

RESULTS OF EVALUATIONS FOR MEASURES TO PREVENT FUTURE LEGACY SITES BY CHANGES IN LICENSEE OPERATIONS

1. BACKGROUND

Following a General Accounting Office recommendation, the U.S. Nuclear Regulatory Commission (NRC) initiated the Site decommissioning Management Program (SDMP) in 1990. The purpose of this program is to focus management attention on remediation of sites that have ceased operation, have significant residual contamination and limited financial resources. Experience has shown that the cost of remediation of these sites is typically very high, in the tens of millions of dollars, because there are large volumes of contaminated material and, often, significant ground water contamination. Both are very expensive to alleviate. In addition to the high cost to the licensees, these sites also require considerable staff resources to effect remediation. Therefore, it is considered prudent to institute measures to reduce the occurrence of such sites in the future.

2. ISSUES DESCRIPTIONS AND DESIRED OUTCOMES

Issues: A number of legacy sites have substantial contamination: approximately two thirds have subsurface soil contamination, and one third also have ground water contamination (this depends on the solubility of the nuclides). These sites operated before the current regulatory decommissioning infrastructure existed. Could more be done through rulemaking, guidance development, or changes to existing operating licenses?

Desired Outcomes: Make changes to the regulatory environment to minimize the potential for legacy sites to occur in the future.

3. EVALUATIONS

3.1 Factors That Could Cause Future Legacy Sites

The information about the existing SDMP sites, especially those proposing restricted release under 10 CFR 20.1403, was reviewed in detail. Two specific factors were condensed from the information about these sites: they had chronic releases of radioactive material to the subsurface environment, NRC did not recognize the extent of this contamination until near cessation of operations.

3.1.1 Chronic releases

Facilities that process large quantities of material, especially in liquid form, have the potential for significant environmental contamination. These facilities are more closely related to chemical processing plants than typical nuclear facilities, such as nuclear power plants (NPPs). As such, the processes tend to be operated to minimize costs and maximize product and profit. This philosophy allows for “wasting” spillage within existing requirements, rather than expending time and money to clean it up; it also engenders limited controls of processes. Staff experience has shown that these operating conditions lead to large amounts of chemical and long-lived radioactive contamination being released to the subsurface environment over an extended

period of time. The acute doses from these releases are below the limits in 10 CFR Part 20 that would initiate regulatory action.

Another common factor is that the cost to dispose of radioactive material, even that with relatively low concentrations, can be very high; contributing elements include packaging, transportation to the few licensed sites, and surcharges on the disposal itself. The cost of disposal may affect their business practices. For example, they may rely more on storing waste, perhaps in settling ponds, rather than in shipping waste to minimize on-site storage. In addition to historic trend of increasing disposal costs, this could increase the opportunity for environmental contamination from pond releases. Such releases could result in substantially higher cost to remediate -- possibly exceeding available financial resources -- at the time of license termination.

3.1.2 Late identification of conditions

Past regulatory oversight of processors of licensed material where there was no potential for nuclear criticality has historically been limited. It focused on such facilities only after repeated problems -- primarily worker exposure -- were identified by summary oversight. This has allowed less serious, but, in some cases, chronic operational weaknesses to go unremarked. The result has been low-level, but long-term, releases of radioactive material to the subsurface environment. Because the radioactive materials combine with subsurface soil or ground water, these releases do not cause immediate exposure to either workers or the public that approach the limits specified in 10 CFR Part 20. It is only when the possible results of unlimited access to the site, and associated exposure pathways -- ingestion, inhalation, etc. -- are being evaluated that the extent of contamination becomes of interest. Often, NRC first becomes cognizant of the extent of the contamination as part of the review of the decommissioning plan, that includes a description of site conditions(site characterization).

3.2 Regulatory Tools and Their Effectiveness

3.2.1 Existing regulations

There are several existing regulations that provide the staff with the capability to become aware of subsurface contamination. These regulations, however, do not specifically address this issue, and need interpretation from the current focus on acute exposure to apply to long term environmental conditions. Examples of these are given below.

Code of Federal Regulations: 10 CFR Part 19 specifies notices and inspections, but is focused primarily on events related to short-term worker exposures.

10 CFR Part 20 provides requirements for protection of the public and workers from excessive exposure to radiation. The emphasis is on preventing and mitigating events that could result in imminent exposures, not projected long-term exposures. The philosophy of including exposures from unremediated sites and to include future, long-term conditions may require rulemaking. For example, 10 CFR 20.1406 specifies that **new** licensees should design and operate facilities to minimize contamination and radioactive waste. This requirement does not apply to existing licenses. Part 20 also supports a vigorous enforcement program, but current focus is, as above, on events resulting in actual or potential immediate exposures.

