Implementation of 10 CFR 20.1406 Through Life Cycle Planning for Decommissioning

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INTRODUCTION

The focus of this paper is on a regulatory guide (draft guide DG-4012) being developed by the Office of Nuclear Regulatory Research for the implementation of 10 CFR 20.1406. The draft guide was published in the Federal Register on July 31, 2007 for a 90 day public comment period. Besides being available in the Federal Register, it is also available electronically in NRC's agency data management system (ADAMS). The accession number is ML0712100110.

10 CFR 20.1406 requires license applicants, other than renewals, after August 20, 1997, "…to describe in the application how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize to the extent practicable, the generation of radioactive waste." The intent of the regulation is to diminish the occurrence and severity of "legacy sites" by taking measures that will reduce and control contamination and facilitate eventual decommissioning.

10 CFR 20.1406 is significant because it applies to all new facilities and in the very near future (perhaps as soon as the fall of 2007), the U.S. Nuclear Regulatory Commission (NRC) anticipates receiving one or more license applications for new nuclear power plants. The regulatory guide is intended to facilitate that licensing by providing suggestions of things an applicant can do to minimize contamination of the facility and the environment, minimize generation of waste, and to facilitate decommissioning.

Over 100 different kinds of activities are covered by license applications submitted to the NRC. They do not all reflect the same potential for contamination of a facility and the environment, or for the generation of radioactive waste. Therefore, an applicant should use sound judgment to evaluate the potential for contamination and the consequences of such contamination in deciding on the extent to which this guide applies to any given facility or activity. Factors which may enter into this decision include form (e.g., dry solids, liquids, gases), inventory, and environmental mobility of unintended releases.

The bulk of the guidance presented in the guide will consist of specific design considerations drawn from nuclear industry experience and lessons learned from decommissioning. These design suggestions provide examples of measures which can be combined to support a contaminant management philosophy for a new facility. The principles embodied in this philosophy are threefold: (1) prevention of unintended release, (2) early detection if there is unintended release of radioactive contamination, and (3) prompt and aggressive clean-up should there be an unintended release of radioactive contamination. If the guiding principles are followed through the use of "good" engineering and science, as well as careful attention to operational practices, it should result in meeting the requirements of 10 CFR 20.1406. All this should be considered in the context of the life cycle of the facility from the early planning stages through the final plans for decommissioning and waste disposal. Some of the mechanisms which can be employed for life cycle planning are described further in the Discussion section which follows.

DISCUSSION

Explore Opportunities for Minimizing Contamination Prior to License Submittal

One of the significant early lessons learned about minimizing the radiological impacts of decommissioning was the importance of early planning for decommissioning. Such planning should include consideration of decommissioning at the time of initial design and continue through facility operations. Prior to license submittal, the applicant should explore opportunities for minimizing contamination of the facility and the environment that carefully consider facility design as well as operating procedures. Thus, the license applicant, during initial facility design planning, should comprehensively consider design aspects, construction, and operation through termination of the license by the U.S. Nuclear Regulatory Commission (NRC). This last aspect includes consideration of decommissioning activities until satisfactory facility and site release is accomplished (i.e., meeting the Subpart E radiological criteria in 10 CFR Part 20, as site-specifically approved by the NRC).

Minimize Leaks and Spills and Provide Containment

Through design and operational practices, licensees should strive to minimize leaks and spills, provide containment in areas where such events might occur, quickly detect and clean up any leaks and spills that do

occur, and take corrective action to stop the leaks. Licensees should control contamination; design areas where licensed materials are used and stored to facilitate operations; and minimize the amount of radiological work performed outside the restricted area.

Prompt Detection of Leakage

In addition to design considerations to control and, if possible, prevent radioactive system leakage, it is important during operations to be able to promptly detect leakage as close as possible to the leakage source to minimize the spread of contamination and to prevent uncontrolled or unmonitored releases and/or widespread contamination. Thus, monitoring and routine surveillance programs become an important part of minimizing potential contamination. This approach should include the placement of instruments to detect leakage at readily accessible locations and to implement operational practices that will enable early detection of contamination. Because leakage detection is only the first step in minimizing contamination, the applicant also should develop mitigation plans for quickly stopping any spread of contamination once it is detected.

