Final Interim Staff Guidance
Evaluation and Acceptance Criteria for 10 CFR 20.1406 to
Support Design Certification and Combined License Applications
DC/COL-ISG-06

Purpose:

The purpose of this interim staff guidance (ISG) is to clarify the U.S. Nuclear Regulatory Commission (NRC) position on acceptable levels of detail and content required for an applicant to demonstrate compliance with Title 10 of the *Code of Federal Regulations*, Section 20.1406 (10 CFR 20.1406 or the Rule). Regulatory Guide (RG) 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life Cycle Planning," describes an acceptable method of demonstrating compliance with this rule. This ISG provides further clarification on the evaluation and acceptance criteria that will be used by NRC staff in reaching a reasonable assurance finding that a design certification (DC) or combined license (COL) applicant has complied with the requirements of 10 CFR 20.1406.

Background:

The financial assurance requirements issued in the January 27, 1988 (53 FR 24018), rule on planning for decommissioning require licensees to provide adequate funding for decommissioning. SECY-03-0069 "Results of the License Termination Rule Analysis," notes that a "legacy site" is a facility that is decommissioning and has an owner who cannot complete the decommissioning work for technical or financial reasons. Legacy sites have two common characteristics: subsurface residual radioactivity in amounts greater than anticipated, and insufficient funds to remediate the radiological contamination to levels that will meet the NRC's license termination criteria. In 2005, NRC staff conducted an evaluation of 82 active and completed decommissioning sites to identify the key operational and technical issues which underlie legacy sites. The evaluation concluded that low level specific activity radioactive process leaks, spills, and controlled and uncontrolled effluents were common to legacy sites. Over the short term, these are below the threshold for reportable effluent release. Over the long-term, these chronic releases accumulate in the subsurface environment and are often not considered for remediation in the decommissioning cost estimate, upon which decommissioning financial assurance is based.

The minimization of contamination regulation, 10 CFR 20.1406, applies to all DC and COL applications submitted after August 20, 1997. The rule requires that applicants describe how they intend to minimize, to the extent practicable, the contamination of the facility, the contamination of the environment, and the generation of radioactive waste. Applicants are also required to describe how they will facilitate decommissioning of the facility. As noted in *Federal Register*, Vol. 62, No. 139 (July 21, 1997) the intent of 10 CFR Part 20, Subpart E, "Radiological Criteria for License Termination," is to provide a clear and consistent regulatory basis for determining the extent to which lands and structures must be remediated before decommissioning of a site can be considered complete and the license terminated. The intent of Section 20.1406 is to emphasize to a license applicant the importance, in an early stage of planning, for facilities to be designed and operated in a way that would minimize the amount of radioactive contamination generated at the site during its operating lifetime and would minimize the generation of radioactive waste during decontamination. Specific minimization requirements

are directed towards those making an application for a new license because it is more likely that consideration of design and operational aspects that would reduce dose and minimize waste can be cost-effective at that time.

In response to current and future DC and COL applicants' need for guidance on 10 CFR 20.1406, NRC staff issued RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," (Agencywide Documents Access and Management System (ADAMS) Accession No. ML080500187) in June of 2008. RG 4.21 (previously issued for public comment as Draft Guide 4012), describes a basis acceptable to the staff for implementing the requirements of 10 CFR 20.1406. This includes a discussion of high level objectives as well as specific actions that can be taken during design, construction, operation, and decommissioning to ensure that, to the extent practicable, contamination of the facility and the environment is minimized, radioactive waste generation is minimized, and decommissioning is facilitated.

Issue:

Pursuant to 10 CFR 20.1406, DC and COL applicants must describe in their applications how they intend to minimize contamination, minimize the generation of radioactive waste, and facilitate decommissioning. In order to meet these requirements, the NRC has provided guidance for applicants to follow in RG 4.21. If this guidance is not followed, the applicant must fully describe the alternate method used to comply with the regulations in 10 CFR 20.1406 and provide sufficient details such that the NRC staff will have sufficient information to conduct its review.

Regardless of the methodology used by the applicant, NRC staff typically rely on the evaluation and acceptance criteria found in NUREG-0800 (Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants), to verify the applicant's compliance with 10 CFR 20.1406. These criteria are of particular importance due to the cross-cutting, performance based nature of both 10 CFR 20.1406 and RG 4.21. However, at this time, the criteria described in NUREG-0800 are not adequate to cover the full scope of the regulation, nor are they adequate to establish minimum level-of-detail requirements for the content of applications. As a result, NRC staff has issued this ISG to supplement NUREG-0800 and application guidance until updated versions of NUREG-0800 are available.