10 CFR Part 21 is focused on component failures, rather than the effects. The “substantial safety hazard” specified in Section 21.21 is generally interpreted to mean events resulting in short-term worker exposure, rather than long-term environmental hazards, such as ground water contamination.

10 CFR 40.32 specifies that for certain facilities or “... any other activity that the Commission determines will significantly affect the quality of the environment ...” the staff shall include the environmental benefits and costs in its evaluation, and issue a license “... with appropriate conditions to protect environmental values.” Environmental reviews that include potential future subsurface and ground water contamination are not currently explicitly required.

10 CFR 40.36 and 40.42 (and equivalent Sections in 10 CFR Parts 30, 70, and 72) specify that upon application, licensees must have a decommissioning funding plan based on current estimates of total decommissioning costs, and financial assurance to support it. Section 40.42 also specifies that part of the decommissioning plan must be an accurate statement of the radiological condition of the site. This, however, only occurs at the end of licensed operations. There are no requirements for licensees to **periodically** report the radiological condition of the site, especially any subsurface contamination, in conjunction with updating costs estimates for decommissioning funding and financial assurance.

3.2.2 Existing guidance

Guidance related to environmental analyses states that effects of subsurface contamination should be included, but there are no specifics on what and when to collect the data. Further, such contamination is generally considered at the time of license termination, when the impacts have already occurred.

There are numerous manual chapters (MCs) and inspection procedures in the Inspection Manual that address short-term conditions. While not specifically focused on long-term environmental issues, these could be readily extended to apply. For example, Inspection Procedure IP 42700, that specifies review of plant procedures, could be used to review plant response to periodic spills, excessive effluent releases, etc. IP 62709 is based on the NPP Maintenance Rule for identifying performance- and risk-based indicators; it could also be used for materials sites, or plant-specific indicators developed within the existing framework. IP 71846 specifically identifies clean up of spills as an inspection item; and IP 84750 addresses how an NPP licensee effectively controls, monitors, and quantifies releases of radioactive materials in liquid, gaseous, and particulate forms to the environment. In combination, these could address potential subsurface contamination issues at any site.

4. Evaluation of Options to Change Regulatory Tools

4.1 Option 1: Require Existing Licensees to Minimize Contamination

In this option, all licensees would be required to design and operate facilities to minimize contamination. This could be achieved by:

4.1.1 Revising 10 CFR 20.1406 by removing the “other than renewals” exemption

Pro: This puts all licensees on same basis.
This “front loads” the costs, rather than waiting to end-of-life when limited revenue controls resources.

Con: This could require substantial physical changes for existing plants.
This requires rule making.

4.1.2 Inserting license conditions at next renewal, using the authority of 10 CFR 40.32(e) and 40.41(e), and equivalent Sections in 10 CFR Parts 30, 70, and 72.

Pro: This puts all licensees on same basis.
“This “front loads” the costs, rather than waiting to end-of-life when limited revenue controls resources.
This does not require rule making.

Con: This could require substantial changes and costs for existing plants.
This would be a change from past practice.

4.2 Option 2: Increased Environmental Monitoring, Reporting and Remediation

Licensees with higher risk for potential subsurface contamination should establish an effective monitoring and reporting program that includes characterization of the subsurface - - geology, hydrology, etc. -- prior to operations, and routinely perform subsurface monitoring to identify the existence of contamination from operations. Some events would require prompt remediation; others could employ additional financial assurance. Risk of contamination would need to be defined, but includes facilities with large volumes of long-lived radionuclides, large throughput and liquid process. This could be achieved by:

4.2.1 Revising 10 CFR 40.31 - 40.32, and equivalent Sections in 10 CFR Parts 30, 70, and 72, to add specific monitoring and reporting requirements; or revise §40.36, etc., to add specific routine licensee reports regarding the condition of the site, including subsurface.

Pro: This focuses resources on early detection of potential problems by monitoring.
This provides clear regulatory basis for routine monitoring and reporting.
This provides a clear regulatory link between the physical condition of the site and the amount of financial assurance.

Con: This adds to the costs of licensing and operations.
This requires additional NRC resources to review.
This requires rule making.

4.2.2 Revising 10 CFR 40.31 - 40.32, and 40.36, and equivalent Sections in 10 CFR Parts 30, 70, and 72, to add specific requirements to either remediate subsurface contamination promptly or increase financial assurance for the full cost of later remediation.

Pro: This encourages clean operations by imposing a short term cost to remediation.
This reduces the amount of contamination remaining at end of life.
This provides adequate financial assurance for future remediation.

Con: This requires staff judgement to determine which events require prompt remediation.
This adds to the cost of interim remediation or financial assurance.
This requires rule making.

4.2.3 Adding specific inspection items to MC 2616 to review subsurface contamination data; or extending Manual Chapter and Inspection Procedures from reactors related to risk-based evaluations to materials sites.

