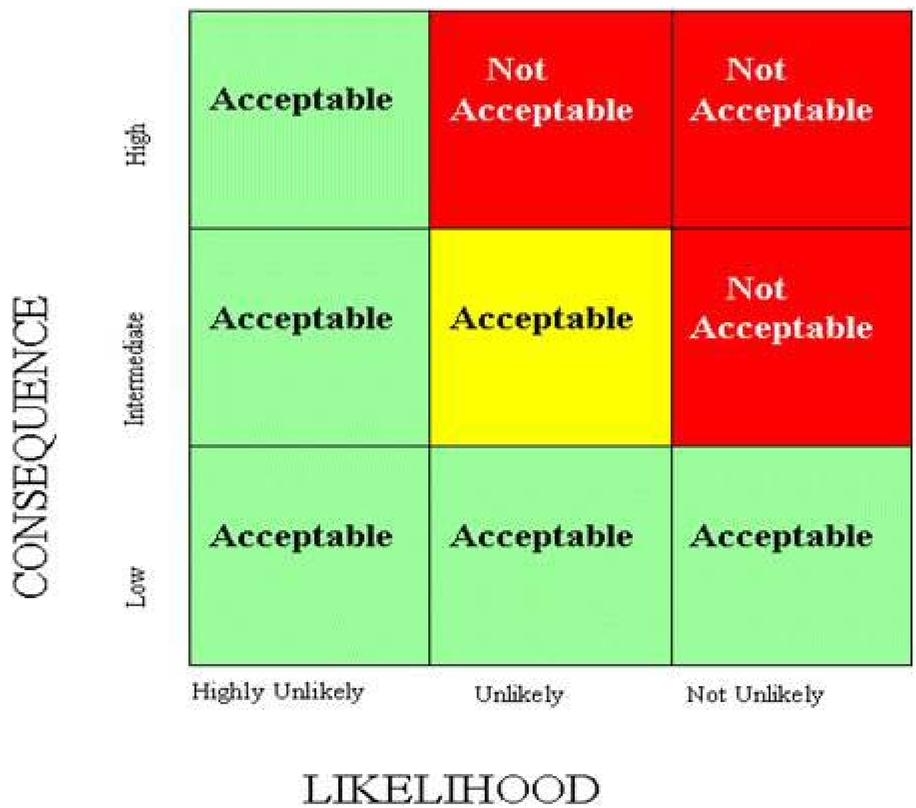

Table 9-4. The Performance Requirements (Part 70.61)

Receptor Event	Worker	Individual Outside Controlled Area (IOC) (aka General Public)
High Consequence: ◙ Prevent to “highly unlikely” ◙ Prevent or mitigate to “intermediate” or “low”	◙ > 100 rem (TEDE) ◙ Endangers life of worker (chemical)	◙ > 25 rem ◙ > 30 mg soluble U ◙ Irreversible or serious, long-lasting health effects (chemical)
Intermediate Consequence: ◙ Prevent to “unlikely” ◙ Mitigage to “low”	◙ > 25 rem ◙ Irreversible or serious long-lasting effects (chemical)	◙ > 5 rem ◙ Mild transient health effects (chemical) ◙ > 5000x Part 20, App B
(Low Consequence)	Mild transient health effects or less	Lesser effects

The performance requirements mention three likelihood categories: highly unlikely, unlikely, and (by default) not unlikely. These are not explicitly defined in the regulation and are required to be described by the licensee (70.65(b)(9)). The SRPs (NUREG-1520, 1702, and 1718) provide guidance. In general, highly unlikely corresponds to an event sequence with a likelihood of 1E-5 per year or less. The unlikely category covers a broader range of 1E-2 to 1E-5 per year, although the guidance more closely equates it with the 1E-4 to 1E-5 per year range. A “credible event” is usually defined as one with a likelihood above 1E-6 per year. The goal of the regulation is to have less than one major (high consequence) fuel cycle event every 100 years in the fuel cycle industry regulated by Part 70.

The performance requirements require the licensees to limit the risk of each credible, high consequence event. Engineered controls, administrative controls, or combinations thereof shall be applied and to the extent needed to reduce the likelihood of the high consequence event so that it is highly unlikely (a prevention strategy) or to reduce the impact to an intermediate consequence event and ensure it has an unlikely likelihood (a combination prevention–mitigation strategy).

Similarly, the performance requirements require the licensees to limit the risk of each credible, intermediate consequence event. Engineered controls, administrative controls, or combinations thereof shall be applied and to the extent needed to reduce the likelihood of the intermediate consequence event so that it is unlikely (a prevention strategy) or to reduce the impact to a low consequence event (a mitigation strategy).

In addition, the performance requirements require that the risk of nuclear criticality accidents must be limited by assuring that under normal and credible abnormal conditions, all nuclear processes are subcritical, including use of an approved margin of subcriticality for safety. Preventive controls and measures must be the primary means of protection against nuclear criticality accidents.

Each engineered or administrative control, or control system necessary to comply with these performance requirements shall be designated as an Item Relied on for Safety (IROFS). The safety program, established and maintained pursuant to 70.62, shall ensure that each Item Relied on for Safety will be available and reliable to perform its intended function when needed and in the context of the performance requirements.

From a strict literal reading of the regulations and associated guidance, one might conclude that NRC would regard "Not Unlikely" events which could result in a worker consequence of just under a Level 2, such as 15 rem, or acute chemical exposure corresponding to an AEGL-2 or ERPG-2, as an acceptable risk, that is, one might conclude that NRC would accept the risk of a worker routinely exposed to airborne concentrations of substances just below that in which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects, or an impaired ability to escape. That is not the intent of NRC and is not an appropriate conclusion. The NRC would not accept routine or not-unlikely multiple exposures at or near these limits. The NRC issued the performance and ISA requirements of Subpart H of 10 CFR 70 in September 2000, as additional safety requirements for fuel cycle facilities. Compliance with 10 CFR Part 20 (including ALARA) and all OSHA and EPA regulations is still required for all facilities for chemical hazards and exposures. NRC reviewers may consider license conditions for specific chemicals and circumstances to ensure adequate assurances of safety.

Chemical Consequences

The performance requirements include chemical consequences. No explicit chemical consequence levels are listed in the regulations and 70.65(b)(7) states applications must contain a description of the proposed quantitative standards used to assess chemical consequences from acute chemical exposures to licensed materials or chemicals produced from licensed materials. Note that the regulation does not mention chemical consequence levels for the third chemical safety area regulated by the NRC; namely, chemical and facility conditions affecting the safety of licensed radioactive materials. In actual licensing practice, the same chemical consequence levels are usually applied to all three chemical safety areas.

The regulation requires the identification of four chemical consequence levels; two each for the worker and public, with one level usually overlapping. The SRPs suggest the use of either Acute Exposure Guideline Levels (AEGL) or Emergency Response Planning Guidelines (ERPGs) as acceptable chemical quantitative standards to meet the performance requirements of 10 CFR 70.61.

The definitions of AEGL Levels are as follows:

AEGL-1 The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation or certain asymptomatic, non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

AEGL-2 The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects, or an impaired ability to escape.

AEGL-3 The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

AEGLs are developed for 30 minute, 1-, 2-, 4-, and 8- hour acute chemical exposures. Specific chemical AEGLs are lower for longer exposure times.

Note that the Standard Operating Procedures for Developing Acute Exposure Guideline Levels for Hazardous Chemicals define the primary purpose of the AEGL Program and the NAC/AEGL Committee as the development of levels for once-in-a-lifetime, short-term exposures to airborne concentrations of acutely toxic, high-priority chemicals.

The definitions of ERPG Levels are as follows:

ERPG-1 The maximum airborne concentration of a substance below which it is believed nearly all individuals could be exposed for up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.

ERPG-2 The maximum airborne concentration of a substance below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective actions.

ERPG-3 The maximum airborne concentration of a substance below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

ERPGs are normalized to a one-hour nominal acute exposure to the chemicals.