Proposed Interim Staff Guidance:

Evaluation Criteria

Applicants for DCs and COLs must meet the requirements of 10 CFR 20.1406 for minimization of contamination. This is accomplished by considering the design features and operation of structures, systems, and components (SSCs) that contain or handle radioactive material as described in a COL applicant's final safety analysis report (FSAR), or in a DC application. If a COL application references a standard DC that meets the requirements of 10 CFR 20.1406 for design features, then the COL applicant needs to only consider those criteria affecting operation and site-specific design features.

At a minimum, as part of the description of design and operational features for all applicable SSCs, the applicant should also describe plans for; limiting leakage, controlling the spread of contamination, detecting leaks early, allowing for appropriate and timely action to mitigate and control the spread of contamination by the future licensee, and reducing the time, effort and hazard to personnel during decommissioning activities. Where appropriate to the type of SSC being considered, the applicant should explicitly describe how these considerations are addressed in the design and operation of the SSC.

General guidance on meeting the requirements of 20.1406 and examples have been developed and are included as Attachment A – "Evaluation and Scoping Information for Systems, Structures and Components 10 CFR 20.1406 Design Review" to this ISG as scoping information for SSCs to assist the staff in evaluation of SSCs having a potential to release radioactive materials to the facility, site, or environment which could contaminate the soil or groundwater. In addition, Attachment C has been developed for various SSCs, citing operational experiences, including actual Event Notices and information included in the Liquid Radioactive Release Lessons Learned Task Force (ADAMS Accession No. ML062650312).

Regulatory positions C.1 through C.4 in RG 4.21 have been provided as specific guidance to applicants on meeting the requirements of 10 CFR 20.1406. C1 through C4 describe concepts to be implemented to provide reasonable assurance that inadvertent spills, leaks, and discharges of liquid, gaseous and solid radioactive effluents are prevented, detected and corrected, that the site is adequately characterized and understood, that decommissioning is planned for and that the generation of radioactive waste is minimized. The measures to be taken by the applicant should be risk-informed and the examples described in RG 4.21, Appendix A should be used by the applicants to determine which measures are applicable. This listing; however, is not intended to be used as a checklist of minimally acceptable design or operational features. Alternative methods to RG 4.21 may be acceptable to meet the requirements of 10 CFR 20.1406, provided the methods are documented fully in the DC or the COL applications, and accepted by the staff.

Additionally, the applicant should document that if a spill, leak, or inadvertent discharge were to occur, design or operational features ensure that the spill, leak, or discharge will be detected promptly, and monitored and evaluated to determine the impact on the environment.

Acceptance Criteria

To determine an applicant's compliance with 20.1406, as it relates to describing a basis acceptable for implementing the requirements of 10 CFR 20.1406, the staff should review the applicant's description of all applicable SSCs and applicable site-specific data against the guidance contained in RG 4.21 to confirm that:

- Adequate design features exist, supplemented with operating programs, processes and procedures (as necessary), and these will provide reasonable assurance that spills, leaks, and inadvertent discharges of radioactive effluents will be prevented to the extent practicable, or minimized.

- In the event the spill, leak, or inadvertent discharge does occur, the staff should verify that there is reasonable assurance that it will be detected in a timely manner. For those SSCs that are typically inaccessible for routine inspection or observation, leak detection

capability, to the extent practical, should allow for the identification and measurement of relatively small leak rates, depending on the concentration (e.g. several gallons per week).

- Design features should be supplemented, as necessary, by operating programs, processes and procedures to monitor spills and leaks and evaluate their impact to the environment.

- The site has been adequately characterized and conceptual site models have been developed which define the site hydro geological setting including subsurface and surface migration pathways under both pre-construction and post-construction conditions. These models are needed to assist with designing monitoring components and procedures, designing protective measures, carrying out remediation, and designing decommissioning activities.

- Design features that facilitate decommissioning should be described, and their role in the decommissioning process should be described. These should include both design features (such as modular components and adequate space for equipment removal) and operating procedures to minimize the amount of residual radioactivity that will require remediation at the time of decommissioning.

- The site has been designed and will be operated to minimize the generation and volume of radioactive waste, both during operation and during decommissioning.