Pro: This focuses resources on potential long-term, environmental problems.
This uses existing guidance to the extent practicable.
This does not require rule making.

Con: This requires additional inspection resources.
This requires additional inspector qualifications in geology, hydrology, etc.
This requires a change of inspection guidance.
This may require substantial staff effort to develop risk-based indicators.

Current regulations and policy allow for these, but do not compel them. For example, Part 20 specifies environmental monitoring; and several MCs/IPs for reactors that focus on performance indicators, risk-based evaluation, etc., could be applied directly to materials sites to achieve this. However, current practice is to focus on potential/events resulting in immediate exposures.

The addition of appropriate license conditions and additional focus during inspections could identify potential problems early. This may need additional inspection resources or a formal risk-based allocation of existing resources that includes long-term conditions.

4.3 Option 3: Revise guidance to better focus enforcement on environmental contamination (non-compliances).

Current guidance and practice do not emphasize enforcement for materials sites which do not have a possibility of nuclear criticality or significant exposure hazard. Guidance which explicitly acknowledges the potential for enforcement sanctions for non-compliances associated with long-term events that result in environmental contamination would encourage licensees to prevent such contamination. In addition, such guidance would help to focus enforcement actions to ensure appropriate licensee corrective action to mitigate the resulting contamination and prevent and/or minimize additional contamination events. This would result in added emphasis on, for example, 10 CFR Section 20.1501 (Surveys and Monitoring), Section 20.2103 (Records of Surveys), Section 20.2203 (Reports of ... radioactive material exceeding constraints or limits), Section 40.36 (record keeping for decommissioning), etc.

Pro: Focuses licensee attention on environmental issues
Assists in identifying problem facilities
Early identification of potential problems, and trenchant emphasis on timely remediation

Con: Change from NRC emphasis on short term exposures

5. RECOMMENDATIONS

The recommendations for regulatory changes are discussed below; further evaluation of cost/benefit during the rulemaking process will be needed to determine the most appropriate specific revisions that should be made.

Chronic Releases

8.1. Revise requirement (10 CFR 20.1406) to remove the “other than renewals” statement, so that both current licensees and new applicants are required to design and operate facilities to minimize contamination. For existing licensees, the emphasis should be on procedural changes. Physical changes to the facility should be made only when procedures fail to reduce releases. There should be a cost-risk-benefit analysis evaluating effects of potential contamination. For example, contamination that impacts groundwater could migrate through large volumes of the subsurface, and potentially beyond the site boundary. This would result in a large cost to remediate, that could be avoided by an investment in prevention. Implement in a rulemaking, revised guidance, and a RIS.

8.2. Increase emphasis on the potential for enforcement sanctions for non-compliances with the requirements related to surveys and monitoring, records of operational and environmental releases, reporting, etc. (i.e., 10 CFR Sections 20.1500, 20.2100, 20.2200, and 40.36). Take enforcement actions, as appropriate, to better focus licensee response to environmental contamination problems resulting from such non-compliances. Implement in revised enforcement guidance and a RIS.

Reporting Deficiencies

8.3. Develop a risk-informed approach that includes requiring definition of sites with “high risk” of subsurface contamination as those with large volumes of long-lived radionuclides, large throughput, or liquid processes. Implement in a rulemaking, revised guidance, and a RIS.

8.4. Implement the risk-informed approach (Recommendation 8.3) to require specific monitoring and reporting programs including subsurface characterization, monitoring, and reporting under two conditions:

- 1) For sites with “high risk”, at license application or renewal, a minimum plan to define and monitor the subsurface (e.g., three to five wells to identify geologic and hydrologic characteristics of the site), and an annual report of the concentrations of contaminants of concern;
- 2) For all sites, on experiencing events(s) that contaminate the subsurface, an expanded monitoring and reporting program that adds wells to fully characterize the extent and migration of resultant plume(s), and more frequent monitoring and reporting, approximately quarterly. This would be done in conjunction with financial assurance requirements. Implement in a rulemaking, revised guidance, and RIS.

8.5. Implement the risk-informed approach (Recommendation 8.3) to increase NRC's inspection focus on sites with "high risk" of environmental contamination concerns by:

- 1) Increasing inspector qualifications in hydrology, geology, etc.;
- 2) Increasing inspections and inspector evaluations of record keeping requirements [i.e., 10 CFR 20.1501 (Surveys and Monitoring); 10 CFR 20.2103 (Records of Surveys); 10 CFR 20.2203 (Reports of radioactive material exceeding constraints or limits);
- 3) Increasing inspections and inspector evaluations of record keeping requirements of 10 CFR 40.36 and others to identify potential problems early; and
- 4) Modifying Manual Chapter 2600, to include performance- and risk-informed evaluations, using those in Manual Chapter 2500 as examples.

Implement in revised inspection procedures and a RIS.