Only limited data exists for human exposure to chemicals. Usually, human test subjects are healthy young male volunteers and only low exposures occur in testing. Usually, there are no test data on women. Chemical exposures during incidents and accidents are not usually measured, or, if they are, the measurements are often inaccurate. Most AEGL and ERPG methods modify animal data obtained over the full range of chemical exposures with this healthy young male human test data obtained over low exposure ranges. The safety reviewer must keep in mind that this may skew the exposure level values and may be non-conservative and non-realistic.

Note that the AEGL and ERPG definitions have similarities to the intermediate and high consequence event discussions in the regulation. However, in use, the reviewer should evaluate the chemical levels proposed by the applicant taking into account the chemicals involved, their chemical effects and mechanisms (e.g., the steepness of the dose/response curves), the derivation and data used to support the standard, the chemical effects upon the general population as compared to subgroups, and their exclusion of certain population subgroups. In actual practice, worker population subgroups usually include healthy men and (some) women in the 18–65 year old range, with some managed health conditions (e.g., asthma). The workforce is usually under a health monitoring program with routine physicals and tests. The general population includes the broader spectrum of ages and health conditions; for example, on average, at least 10% of the general population is aged 65 or older. In addition, the safety reviewer has to be aware that site specific conditions (e.g., nearby schools, hospitals, or nursing homes) may also influence the selection of chemical consequence levels. Thus, for some chemicals, workforces, and populations, a different level, such as Level 2, may better represent a fatality threshold than a Level 3.

Safety Program and Integrated Safety Analysis (ISA)

Each licensee or applicant shall establish and maintain a safety program that demonstrates compliance with the performance requirements. The safety program may be graded such that management measures applied are graded commensurate with the reduction of the risk attributable to that item.

Each licensee or applicant shall establish and maintain records that demonstrate compliance with the requirements for process safety, ISA, and management measures. Records of failures must be readily retrievable and available for NRC inspection, documenting each discovery that an IROFS or management measure has failed to perform its function upon demand or has degraded such that the performance requirements are not satisfied. These records must identify the IROFS or management measure that has failed and the safety function affected, the date of discovery, date (or estimated date) of the failure, duration (or estimated duration) of the time that the item was unable to perform its function, any other affected items relied on for safety or management measures and their safety function, affected processes, cause of the failure, whether the failure was in the context of the performance requirements or upon demand or both, and any corrective or compensatory action that was taken. A failure must be recorded at the time of discovery and the record of that failure updated promptly upon the conclusion of each failure investigation of an IROFS or management measure.

Process safety information must be maintained by the applicant in order to enable the performance and maintenance of an integrated safety analysis. This process safety information must include information pertaining to the hazards of the materials used or produced in the process, information pertaining to the technology of the process, and information pertaining to the equipment in the process.

An Integrated Safety Analysis (ISA) is a systematic analysis to identify facility and external hazards and their potential for initiating accident sequences, the potential accident sequences, their likelihood and consequences, and the IROFS. As used in Part 70, integrated means joint consideration of, and protection from, all relevant hazards, including radiological, nuclear criticality, fire, and chemical. However, with respect to compliance with these Part 70 regulations, the NRC requirement is limited to consideration of the effects of all relevant hazards on radiological safety, prevention of nuclear criticality accidents, or chemical hazards directly associated with NRC licensed radioactive material. An ISA can be performed process by process, but all processes must be integrated, and process interactions considered.

Per Part 70.62, each licensee or applicant shall conduct and maintain an integrated safety analysis, that is of appropriate detail for the complexity of the process, that identifies:

- Radiological hazards related to possessing or processing licensed material at its facility;
- Chemical hazards of licensed material and hazardous chemicals produced from licensed material;
- Facility hazards that could affect the safety of licensed materials and thus present an increased radiological risk;
- Potential accident sequences caused by process deviations or other events internal to the facility and credible external events, including natural phenomena; and
- The consequence and the likelihood of occurrence of each potential accident sequence identified, and the methods used to determine the consequences and likelihoods.

The ISA must also identify each IROFS; the characteristics of its preventive, mitigative, or other safety function; and the assumptions and conditions under which the item is relied upon to support compliance with the performance requirements.

The ISA must be performed by a team with expertise in engineering and process operations to ensure the adequacy of the process. The team shall include at least one person who has experience and knowledge specific to each process being evaluated, and persons who have experience in nuclear criticality safety, radiation safety, fire safety, and chemical process safety. One member of the team must be knowledgeable in the specific ISA methodology used.

Management Measures

Each applicant or licensee shall establish management measures to ensure compliance with the performance requirements. The measures applied to a particular engineered or administrative control or control system may be graded commensurate with the reduction of the risk attributable to that control or control system. The management measures shall ensure that engineered and administrative controls and control systems that are identified as IROFS are designed, implemented, and maintained, as necessary, to ensure they are available and reliable to perform their function when needed, to comply with the performance requirements.

Management measures include configuration management, maintenance, training and qualifications, procedures, audits and assessments, incident investigations, and quality assurance elements (e.g., records management). Configuration management is further discussed in 70.72 and QA program criteria are discussed in Parts 50, 63, 71, and 72, in addition to Part 70 (e.g., 70.64).

ISA Calculations

Part 70 does not require quantitative calculations of frequency. For example, safety strategies involving demonstrated performance, large safety margins, low failure rates, short surveillance intervals, a high level of QA, redundancy, a high degree of independence, and a clear preference of the controls (passive over active, engineered over administrative) may be determined qualitatively in order to reach a safety conclusion. However, reviews may require circumstances where these characteristics are not obvious and quantitative calculations may be necessary. Such quantitative analyses may start with a logical depiction of the event sequence, such as event or fault trees. Failure rates and frequencies are then estimated.

If fundamental failure data is available, then failure rates for a single IROFS may be estimated as follows:

Operating Control: u = unreliability = FRr x t
An example is a ventilation system

Actuation of standby control: u = unavailability = FRd x T
An example is a safety relief valve

Actuation and operation: u = undependability = FRr x t + FRd x T
An example is an emergency diesel generator producing electricity

FRr = Failure Rate during running operation
FRd = failure rate on demand
t = operating time
T = idle or standby time

The failure rate for a safety system incorporating two or three independent IROFS can be estimated as:

Failure Rate (two IROFS system) = FR(1) x u(2) + FR(2) x u(1)

Failure Rate (three IROFS system) = FR(1) x u(2) x u(3) + FR(2) x

u(1) x u(3) + FR(3) x u(1) x u(2)

Maintenance and surveillance intervals can also be included separately in the calculations, if desired. More system level approaches are possible, such as LOPA (Layer Of Protection Analysis) and hazard indices. The guidance and standard texts provide more examples.
Baseline Design Criteria (BDC)
70.64(a) requires applicants to address the following BDC in new facilities:

(1) Quality standards and records. The design must be developed and implemented in accordance with management measures, to provide adequate assurance that items relied on for safety will be available and reliable to perform their function when needed. Appropriate records of these items must be maintained by or under the control of the licensee throughout the life of the facility.

(2) Natural phenomena hazards. The design must provide for adequate protection against natural phenomena with consideration of the most severe documented historical events for the site.

(3) Fire protection. The design must provide for adequate protection against fires and explosions.

(4) Environmental and dynamic effects. The design must provide for adequate protection from environmental conditions and dynamic effects associated with normal operations, maintenance, testing, and postulated accidents that could lead to loss of safety functions.

(5) Chemical protection. The design must provide for adequate protection against chemical risks produced from licensed material, facility conditions which affect the safety of licensed material, and hazardous chemicals produced from licensed material.

(6) Emergency capability. The design must provide for emergency capability to maintain control of:

    (i) Licensed material and hazardous chemicals produced from licensed material;

    (ii) Evacuation of onsite personnel; and

(iii) Onsite emergency facilities and services that facilitate the use of available offsite services.