Avoid Release of Contamination from Undetected Leaks

Past experience has shown that structures, systems or components (SSC) containing radiation that are not readily accessible for surveillance can be the source of undetected leaks of radioactive material over a prolonged period of time. The contamination from undetected leaks can accumulate as subsurface residual radioactivity that may need to be remediated prior to license termination. SSC that are buried or are in contact with soil, such as spent fuel pools (SFPs), tanks in contact with the ground, and buried pipes, are particularly susceptible to undetected leakage. The available data from plants being decommissioned indicate that it was not uncommon for some level of undetected releases to occur in the subsurface environment during the plant operating life. These releases were generally minor leaks that occurred over an extended period of time. Many of the leaks occurred in areas where it was difficult or impossible to conduct regular inspections. This likely contributed to the failure to identify the leaks at the time of occurrence. Monitoring of systems was not sufficiently sensitive to identify small leaks and leakage rates. Such situations and conditions should be avoided during facility design. It is desirable to include leak detection systems within the facility design that are capable of detecting minor leaks that otherwise over time could potentially cause significant environmental contamination. It is also desirable to design the facility such that any SSC which has the potential for leakage is provided with adequate leak detection capability.

Measures for Reducing the Need to Decontaminate Equipment and Plant Areas

Licensees can reduce the need to decontaminate equipment and plant areas by taking measures that will decrease the probability of any release, reduce any leakage released, and decrease the spread of the contaminant from the source (e.g., from systems or components that must be opened for service or replacement). Such preventive and corrective measures can include auxiliary ventilation systems, treatment of the exhaust from vents and overflows, and techniques to control releases (i.e., capping or elevating uncontrolled drains, use of barriers or dikes, use of controlled sumps, and protection of SSC from inclement weather). Leakage from components containing radioactive liquids can be reduced by the proper selection of corrosion resistant materials; the use of industry consensus code repair/replacement requirements; adequate quality assurance, design standards, improved and expanded inspection requirements; improved protection of buried components (e.g., galvanic corrosion protection, coatings); and design considerations such as double-walled pipes and tanks with annulus monitoring. Minimization of leakage from SSC also involves corrective action strategies linked to monitoring analyses.

Operational Practices Should be Periodically Reviewed

Operational practices are another important consideration in meeting the objectives of 10 CFR 20.1406. These practices should be subjected to periodic review to ensure that facility personnel follow operating procedures; that operating procedures are revised to reflect the installation of new or modified equipment or plant processes; and that personnel qualification and training are kept current with the latest versions of operational programs and procedures. Operational programs and procedures should be subjected to review and evaluation following events that resulted in leaks and spills of radioactive materials. As part of the root-cause analysis, the evaluation should determine (1) whether procedures, equipment, and operator errors contributed to the event and releases, and (2) identify immediate and long-term corrective actions. The results of such lessons-learned should then be assessed as to their broader applicability to similar or related facility operations and incorporated as needed into revised programs and procedures.

Related Regulatory Guides on Minimization of Contamination

Much of the guidance found in the following two regulatory guides also applies to the minimization of contamination : (1) Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants," as it relates to potential contamination, and (2) Regulatory Guide 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable," as it relates to the reduction of occupational radiation exposures, also applies to minimization of contamination. As applicable, this guidance incorporates elements from these regulatory guides.

Proper Records will Facilitate Decommissioning

The provisions of 10 CFR 50.75(g) contain requirements for maintaining records "...of information important to the safe and effective decommissioning of the facility." Parallel requirements are in 10 CFR 30.35(g), 40.36(f), 70.25(g), and 72.30(d) for materials licensees to maintain records important for decommissioning. These records furnish information important to the decommissioning process by providing details on contaminating events and residual levels of contamination in the environment. It is also important to capture events (e.g., leaks or spills) which might not necessarily be recorded under the provision of 10 CFR 50.75(g) et al. but which may be important to facilitate remediation of residual radioactivity and decommissioning. Properly recording these events when they occur and maintaining records in a readily accessible manner can aid in the eventual decommissioning of the facility.

Final Site Configuration to Prevent or Confine Contamination

License applicants should consider the final site configuration to aid in preventing or confining the migration of radionuclides offsite via an unmonitored pathway. They should develop an onsite monitoring program as an integral part of the radiological environmental monitoring program (REMP), to provide early detection and quantification of leaks and spills and maintain a current baseline of radiological and hydrogeological parameters.

IMPLEMENTATION OF THE GUIDE

No backfit is intended in connection with issuance of this regulatory guide. This guide reflects current NRC staff guidance in license application reviews. Therefore, except in those cases in which the applicant proposes an acceptable alternative method for complying with the specified portions of the Commission's regulations, the methods described herein will continue to be used in the evaluation of license applications until this guide is revised as a result of suggestions from the public or additional staff review.

Over 100 different kinds of activities are covered by license applications submitted to the NRC. They do not all reflect the same potential for contamination of a facility and the environment, or for the generation of radioactive waste. Therefore, an applicant should use sound judgment to evaluate the potential for contamination and the consequences of such contamination in deciding on the extent to which this guide applies to any given facility or activity. Factors which may enter into this decision include form (e.g., dry solids, liquids, gases), inventory, and environmental mobility of unintended releases. Figure 1 is a flow diagram indicating the decision paths an applicant might take in determining the applicable of this guide.