Final Resolution:

In the near-term, the guidance to minimize contamination, minimize the generation of radioactive waste, and facilitate decommissioning will be resolved in upcoming updates of RG 1.206, "Combined License Applications for Nuclear Power Plants," NUREG-0800, and other affected guidance documents. Potentially affected sections of these documents include those parts dealing with site characteristics, plant systems, waste management, and radiation protection (*e.g.*, FSAR Chapters 2, 5, 9, 10, 11, 12, and 13). The ISG shall remain in effect until it has been superseded, withdrawn, or incorporated into a revision of the Standard Review Plan (SRP) and RG 1.206.

The NRC staff notes that the industry is developing a template (NEI-08-08) that is intended to assist COL applicants in addressing operational compliance with 10 CFR 20.1406. The industry and NRC staff efforts are being coordinated to ensure consistent guidance is being provided to applicants and that the guidance supports future NRC staff review of applications.

Applicability:

This ISG is applicable to all DC and COL applications submitted under 10 CFR Part 52. Reviews under this ISG will be performed and documented by various disciplines throughout the Agency. Review responsibilities are related to organizations responsible for review of the design features and operation of all SSC's included in COL applications and design control documents. This ISG shall be implemented on the day following its approval. It shall remain in

effect until it has been superseded, withdrawn, or incorporated into a revision of the SRP and RG 1.206.

References:

1. 10 CFR 20.1406, “Minimization of Contamination.”

2. RG 4.21, “Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning.”

Attachment A

Evaluation and Scoping information for Systems, Structures and Components 10 CFR 20.1406 Design Review

I. General Guidance

Perform an evaluation of SSCs that contain or could contain radioactive liquids or material. Those SSCs that have a potential to release radioactive materials to the facility, site, or environment which could contaminate the soil or groundwater should be evaluated.

The regulations require that both design and operational processes be addressed. RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," describes an acceptable method for applicants to meet the regulation. RG 4.21 also includes a list of examples that may be used to determine areas to address.

Examples of SSCs, such as those listed in Attachment B, include, but are not limited to, radioactive waste systems, building sumps and drains, spent fuel storage pools and other systems where, based on operational experience, the likelihood of such releases could occur. Typical systems and operational experience instances are included in Attachment C of this ISG.

II. General SSC Screening

If the general screening indicates review is warranted, review the FSAR description provided to determine if the applicant has included design or operational features to address compliance with 10 CFR 20.1406. Request additional information or discuss with the Division of Construction Inspection and Operational Programs, Health Physics Branch if additional information is needed.

1. Systems/Components:

a. Does the system contain or potentially contain *radioactive materials*? (See RG 4.21, Appendix A for examples)

AND;

b. Is the system separated from the environment by a single barrier?

- Tank/Sump with an exterior wall or floor
- Single walled pipe located in an area not accessible for inspection (buried pipe trench, pipe drains, etc.)

OR;

c. Are portions of the system located outside of a structure designed to contain a release of *radioactive materials*?

OR;

d. Has operational experience demonstrated that the system or components has previously resulted in a release of *radioactive materials?*

2. **Structures:**

a. Does the structure envelope a system or components that contain or potentially contain *radioactive materials*?

AND;

b. Are there any below grade penetrations (e.g., piping, conduit) to the environment?

OR;

c. Are there any below grade concrete joints (e.g., floor to floor, walls to floor) that connect to the environment?

OR;

d. Does the structure contain *radioactive materials* that are separated from the environment by a single barrier? (retention pond with liner, or radioactive waste pipe running between buildings)

Attachment B

Examples of Systems, Structures, and Components for 20.1406 Review

The list below provides examples of typical SSCs that typically have a potential to release radioactive material to the facility, site, or environment. Additional operating experience is provided as background information. This list is not intended to be complete and comprehensive, nor is it intended to be a checklist of minimally acceptable facility design features.