(7) Utility services. The design must provide for continued operation of essential utility services.

(8) Inspection, testing, and maintenance. The design of IROFS must provide for adequate inspection, testing, and maintenance, to ensure their availability and reliability to perform their function when needed.

(9) Criticality control. The design must provide for criticality control including adherence to the double contingency principle.

(10) Instrumentation and controls. The design must provide for inclusion of instrumentation and control systems to monitor and control the behavior of IROFS.

Facility and system design and facility layout must be based on defense-in-depth practices. As used in Part 70.64, requirements for new facilities or new processes at existing facilities, defense-in-depth practices means a design philosophy, applied from the outset and through completion of the design, that is based on providing successive levels of protection such that health and safety will not be wholly dependent upon any single element of the design, construction, maintenance, or operation of the facility. The net effect of incorporating defense-in-depth practices is a conservatively designed facility and system that will exhibit greater tolerance to failures and external challenges. The risk insights obtained through performance of the integrated safety analysis can be then used to supplement the final design by focusing attention on the prevention and mitigation of the higher-risk potential accidents.

The design must incorporate, to the extent practicable:

(1) Preference for the selection of engineered controls over administrative controls to increase overall system reliability; and

(2) Features that enhance safety by reducing challenges to IROFS.

Change Process

Facility changes and the change process are discussed in Part 70.72. This requires the licensee to establish a configuration management system to evaluate; implement; and track each change to the site, structures, processes, systems, equipment, components, computer programs, and activities of personnel. Written documentation and requirements must be addressed prior to implementing changes.

Changes may be made without prior NRC approval if they:

- Do not create new types of accidents and sequences that, without IROFS, would exceed the performance requirements and that have not been previously described in the ISA.
- Do not use new processes, technologies, or control systems for which the licensee has no prior experience.
- Do not remove an IROFS without at least an equivalent replacement of the safety function.
- Do not remove a sole IROFS.

In general, any of these changes require some type of equivalency in terms of size, type, scope, parameters, functions, and/or safety. Revised ISA summary pages on changes not requiring prior NRC approval are supplied to the NRC annually.

Changes requiring prior NRC approval usually involve significant differences, substitutions, and/or, in practical terms, costs. Such changes require a written license amendment, with supporting documentation, submitted to the NRC. The NRC reviews the amendment request. There is no preset approval time period; for fuel cycle facilities, relatively simple amendment requests might take 3–6 months, while more complex amendment requests might take longer (6–12 months). Prior approval from the NRC is required prior to the licensees implementing the changes covered by the amendments process.

National Environmental Policy Act (NEPA)

The NRC requirements for NEPA at its licensed facilities are primarily codified in Part 51. Significantly, an environmental impact statement (EIS) and a hearing (70.23a) are required for licensing of a uranium enrichment facility. However, for a test loop, an EIS may not be necessary if the enriched and depleted streams are remixed as part of the test, and, thus, there is no net enrichment and no uranium enrichment facility.

Activity 1: Event Reporting

PURPOSE: To identify the general event reporting requirements for gaseous diffusion plants.

INSTRUCTIONS: Obtain access to or a copy of 10 CFR 76 - "Certification of Gaseous Diffusion Plants." Match the correct event reporting category in Column A to each event listed in Column B by placing the proper letter in each blank. Answers are located in the answer key section of the Trainee Guide.

Column A

A. Immediate Report (within 1 hour after discovery)

B. Four-hour Report

C. Twenty-four hour Report

Column B

1. _____ An unplanned contamination event that involves a quantity of material greater than five times the lowest annual limit on uptake.
2. _____ An explosion of a 2S sample container containing 3.5% U-235.
3. _____ A criticality event.
4. _____ A radiological release in a building that prevents immediate protective actions necessary to avoid exposures that could exceed regulatory limits.
5. _____ A Site Area Emergency.
6. _____ A worker injury that requires unplanned medical treatment where the worker is found to have skin contamination.
7. _____ A criticality alarm system detector is found to be inoperable during routine surveillance.
8. _____ A U-tube sample containing UF_6 is found in a contractor vehicle outside the protected area of the plant.
9. _____ A monthly inventory of a locked cage of enriched uranium-bearing containers shows a loss of two containers.

Self-Check Questions 9-1

INSTRUCTIONS: Complete the following questions. Answers are located in the answer key section of the Trainee Guide.

Complete the following questions. Answers are located in the answer key section of the Trainee Guide.

1. Who operates the gaseous diffusion plants?

2. What did the Energy Policy Act of 1992 authorize the NRC to do?

3. A revision of 10 CFR Part 70 resulted in a major performance-based requirement that takes into consideration probable risks, consequences, likelihoods of occurrence, and integration of hazards. What is this new requirement?

4. Identify chemical and plant hazards regulated by the NRC.

5. Explain chemical consequence levels and their limitations.

6. Match the subparts of 10 CFR Part 76 in column A with the appropriate requirements in column B.

Column A

A. General Provisions
B. Application
C. Certification
D. Safety
E. Safeguards and Security
F. Reports and Inspections
G. Enforcement

Column B

1. ______ Scope of acceptable technical safety requirements
2. ______ Completeness and accuracy of information in the application and certification process
3. ______ Limiting control settings
4. ______ Event reporting and NRC inspection processes
5. ______ Sets annual renewal requirements
6. ______ Describes the procedure for plant changes
7. ______ Sets the specific requirements for physical security
8. ______ Sets the scope of violations and penalties allowed

MODULE 9.0: Regulations

Learning Objective

When you finish this section, you will be able to:

9.1.4 Identify export–import regulations of enrichment technologies.

10 CFR Part 110, Export and Import of Nuclear Equipment and Material

10 CFR Part 110, “Export and Import of Nuclear Equipment and Material”, is subject to NRC enforcement action. The regulations in this Part prescribe licensing, enforcement, and rulemaking procedures and criteria, under the Atomic Energy Act, for the export of nuclear equipment and material, and the import of nuclear equipment and material.

Facilities and equipment subject to export/import control include:

(a) Nuclear reactors and especially designed or prepared equipment and components for nuclear reactors.

(b) Plants for the separation of isotopes of uranium (source material or special nuclear material) including gas centrifuge plants, gaseous diffusion plants, aerodynamic enrichment plants, chemical exchange or ion exchange enrichment plants, laser based enrichment plants, plasma separation enrichment plants, electromagnetic enrichment plants, and especially designed or prepared equipment, other than analytical instruments, for the separation of isotopes of uranium.

(c) Plants for the separation of the isotopes of lithium and especially designed or prepared assemblies and components for these plants.

(d) Plants for the reprocessing of irradiated nuclear reactor fuel elements and especially designed or prepared assemblies and components for these plants.

(e) Plants for the fabrication of nuclear reactor fuel elements and especially designed or prepared assemblies and components for these plants.

(f) Plants for the conversion of uranium and plutonium and especially designed or prepared assemblies and components for these plants.

(g) Plants for the production, separation, or purification of heavy water, deuterium, and deuterium compounds and especially designed or prepared assemblies and components for these plants.

(h) Plants for the production of special nuclear material using accelerator-driven subcritical assembly systems capable of continuous operation above 5 MWe thermal.

(i) Other nuclear-related commodities are under the export licensing authority of the Department of Commerce.

Appendices to Part 110 provide summary information and examples regarding equipment and processes covered in each of these areas. The text below provides the Part 110 information for gas centrifuge, gaseous diffusion, and laser-based enrichment processes.