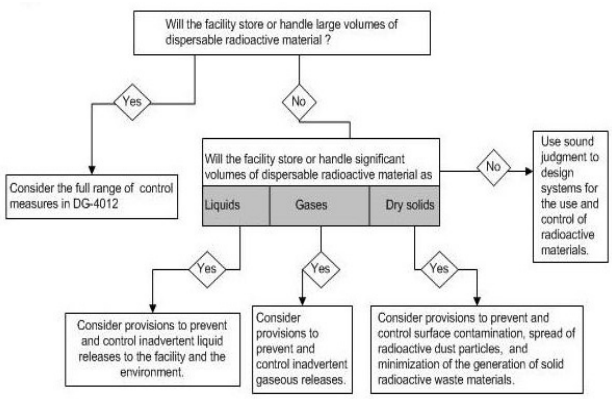

Figure 1: Decision Tree for 10 CFR 20.1406

If the facility will store or handle large volumes of dispersable radioactive material then the applicant should consider the full range of the measures found in the guide. If the facility will still handle significant amounts of dispersable radioactive material (e.g., amounts which if released might result in extensive clean-up activities either during operation or decommissioning) then the form of the material needs to be considered. For example, for a liquid, consideration should be given to the provisions to prevent and control inadvertent liquid releases. Similarly for a gas, consideration should be given to the provisions to control inadvertent gaseous releases. This also applies to dry solids. It should be noted that there are no exceptions in the regulations with regard to the applicability of 10 CFR 20.1406 for license applications after August 20, 1997. Even applications that

do not deal with large or significant amounts of radioactive material need to address the minimization and facilitation provisions of the regulations but should do so using common sense and good judgment. Table 1 provides further information which may be useful in determining the applicability of the guide.

Table I. Applicability of DG-4012 Relative to Type of Facility, Physical Form of Radioactive Material (liquid, gas, solid), Half life, and Inventory (High, Intermediate, Low)

Legend: 3 (highest likelihood of using the measures in this guide)
2 (moderate likelihood of using the measures in this guide)
1 (low likelihood of using the measures in this guide)

Type of facility or use of radioactive material	Physical form of radioactive material involved		
	liquid	gas	dry solid
Group 1	High inventory, long half life – Power Plants and Fuel Cycle Facilities		
commercial nuclear power plant	3	3	3
fuel fabrication plant	3	3	3
enrichment plant	3	3	3
reprocessing facility	3	3	3
Group 2	High inventory, long half life – Waste Disposal Facilities		
high level waste disposal facility	1	2	2
low level waste disposal facility	2	1	3
Group 3	Intermediate to low inventory, long half life		
uranium mills and mines	2	2	2
research and test reactors	2	2	3
Group 4	Low inventory, half life generally not long		
medical use of radioactive material	2 * emphasis on inventory control	1	2 * emphasis on inventory control
industrial use of radioactive material	1	2	1 dependent on material. *emphasis on inventory control
medical or industrial use of sealed sources	1	1	1

Table I: Applicability of Draft Guide

For major, complex facilities with significant inventories of radioactive material such as a commercial nuclear power plant, enrichment facility, fuel fabrication facility, or a radioactive waste disposal facility (Table 1, Groups 1 and 2), this guide should assist an applicant in meeting the requirements of 10 CFR 20.1406. For smaller facilities which do not have large inventories, especially ones in which the material has a short half-life or is in the form of a sealed source (Table 1, Group 4), an applicant would need to consider only those design measures which directly apply to the type of radioactive material and processes to be authorized and the potential for contamination of the facility or environment. In this case, applicants should focus on historical information that reflects the likelihood of contamination of the facility and environment to identify the systems that should be designed and operated consistent with 10 CFR 20.1406.

SUMMARY AND CONCLUSIONS

The principles of the guide are threefold: prevention, early detection, and prompt response. If these guiding principles are followed through the use of "good" engineering and science, as well as careful attention to operational practices, it should result in meeting the requirements of 10 CFR 20 In summary, the thrust of this guide is for an applicant to use technically sound engineering judgment and a practical risk-informed approach to achieve the objectives of 10 CFR 20.1406. This approach should consider the materials and processes involved (e.g., solids, liquids, gases) and focus on: (1) the relative significance of potential contamination; (2) areas most susceptible to leaks; and (3) the appropriate level of consideration to prevention and control of contamination that should be incorporated in facility design. Since the applicability of the guidance is a facility-by-facility decision, early consultation with the NRC is strongly suggested.