- Spent Fuel Storage and Transfer Systems
  - Spent Fuel Pool (SFP)
  - SFP Transfer Canal
  - SFP Leak Detection System

- Tanks and Piping
  - Radwaste Tanks and Piping
  - Condensate Storage Tank and Piping
  - High-Pressure Coolant Injection (HPCI) and Emergency Service Water Piping
  - Refueling Water Storage Tank
  - Service Water and Component Cooling
  - Auxiliary Steam Lines
  - Cooling Tower Blowdown Line
  - Circulating water system piping
  - Retention Tanks
  - Discharge Canals and Piping (including air relief valves on lines)

- Drains
  - Water Treatment System Drains
  - Floor and Roof Drains
  - Laundry System Drains
  - Contaminated Sink Drains

- Secondary Systems
  - Plant Chilled Water System
  - Cooling Tower Basin

- Radwaste Systems
  - Waste Disposal System Valves
  - Resin Fill Valve
  - Retention Ponds

- Building
  - Building Sumps
  - Seismic Gaps
  - Joints

Table 1
Operating Experiences for Review

SSC	Occurrence	Problem
Piping		
Non-safety, HPCI suction and return piping	Underground Pipe Leakage	Inadequate pipe design/maintenance
Condensate Tank, Condensate transfer system (underground pipe)	Degraded pipe caused leak. Liquid traveled outside the protected area via an underground telephone cable conduit run.	Inadequate pipe design/maintenance
Turbine Building Sump Discharge Line	Frozen end of discharge line caused liquid to backup and leak.	No freeze protection
Radwaste liquid Effluent release pipe	Degraded effluent line piping	Inadequate pipe design
Coolant Tower Blowdown Line	Cooling tower blowdown line leak due to failure in piping.	Inadequate pipe design
Turbine and Waste Treatment Building Sump Discharge Line	Line leaked due to degraded condition of pipe	Inadequate pipe design
Underground pipe containing Uranium Bearing Discharge	Pipe ruptured underground and might have been undetected for years.	Inadequate pipe design/maintenance
Sumps		
Clean Sumps	Steam Leaks condensed and ran into clean sumps which were routed to storm drain pond.	Inadequate maintenance
Steam Lines		
Auxiliary Steam Lines	Steam and liquid leaks through seals, joints, and degraded pipes.	Inadequate maintenance
Retention Ponds		
Unlined Storm Drain Stabilization Pond (SDSP)	Tritium was found in two man holes located close to an unlined SDSP. The storm drain collector basin received overflow from the Turbine Building air-wash system, which contained small amounts of tritium	Inadequate design

Table 1
Operating Experiences for Review

Operating Practices		
Boric acid concentrator system (evaporator system) releases	Past operational practices during releases during rainy days from the system resulting in rain deposition and wash down of roof drains.	Inadequate operator procedures
Condensate transfer System	Liquid discharged from circulating water discharge tunnel via fire protection system and a portion of the service water system due to operator error.	Procedure Compliance
Outdoor storage of contaminated equipment	Contamination leached from equipment onto soil.	Inadequate procedures or operational controls
Condensate Storage Tank	Water overflowed from Condensate Storage Tank into a tunnel. Tunnel had potential to allow small amount of this water to permeate into the ground.	Inadequate procedures
Retention tank containing radioactive liquid	Retention tank containing uranium bearing liquid overflowed onto soil. Tank was undergoing maintenance and was not tight at the time.	Inadequate maintenance
Equipment		
Circulating Water Blowdown Line	Vacuum Breakers in blowdown line leaked while radioactive liquid traveled down the pipe.	Inadequate maintenance
Flange in feed water system venturi	Leak in system. Under drain system captured most of tritium from leakage.	Inadequate design/maintenance.
Steam Generator Tube leak	Liquid leaked from degraded Steam Generator Tube.	Inadequate design/maintenance
Tanks		
Storm Drains around Liquid Waste Holdup Tank	Liquid leaked through cracks in the asphalt berm around a Liquid Waste Holdup Tank Area into the groundwater.	Inadequate design/maintenance

Table 1
Operating Experiences for Review

Fuel Storage and Handling		
SFP	Estimated 141,500 gallons of SFP water was released in the gap between two reactor buildings into other buildings and surrounding environment. Operational/configuration control errors resulted in deflation of SFP seals and resultant leak.	Inadequate design and operational/configuration control error.
SFP	Liner leakage and hairline crack in Fuel Storage Building wall.	Inadequate design, bad weld
SFP	Failure of curtain drain	Inadequate design
SFP	SFP water leaked into narrow seismic gap due to clog in tell-tale drain system.	Inadequate maintenance
SFP	Defect in liner of cask loading pool resulted in leakage from cask loading pool.	Inadequate design
SFP Transfer Sleeve	Leakage through fuel transfer sleeve into abandoned Unit 2 facilities.	Inadequate design