Gas Centrifuge Equipment Examples

Appendix B to Part 110, "Illustrative List of Gas Centrifuge Enrichment Plant Components Under NRC's Export Licensing Authority"

1. Assemblies and components especially designed or prepared for use in gas centrifuges.

Note: The gas centrifuge normally consists of a thin-walled cylinder(s) of between 75mm (3 ins.) and 400 mm (16 ins.) diameter contained in a vacuum environment and spun at high peripheral speed (of the order of 300 m/per second and more) with the central axis vertical. In order to achieve high speed, the materials of construction for the rotating rotor assembly, and hence its individual components, have to be manufactured to very close tolerances in order to minimize the unbalance. In contrast to other centrifuges, the gas centrifuge for uranium enrichment is characterized by having within the rotor chamber a rotating disc-shaped baffle(s) and a stationary tube arrangement for feeding and extracting UF_6 gas and featuring at least 3 separate channels of which 2 are connected to scoops extending from the rotor axis towards the periphery of the rotor chamber. Also contained within the vacuum environment are a number of critical items which do not rotate and which, although they are especially designed, are not difficult to fabricate nor are they fabricated out of unique materials. A centrifuge facility, however, requires a large number of these components so that quantities can provide an important indication of end use.

1.1 Rotating Components.

(a) Complete Rotor Assemblies: Thin-walled cylinders, or a number of interconnected thin-walled cylinders, manufactured from one of the high strength-to-density ratio materials described in the note to this Section.

(b) If interconnected, the cylinders are joined together by flexible bellows or rings as described in 1.1(c). The rotor is fitted with an internal baffle(s) and end caps, as described in 1.1 (d) and (e), if in final form. However, the complete assembly may be delivered only partly assembled.

(c) Rotor Tubes: Especially designed or prepared thin-walled cylinders with thickness of 12mm (.50 in.) or less, a diameter of between 75mm (3 ins.) and 400mm (16 ins.), and manufactured from one of the high strength-to-density ratio materials described in the note to this Section.

(d) Rings or Bellows: Components especially designed or prepared to give localized support to the rotor tube or to join together a number of rotor tubes. The bellows in a short cylinder of wall thickness 3mm (.125 in.) or less, a diameter of between 75mm (3 ins.) and 400mm (16 ins.), having a convolute, and manufactured from one of the high strength-to-density ratio materials described in the note to this Section.

(e) Baffles: Disc shaped components of between 75mm (3 ins.) and 400mm (16 ins) diameter especially designed or prepared to be mounted inside the centrifuge rotor tube, in order to isolate the take-off chamber from the main separation chamber and, in some cases, to assist the UF_6 gas circulation within the main separation chamber of the rotor tube, and manufactured from one of the high strength-to-density ratio materials described in the note to this Section.

(f) Top Caps/Bottom Caps: Disc shaped components of between 75mm (3 ins) and 400mm (16 ins) diameter especially designed or prepared to fit to the ends of the rotor tube, and so contain the UF_6 within the rotor tube, and in some cases to support, retain or contain as an integrated part, an element of the upper bearing (top cap) or to carry the rotating elements of the motor and lower bearing (bottom cap), and manufactured from one of the high strength-to-density ratio materials described in the Note to this Section.

Note: The materials used for centrifuge rotating components are:

(a) Maraging steel capable of an ultimate tensile strength of 2.050 x 109 N/m2(300,000 lb/in2) or more.

(b) Aluminium alloys capable of an ultimate tensile strength of 0.460 x 109 N/m2 (67,000 lb/in2) or more.

(c) Filamentary materials suitable for use in composite structures and having a specific modulus of 3.18 x 106m or greater and a specific ultimate tensile strength of 7.62 x 104m or greater.

("Specific Modulus" is the Young's modulus in N/m2 divided by the specific weight in N/m3 when measured at a temperature of23±2̊C and a relative humidity of 50±5%. "Specific tensile strength" is the ultimate tensile strength in N/m2 divided by the specific weight in N/m3 when measured at a temperature of 23±2̊C and a relative humidity of 50±5%.)

1.2 Static Components.

(a) Magnetic Suspension Bearings: Especially designed or prepared bearing assemblies consisting of an annular magnet suspended within a housing containing a damping medium. The housing will be manufactured from a UF_6 resistant material (see Note to Section 2). The magnet couples with a pole piece or a second magnet fitted to the top cap described in Section 1.1(e). The magnet may be ring-shaped with a relation between outer and inner diameter smaller or equal to 1.6:1. The magnet may be in a form having an initial permeability of 0.15 Henry/meter (120,000 in CGS units) or more, or a remanence of 98.5 percent or more, or an energy product of greater than 80,000 joules/m3 (10 x 106 gauss–oersteds.) In addition to the usual material properties, it is a prerequisite that the deviation of the magnetic axes from the geometrical axes is limited to very small tolerances (lower than 0.1mm) or that homogeneity of the material of the magnet is specially called for.

(b) Bearings/Dampers: Especially designed or prepared bearings comprising a pivot/cup assembly mounted on a damper. The pivot is normally a hardened steel shaft polished into a hemisphere at one end with a means of attachment to the bottom cap described in Section 1.1(e) at the other. The shaft may, however, have a hydrodynamic bearing attached. The cup is pellet-shaped with hemispherical indentation in one surface. These components are often supplied separately to the damper.

(c) Molecular Pumps: Especially designed or prepared cylinders having internally machined or extruded helical grooves and internally machined bores. Typical dimensions are as follows: 7mm (0.3 ins.) to 400mm (16 ins.) internal diameter, 10mm (0.4 ins.) or more wall thickness, 1 to 1 length to diameter ratio. The grooves are typically rectangular in cross-section and 2mm (0.08 in.) or more in depth.

(d) Motor Stators: Especially designed or prepared ring shaped stators for high speed multi-phase AC hysteresis (or reluctance) motors for synchronous operation within a vacuum in the frequency range of 600–2000 Hz and a power range of 50–1000 volts amps. The stators consist of multi-phase windings on a laminated low loss iron core comprised of thin layers typically 2.0 mm (0.08 in) thick or less.

(e) Centrifuge housing/recipients: Components especially designed or prepared to contain the rotor tube assembly of a gas centrifuge. The housing consists of a rigid cylinder of wall thickness up to 30 mm (1.2 in) with precision machined ends to locate the bearings and with one or more flanges for mounting. The machined ends are parallel to each other and perpendicular to the cylinder's longitudinal axis to within 0.05 degrees or less. The housing may also be a honeycomb type structure to accommodate several rotor tubes. The housings are made of or protected by materials resistant to corrosion by UF_6.

(f) Scoops: Especially designed or prepared tubes of up to 12 mm (0.5 in) internal diameter for the extraction of UF_6 gas from within the rotor tube by a Pitot tube action (that is, with an aperture facing into the circumferential gas flow within the rotor tube, for example by bending the end of a radially disposed tube) and capable of being fixed to the central gas extraction system. The tubes are made of or protected by materials resistant to corrosion by UF_6.

2. Especially designed or prepared auxiliary systems, equipment and components for gas centrifuge enrichment plants.

Note: The auxiliary systems, equipment and components for a gas centrifuge enrichment plant are the systems of the plant needed to feed UF_6 to the centrifuges to link the individual centrifuges to each other to form cascades (or stages) to allow for progressively higher enrichments and to extract the product and tails of UF_6 from the centrifuges, together with the equipment required to drive the centrifuges or to control the plant.

Normally UF_6 is evaporated from the solid using heated autoclaves and is distributed in gaseous form to the centrifuges by way of cascade header pipework. The "product" and "tails" of UF_6 gaseous streams flowing from the centrifuges are also passed by way of cascade header pipework to cold traps (operating at about 5-10°C) where they are condensed prior to onward transfer into suitable containers for transportation or storage. Because an enrichment plant consists of many thousands of centrifuges arranged in cascades, there are many kilometers of cascade header pipework incorporating thousands of welds with a substantial amount of repetition of layout. The equipment, component and piping systems are fabricated to very high vacuum and cleanliness standards.

The following items either come into direct contact with UF_6 process gas or directly control the centrifuge and the passage of the gas from centrifuge to centrifuge and cascade to cascade.

(a) Feed Systems/Product and Tails Withdrawal Systems:

Especially designed or prepared process systems including:

1. Feed autoclaves (or stations), used for passing UF_6 to the centrifuge cascades at up to 100 KN/m2 (15 psi) and at a rate of 1 kg/h or more.

2. Desublimers (or cold traps) used to remove UF_6 from the cascades at up to 3 kN/m2 (0.5 lb/in2) pressure. The desublimers are capable of being chilled to 5–10°C and heated to 50–100°C.

3. Product and tails stations used for trapping UF_6 into containers.

This plant equipment and pipework are wholly made of or lined with UF_6 resistant materials (see Note to this Section) and are fabricated to very high vacuum and cleanliness standards.

(b) Machine Header Piping Systems:

Especially designed or prepared piping systems and header systems for handling UF_6 within the centrifuge cascades.

This piping network is normally of the "triple" header system with each centrifuge connected to each of the headers. There is thus a substantial amount of repetition in its form. It is wholly made of UF_6 resistant materials (see Note to this Section) and is fabricated to very high vacuum and cleanliness standards.

(c) UF_6 Mass Spectrometers/Ion Sources: Especially designed or prepared magnetic or quadrapole mass spectrometers capable of taking "on-line" sample of feed, product or tails from UF_6 gas streams and having all of the following characteristics:

1. Unit resolution for mass greater than 320.

2. Ion sources constructed of or lined with nichrome, monel or nickel-plate.

3. Electron bombardment ionization sources.

4. Having a collector system suitable for isotope analysis.

(d) Frequency Changers: Frequency changers (also known as converters or invertors) especially designed or prepared to supply motor stators as defined under Section 1.2(d), or parts, components and subassemblies of such frequency changers having all of the following characteristics:

1. A multiphase output of 600Hz to 2000Hz.

2. High stability (with frequency control better than 0.1%).

3. Low harmonic distortion (less than 2%).

4. An efficiency of greater than 80%.

Note: Materials resistant to corrosion by UF_6 include stainless steel, aluminum, aluminum alloys, nickel or alloys containing 60% or more nickel.

Gaseous Diffusion Equipment Examples

Appendix C to Part 110, "Illustrative List of Gaseous Diffusion Enrichment Plant Assemblies and Components Under NRC Export Licensing Authority," provides a list of equipment and components to be considered during the licensing and inspection processes. The following are excerpts that relate directly to the Gaseous Diffusion Enrichment process.

Note: In the gaseous diffusion method of uranium isotope separation, the main technological assembly is a special porous gaseous diffusion barrier, heat exchanger for cooling the gas (which is heated by the process of compression), seal valves and control valves, and pipelines. Inasmuch as gaseous diffusion technology uses UF_6, all equipment, pipeline and instrumentation surfaces (that come in contact with the gas) must be made of materials that remain stable in contact with UF_6. A gaseous diffusion facility requires a number of these assemblies, so that quantities can provide an important indication of end use.

The auxiliary systems, equipment and components for gaseous diffusion enrichment plants are the systems of plant needed to feed UF_6 to the gaseous diffusion assembly to link the individual assemblies to each other to form cascades (or stages) to allow for progressively higher enrichments and to extract the "product" and "tails" UF_6 from the diffusion cascades. Because of the high inertial properties of diffusion cascades, any interruption in their operation, and especially their shut-down, leads to serious consequences. Therefore, a strict and constant maintenance of vacuum in all technological systems, automatic protection for accidents, and precise automated regulation of the gas flow is of importance in a gaseous diffusion plant. All this leads to a need to equip the plant with a large number of special measuring, regulating, and controlling systems.

Normally UF_6 is evaporated from cylinders placed within autoclaves and is distributed in gaseous form to the entry point by way of cascade header pipework. The "product" and "tails" UF_6 gaseous streams flowing from exit points are passed by way of cascade header pipework to either cold traps or to compression stations where the UF_6 gas is liquefied prior to onward transfer into suitable containers for transportation or storage. Because a gaseous diffusion enrichment plant consists of a large number of gaseous diffusion assemblies arranged in cascades, there are many kilometers of cascade header pipework, incorporating thousands of welds with substantial amounts of repetition of layout. The equipment, components, and piping systems are fabricated to very high vacuum and cleanliness standards.

These items listed below either come into direct contact with the UF_6 process gas or directly control the flow within the cascade. All surfaces that come into contact with the process gas are wholly made of, or lined with, UF_6-resistant materials. For the purposes of this appendix, the materials resistant to corrosion by UF_6 include stainless steel, aluminum, aluminum alloys, aluminum oxide, nickel or alloys containing 60% or more nickel, and UF_6-resistant fully fluorinated hydrocarbon polymers.

1. Assemblies and components especially designed or prepared for use in gaseous diffusion enrichment.

   1.1 Gaseous Diffusion Barriers

   Specially designed or prepared thin, porous filters, with a pore size of 100-1000 A (angstroms), a thickness of 5 mm or less, and for tubular forms, a diameter of 25 mm or less, made of metallic, polymer or ceramic materials resistant to corrosion by UF_6, and especially prepared compounds or powders for the manufacture of such filters. Such compounds and powders include nickel or alloys containing 60% or more nickel, aluminum oxide, or UF_6-resistant fully fluorinated hydrocarbon polymers having a purity of 99.9 percent or more, a particle size less than 10 microns, and a high degree of particle size uniformity, which are especially prepared for the manufacture of gaseous diffusion barriers.

   1.2 Diffuser Housings

   Specially designed or prepared hermetically sealed cylindrical vessels greater than 30 cm in diameter and greater than 90 cm in length, or rectangular vessels of comparable dimensions, which have an inlet connection and two outlet connections all of which are greater than 5 cm in diameter, for containing the gaseous diffusion barrier, made of or lined with UF_6-resistant materials and designed for horizontal or vertical installation.

   1.3 Compressors and Gas Blowers

   Specially designed or prepared axial, centrifugal, or positive displacement compressors, or gas blowers with a suction volume capacity of 1 m3/min or more of UF_6, and with a discharge pressure of up to several hundred kN/m2 (100 PSI), designed for long-term operation in the UF_6 environment with or without an electrical motor of appropriate power, as well as separate assemblies of such compressors and gas blowers. These compressors and gas blowers have a pressure ratio between 2/1 and 6/1 and are made of, or lined with, materials resistant to UF_6.

1.4 Rotary Shaft Seals

Specially designed or prepared vacuum seals, with seal feed and seal exhaust connections, for sealing the shaft connecting the compressor or the gas blower rotor with the driver motor so as to ensure a reliable seal against in-leaking of air into the inner chamber of the compressor or gas blower which is filled with UF_6. Such seals are normally designed for a buffer gas in-leakage rate of less than 1000 cm3/min.

1.5 Heat Exchangers for Cooling UF_6

Specially designed or prepared heat exchangers made of or lined with UF6 resistant materials (except stainless steel) or with copper or any combination of those metals, and intended for a leakage pressure change rate of less than 10 N/m2 (0.0015 PSI) per hour under a pressure difference of 100 kN/m2 (15 PSI).

2. Auxiliary systems, equipment and components especially designed or prepared for use in gaseous diffusion enrichment.

2.1 Feed Systems/Product and Tails Withdrawal Systems

Specially designed or prepared process systems, capable of operating at pressures of 300 kN/m2 (45 PSI) or less, including:

1. Feed autoclaves (or systems), used for passing UF_6 to the gaseous diffusion cascades;

2. Desublimers (or cold traps) used to remove UF_6 from diffusion cascades;

3. Liquefaction stations where UF_6 gas from the cascade is compressed and cooled to form liquid UF_6; and

4. "Product" or "tails" stations used for transferring UF_6 into containers.

2.2 Header Piping Systems

Specially designed or prepared piping systems and header systems for handling UF_6 within the gaseous diffusion cascades. This piping network is normally of the "double" header system with each cell connected to each of the headers.

2.3 Vacuum Systems

(a) Specially designed or prepared large vacuum manifolds, vacuum headers and vacuum pumps having a suction capacity of 5 m3/min or more.

(b) Vacuum pumps especially designed for service in UF_6-bearing atmospheres made of, or lined with, aluminum, nickel, or alloys bearing more than 60 percent nickel. These pumps may be either rotary or positive displacement, may have fluorocarbon seals, and may have special working fluids present.

2.4 Special Shut-Off and Control Valves

Specially designed or prepared manual or automated shut-off and control bellows valves made of UF_6 resistant materials with a diameter of 4 cm to 1.5 m for installation in main and auxiliary systems of gaseous diffusion enrichment plants.

2.5 UF_6 Mass Spectrometers/Ion Sources

Specially designed or prepared magnetic or quadruple mass spectrometers capable of taking "on-line" samples of feed, product or tails, from UF_6 gas streams and having all of the following characteristics:

(a) unit resolution for mass greater than 320;

(b) ion sources constructed of or lined with nichrome or monel or nickel plated;

(c) electron bombardment ionization sources; and

(d) having a collector system suitable for isotopic analysis.

Laser-Based Enrichment Equipment Examples

Appendix F to Part 110, “Illustrative List of Laser-Based Enrichment Plant Equipment and Components Under NRC’s Export Licensing Authority”

Note: Present systems for enrichment processes using lasers fall into two categories: the process medium is atomic uranium vapor and the process medium is the vapor of a uranium compound. Common nomenclature for these processes include: first category-atomic vapor laser isotope separation (AVLIS or SILVA); second category-molecular laser isotope separation (MLIS or MOLIS) and chemical reaction by isotope selective laser activation (CRISLA). The systems, equipment and components for laser enrichment plants include: (a) devices to feed uranium-metal vapor for selective photo-ionization or devices to feed the vapor of a uranium compound for photo-dissociation or chemical activation; (b) devices to collect enriched and depleted uranium metal as "product" and "tails" in the first category, and devices to collect dissociated or reacted compounds as "product" and unaffected material as 'tails' in the second category; (c) process laser systems to selectively excite the uranium-235 species; and (d) feed preparation and product conversion equipment. The complexity of the spectroscopy of uranium atoms and compounds may require incorporation of a number of available laser technologies.

All surfaces that come into contact with the uranium or UF_6 are wholly made of or protected by corrosion-resistant materials. For laser-based enrichment items, the materials resistant to corrosion by the vapor or liquid of uranium metal or uranium alloys include yttria-coated graphite and tantalum; and the materials resistant to corrosion by UF_6 include copper, stainless steel, aluminum, aluminum alloys, nickel or alloys containing 60% or more nickel and UF_6-resistant fully fluorinated hydrocarbon polymers.

Many of the following items come into direct contact with uranium metal vapor or liquid or with process gas consisting of UF_6 or a mixture of UF_6 and other gases:

(1) Uranium vaporization systems (AVLIS).

Especially designed or prepared uranium vaporization systems that contain high-power strip or scanning electron beam guns with a delivered power on the target of more than 2.5 kW/cm.

(2) Liquid uranium metal handling systems (AVLIS).

Especially designed or prepared liquid metal handling systems for molten uranium or uranium alloys, consisting of crucibles and cooling equipment for the crucibles.

The crucibles and other system parts that come into contact with molten uranium or uranium alloys are made of or protected by materials of suitable corrosion and heat resistance, such as tantalum, yttria-coated graphite, graphite coated with other rare earth oxides or mixtures thereof.

(3) Uranium metal "product" and "tails" collector assemblies (AVLIS).

Especially designed or prepared "product" and "tails" collector assemblies for uranium metal in liquid or solid form. Components for these assemblies are made of or protected by materials resistant to the heat and corrosion of uranium metal vapor or liquid, such as yttria-coated graphite or tantalum, and may include pipes, valves, fittings, "gutters", feed-throughs, heat exchangers and collector plates for magnetic, electrostatic or other separation methods.

(4) Separator module housings (AVLIS).

Especially designed or prepared cylindrical or rectangular vessels for containing the uranium metal vapor source, the electron beam gun, and the "product" and "tails" collectors.

These housings have multiplicity of ports for electrical and water feed-throughs, laser beam windows, vacuum pump connections and instrumentation diagnostics and monitoring with opening and closure provisions to allow refurbishment of internal components.

(5) Supersonic expansion nozzles (MLIS).

Especially designed or prepared supersonic expansion nozzles for cooling mixtures of UF_6 and carrier gas to 150 K or less which are corrosion resistant to UF_6.

(6) Uranium pentafluoride product collectors (MLIS).

Especially designed or prepared uranium pentafluoride (UF_5) solid product collectors consisting of filter, impact, or cyclone-type collectors, or combinations thereof, which are corrosion resistant to the UF_5/UF_6 environment.

(7) UF_6/carrier gas compressors (MLIS).

Especially designed or prepared compressors for UF_6/carrier gas mixtures, designed for long term operation in a UF_6 environment. Components of these compressors that come into contact with process gas are made of or protected by materials resistant to UF_6 corrosion.

(8) Rotary shaft seals (MLIS).

Especially designed or prepared rotary shaft seals, with seal feed and seal exhaust connections, for sealing the shaft connecting the compressor rotor with the driver motor to ensure a reliable seal against out-leakage of process gas or in-leakage of air or seal gas into the inner chamber of the compressor which is filled with a UF_6/carrier gas mixture.

(9) Fluorination systems (MLIS).

Especially designed or prepared systems for fluorinating UF_5 (solid) to UF_6 (gas).

These systems are designed to fluorinate the collected UF_5 powder to UF_6 for subsequent collection in product containers or for transfer as feed to MLIS units for additional enrichment. In one approach, the fluorination reaction may be accomplished within the isotope separation system to react and recover directly off the "product" collectors. In another approach, the UF_5 powder may be removed/transferred from the "product" collectors into a suitable reaction vessel (e.g., fluidized-bed reactor, screw reactor or flame tower) for fluorination. In both approaches equipment is used for storage and transfer of fluorine (or other suitable fluorinating agents) and for collection and transfer of UF_6.

(10) UF_6 mass spectrometers/ion sources (MLIS).

Especially designed or prepared magnetic or quadrupole mass spectrometers capable of taking "on-line" samples of feed, "product" or "tails," from UF_6 gas streams and having all of the following characteristics:

(i) Unit resolution for mass greater than 320;

(ii) Ion sources constructed of or lined with nichrome or monel or nickel plated;

(iii) Electron bombardment ionization sources; and

(iv) Collector system suitable for isotopic analysis.

(11) Feed systems/product and tails withdrawal systems (MLIS).

Especially designed or prepared process systems or equipment for enrichment plants made of or protected by materials resistant to corrosion by UF_6, including:

(i) Feed autoclaves, ovens, or systems used for passing UF_6 to the enrichment process;

(ii) Desublimers (or cold traps) used to remove UF_6 from the enrichment process for subsequent transfer upon heating;

(iii) Solidification or liquefaction stations used to remove UF_6 from the enrichment process by compressing and converting UF_6 to a liquid or solid; and

(iv) "Product" or "tails" stations used to transfer UF_6 into containers.

(12) UF_6/carrier gas separation systems (MLIS).

Especially designed or prepared process systems for separating UF_6 from carrier gas. The carrier gas may be nitrogen, argon, or other gas.

These systems may incorporate equipment such as:

(i) Cryogenic heat exchangers or cryoseparators capable of temperatures of -120ºC or less;

(ii) Cryogenic refrigeration units capable of temperatures of -120ºC or less; or

(iii) UF_6 cold traps capable of temperatures of -20ºC or less.

(13) Lasers or Laser systems (AVLIS, MLIS and CRISLA).

Especially designed or prepared for the separation of uranium isotopes. The laser system for the AVLIS process usually consists of two lasers: a copper vapor laser and a dye laser. The laser system for MLIS usually consists of a CO_2 or excimer laser and a multi-pass optical cell with revolving mirrors at both ends. Lasers or laser systems for both processes require a spectrum frequency stabilizer for operation over extended periods.

MODULE 9.0: Regulations

Learning Objective

When you finish this section, you will be able to:

9.1.5 Explain an overview of other NRC regulations important for enrichment facilities.

This regulation defines workers and identifies worker-related provisions, including protection. A worker is defined as an individual engaged in activities licensed by the Commission and controlled by a licensee (e.g., a company), but does not include the licensee itself. Most notably, Part 19.12 lists instructions for workers; namely, individuals who in the course of employment are likely to receive an occupational dose in excess of 100 mrem in a year shall be:

(1) Kept informed of the storage, transfer, or use of radiation and/or radioactive material;

(2) Instructed in the health protection problems associated with exposure to radiation and/or radioactive material, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed;

(3) Instructed in, and required to observe, to the extent within the workers control, the applicable provisions of Commission regulations and licenses for the protection of personnel from exposure to radiation and/or radioactive material;

(4) Instructed of their responsibility to report promptly to the licensee any condition which may lead to or cause a violation of Commission regulations and licenses or unnecessary exposure to radiation and/or radioactive material;

(5) Instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation and/or radioactive material; and

(6) Advised as to the radiation exposure reports which workers may request pursuant to Part 19.13.

In determining those individuals who are (radiological) workers, licensees must take into consideration assigned activities during normal and abnormal situations involving exposure to radiation and/or radioactive material which can reasonably be expected to occur during the life of a licensed facility. The extent of these instructions must be commensurate with potential radiological health protection problems present in the work place.

The Part 19 definitions for worker are used in other regulations, such as Part 70.

10 CFR 20, Standards for Protection Against Radiation

This includes the annual radiation limits from the exposure to radiation and radioactive materials. Part 20.1201 provides the annual occupational dose limit, which is the more limiting of:

(i) The total effective dose equivalent being equal to 5 rems (0.05 Sv); or

(ii) The sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems (0.5 Sv).

(iii) A lens dose equivalent of 15 rems (0.15 Sv); and

(iv) A shallow-dose equivalent of 50 rem (0.5 Sv) to the skin of the whole body or to the skin of any extremity.

Doses received in excess of the annual limits, including doses received during accidents, emergencies, and planned special exposures, must be subtracted from the limits for planned special exposures that the individual may receive during the current year (see Part 20.1206(e)(1)) and during the individual's lifetime (see Part 20.1206(e)(2)).

The assigned deep-dose equivalent must be for the part of the body receiving the highest exposure. The assigned shallow-dose equivalent must be the dose averaged over the contiguous 10 square centimeters of skin receiving the highest exposure. The deep-dose equivalent, lens-dose equivalent, and shallow-dose equivalent may be assessed from surveys or other radiation measurements for the purpose of demonstrating compliance with the occupational dose limits, if the individual monitoring device was not in the region of highest potential exposure, or the results of individual monitoring are unavailable.

Derived air concentration (DAC) and annual limit on intake (ALI) values are presented in Table 1 of Appendix B to Part 20 and may be used to determine the individual's dose (see Part 20.2106) and to demonstrate compliance with the occupational dose limits.

In addition to the annual dose limits, the licensee shall limit the soluble uranium intake by an individual to 10 milligrams in a week in consideration of chemical toxicity (see note 3 of Appendix B to Part 20).

The licensee shall reduce the dose that an individual may be allowed to receive in the current year by the amount of occupational dose received while employed by any other person (see Part 20.2104(e)).

Part 20.1301 contains the annual limit for individuals along with other requirements:

(a) Each licensee shall conduct operations so that —

(1) The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year, exclusive of the dose contributions from background radiation, from any administration the individual has received, from exposure to individuals administered radioactive material and released under Part 35.75, from voluntary participation in medical research programs, and from the licensee's disposal of radioactive material into sanitary sewerage in accordance with Part 20.2003; and

(2) The dose in any unrestricted area from external sources, exclusive of the dose contributions from patients administered radioactive material and released in accordance with Part 35.75, does not exceed 0.002 rem (0.02 millisievert) in any one hour.

(b) If the licensee permits members of the public to have access to controlled areas, the limits for members of the public continue to apply to those individuals.

(c) Notwithstanding paragraph (a)(1) of this section, a licensee may permit visitors to an individual who cannot be released, under Part 35.75, to receive a radiation dose greater than 0.1 rem (1 mSv) if—

(1) The radiation dose received does not exceed 0.5 rem (5 mSv); and

(2) The authorized user, as defined in 10 CFR Part 35, has determined before the visit that it is appropriate.

(d) A licensee or license applicant may apply for prior NRC authorization to operate up to an annual dose limit for an individual member of the public of 0.5 rem (5 mSv).

The NRC may impose additional restrictions on radiation levels in unrestricted areas and on the total quantity of radionuclides that a licensee may release in effluents in order to restrict the collective dose to the public.

In addition, per Part 20.1101, the licensee shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as reasonably achievable (ALARA). Note that ALARA includes engineering controls, and, consequently, can affect facility design.

Subpart E contains the radiological criteria for license termination. It allows both unrestricted and restricted conditions. Unrestricted site release is based upon an all pathways annual TEDE not exceeding 25 mrem/yr, with application of ALARA.

Restricted release also uses a 25 mrem/yr TEDE with ALARA, after application of legally enforceable institutional controls. Removal of the controls would not result in doses exceeding 100 mrem/yr, or, with additional requirements due to site specific conditions, 500 mrem/yr.

10 CFR 61, Licensing Requirements for Land Disposal of Radioactive Waste

The Part 61 regulations establish, for land disposal of radioactive waste, the procedures, criteria, and terms and conditions upon which the NRC issues licenses for the disposal of radioactive wastes containing byproduct, source and special nuclear material received from other persons. Disposal of waste by an individual licensee is set forth in Part 20. Land disposal does not include geologic disposal, such as in a repository. In general, the Part 61 regulation applies to the near-surface disposal of low-level waste.

Part 61 identifies four types of low-level wastes; these are, in order of increasing radioactivity and disposal requirements: Class A, Class B, Class C, and Greater Than Class C (GTCC). Isotopic and quantity/concentration criteria delineate the waste categories. GTCC waste is generally not suitable for near-surface disposal. GTCC waste containing more than 100 nanocuries/g of transuranic isotopes is also called transuranic (TRU) waste.

This is a performance based regulation. Concentrations of radioactive material which may be released to the general environment in ground water, surface water, air, soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as reasonably achievable.

10 CFR 71, Packaging And Transportation of Radioactive Materials

This regulation establishes requirements for packaging, preparation for shipment, and transportation of licensed material; and procedures and standards for NRC approval of packaging and shipping procedures for fissile material and for a quantity of other licensed material in excess of a Type A quantity (i.e., a Type B quantity). In general, packaging and transportation of Type B materials has more requirements, including container drop testing and fire tests.

The packaging and transport of licensed material are also subject to other NRC regulations (e.g., 10 CFR Parts 20, 21, 30, 40, 70, and 73) and to the regulations of other agencies (e.g., the U.S. Department of Transportation (DOT) and the U.S. Postal Service)1 having jurisdiction over means of transport. The NRC requirements are in addition to, and not in substitution for, the other requirements.

10 CFR 73, Physical Protection of Plants and Materials

This regulation prescribes requirements for the establishment and maintenance of a physical protection system which will have capabilities for the protection of special nuclear material at fixed sites and in transit and of plants in which special nuclear material is used. It identifies design basis threats for use to design safeguards systems to protect against acts of radiological sabotage and to prevent the theft or diversion of special nuclear material.

10 CFR 74, Material Control And Accounting of Special Nuclear Material

This regulation contains the requirements for the control and accounting of special nuclear material at fixed sites and for documenting the transfer of special nuclear material. General reporting requirements as well as specific requirements for certain licensees possessing special nuclear material of low strategic significance, special nuclear material of moderate strategic significance, and formula quantities of strategic special nuclear material are included. Requirements for the control and accounting of source material at enrichment facilities are also included.

Regulations on Recovery

Twenty-six uranium recovery facilities were licensed by the NRC in 2001 under 10 CFR 40. However, the operational status of many of the facilities is changing. Several conventional mills have either been decommissioned or are undergoing decommissioning. One mill has been put on stand-by status. Two sites have had licenses terminated by the NRC upon closure of the sites, but have a DOE general license. The license for the one ion-exchange facility has been terminated. Three in-situ leach facilities are operating and one is undergoing licensing.

In the Agreement States of Colorado, Texas, and Washington, seven conventional uranium mills are nonoperational. One mill in Colorado is operating and processing ore.

The mills that have ceased operation are expected to begin, or have already started, reclamation activities to provide long-term stabilization and closure of the tailings impoundments and the sites. After surface decontamination has been completed at a site, ground water monitoring or remediation continues.

The NRC evaluates and concurs in DOE remedial action plans for inactive uranium mill tailing sites as required by Title I of the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA).

Licensees are also evaluated for NEPA requirements. Facilities must submit Environmental Assessments (EA) and, in some cases, an Environmental Impact Statement (EIS).

The waste rock, or tailings, produced by the milling process contains radioactivity and hazardous chemicals, so its disposal is carefully controlled. During the operation of the uranium mill, people and all wildlife are excluded from the tailings impoundment area. When milling operations cease, the impoundment area is reclaimed and permanently isolated from the environment. This is done by first sealing the area with a soil cover at least 10 feet thick and then planting it with native grassland vegetation or covering it with a protective rock cover. Because of these reclamation procedures, the radon emissions from the tailings themselves are effectively reduced to the levels of the natural soils in the area.

The uranium industry must also address water quality under the Atomic Energy Act and the Clean Water Act. The water released at any point during the milling must meet strict standards to protect ground water and surface water quality. The tailings disposal areas must be sealed both beneath and, after reclamation, above. The sealing mechanisms consist of clay and special artificial liners, which prevent seepage.

Table 9-5. 10 CFR Part 76 - Certification of Gaseous Diffusion Plants

Subpart	Description
A - General Provisions	Provides the purpose, scope, and general approach to managing the regulatory environment and communication of the gaseous diffusion plants.
B - Application Part 76.45	Sets the certification application procedure and contents as well as setting the annual renewal requirements. Permits amendments to certificates, establishing a formal process for Proposed new or modified activities. The amendment application should contain sufficient information for the NRC to make findings of compliance or acceptability in same manner as required for original certificate.
C - Certification Part 76.68	Sets the additional regulatory requirements from other Parts, describes the issuance, denial, expiration, and termination of certificates, describes the procedure for plant changes, and post issuance procedures. Covers plant changes. Requires safety analysis, SAR update that demonstrates no undue risk to public. The changes may not decrease the effectiveness of the plant's safety, safeguards, and security programs or may not involve a change in certificate of compliance or approved compliance plan.
D - Safety	Describes the use and transfer of radioactive materials, sets the scope of accident assessment, technical safety requirements, criticality accident requirements, emergency planning, quality assurance, and training.
E - Safeguards and Security	Sets the specific requirements for physical security, special nuclear material accountability and control, and protection of certain information.
F - Reports and Inspections	Describes the event reporting and NRC inspection processes.
G - Enforcement	Sets the scope of violations and penalties allowed under law for enforcement of GDP regulations purposes.

Regulations on Fuel Fabrication

United States fuel fabrication plants are subject to regulation at both the state and federal levels. These facilities are licensed by the NRC to possess and use special nuclear material pursuant to the regulations specified in 10 CFR Part 70, Domestic Licensing of Special Nuclear Material. MOX and new enrichment technologies such as centrifuge processes are regulated under Part 70.

Table 9-6 shows new subparts E and H of 10 CFR 70 that set forth terms and conditions for licenses (E) and establish performance requirements (H) that require an Integrated Safety Analysis (ISA). See Table 4-7 in Module 4.0 or Table 5-5 in Module 5.0 for additional information.

Table 9-6. 10 CFR Part 70 - Domestic Licensing of Special Nuclear Material

Subpart	Description
E - Licenses Part 70.34, Amendment of Licenses	Sets forth terms and conditions for licenses. Applications for amendment of a license shall be filed in accordance with Part 70.21(a) and must specify what the licensee wants amended and the grounds for such amendment. Full documentation and updates are required by the licensee/facility.
H- Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of SNM	Sets forth performance requirements that require an Integrated Safety Analysis (ISA); establishes safety program and the ISA; establishes content and approval requirements for license applications.

The Nuclear Regulatory Commission has determined that any application for a new enrichment facility must be made under 10 CFR Part 70, even if the new facility is located at a GDP.

It's time to schedule a progress meeting with your administrator. Review the progress review meeting form on the next page. In Part III, as a Regulator, write your specific questions to discuss with the administrator.

PROGRESS REVIEW MEETING FORM

Date Scheduled: ________________________________**Location:**______________________

I. The following suggested items should be discussed with the administrator as to how they pertain to your current position:

- ◙ Overview of NRC regulations of enrichment facilities.
- ◙ Identify NRC regulations of gaseous diffusion plants (Part 76).
- ◙ Identify NRC regulations for other enrichment facilities (Part 70).
- ◙ Identify export–import regulations of enrichment technologies (Part 110).
- ◙ Overview of other NRC regulations important for enrichment facilities.

II. Use the space below to take notes during your meeting.

MODULE 9.0: Regulations

III. As a Regulator:

- ◙ What have been the most recent problems at the gaseous diffusion plants?
- ◙ What are the administrative and engineering controls used at the gaseous diffusion plants? Tell me how administrative controls and engineering controls are effective or not effective.
- ◙ What documentation would you recommend that I review before I visit the gaseous diffusion plants?
- ◙ What have been some of the problems associated with the application of the revised Part 70?

Use the space below to write your specific questions.

IV. Further assignments? If yes, please note and complete. If no, initial completion of progress meeting on tracking form.

Ensure that you and your administrator have dated and initialed your progress on your tracking form for this module.
Go to the module summary.

MODULE SUMMARY

Key Points:

- The NRC regulates enrichment facilities for environmental, safety, and health reasons, and to safeguard the facilities and materials from loss, theft, or diversion.
- The NRC applies ALARA considerations to the regulation of enrichment facilities. ALARA has to be considered in the design of facilities.
- The NRC regulates three areas of chemical safety at enrichment facilities: the hazardous chemical effects of radioactive materials, hazardous chemicals produced from radioactive materials, and hazardous chemicals that affect the safe handling of radioactive materials.
- The NRC uses a certificate approach to regulate the GDPs, under Part 76. Part 76 applies a deterministic regulatory approach based upon the historical operations and experience at the GDP facilities.
- All other, non-GDP enrichment facilities are regulated under Part 70. Part 76 cannot be used to regulate new enrichment facilities at GDP sites—Part 70 must be applied. However, programs used for the GDPs and approved under Part 76 may also be used for new enrichment facilities at GDP sites and incorporated by reference into the Part 70 application.
- Part 70 incorporates risk-informed and performance based approaches to regulation. It includes three consequence levels, three likelihood categories, three receptors, and two types of effects (radiological and chemical). These are called performance requirements.
- Part 70 requires high and intermediate consequence events to have safety controls to reduce their consequences and/or likelihoods. These safety controls are designated as Items Relied On For Safety.
- Part 70 uses an integrated safety analysis (ISA) to determine IROFSs.
- The NRC has export–import controls applicable to enrichment facilities, equipment, and materials.

Congratulations!

Congratulations! You have completed the final module of the Fuel Cycle Processes Directed Self-Study Course. Go to the Directed Self-Study Course Process in the Trainee Guide. Ensure completion of all process steps.