

# U.S. NUCLEAR REGULATORY COMMISSION SITE DECOMMISSIONING MANAGEMENT PLAN

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## ABSTRACT

The Nuclear Regulatory Commission has identified over 40 nuclear material sites that warrant special attention by the NRC. While none of these sites represent an immediate threat to public health and safety, they have contamination that exceeds NRC limits for unrestricted release. These sites have buildings, former waste disposal areas, large piles of tailings, groundwater, and soil contaminated with low levels of uranium or thorium or other radionuclides. Consequently, they present varying degrees of radiological hazard, cleanup complexity, and cost.

NRC believes that the best approach for minimizing the potential for unnecessary radiation exposures and environmental contamination in the future is to ensure that these sites are cleaned up in a timely and effective manner. In 1990, the NRC implemented the Site Decommissioning Management Plan (SDMP) to identify and resolve issues associated with the timely cleanup of these sites. The SDMP provides a comprehensive strategy for NRC and licensee activities dealing with the cleanup and closure of contaminated nuclear facilities over which NRC has jurisdiction. The SDMP does not include the more routine decommissioning cases such as nuclear power reactors or other contaminated facilities that will be cleaned up as a normal part of operations. This paper will describe the following aspects of the SDMP:

- criteria for listing a site in the SDMP,
- contamination at SDMP sites,
- major policy issues affecting the timely decommissioning of SDMP sites and future contaminated sites, and
- SDMP site decommissioning status.

## INTRODUCTION

Each year the U.S. Nuclear Regulatory Commission must evaluate requests, mainly from materials licensees, to discontinue licensed operations. The majority of those requests are routine and relatively straight forward and are acted on in a timely manner such that the sites are remediated, if necessary, and released for unrestricted use. However, in papers presented to the Commissioners of the NRC (Commission) in October 1988 (1) and December 1989 (2), the NRC staff (staff) listed over 30 materials licensee sites (the list has since grown to 46) involving unique and difficult decommissioning issues requiring special attention from the staff to ensure their timely decommissioning. While none of these sites represent an immediate threat to public health and safety, they have contamination that exceeds NRC limits for unrestricted release. All of these sites require some degree of remediation, and several involve regulatory issues that must be addressed by the Commission before they can be released for unrestricted use and the applicable licenses terminated.

These problematic sites have buildings, former waste disposal areas, large piles of slag, ground water, and soil contaminated with low levels of uranium, thorium, or other radionuclides. Consequently, they present varying degrees of radiological hazard, remediation complexity, and cost. Some of the sites are still under the control of active NRC licenses, whereas licenses for other sites may have already been terminated or may have never been issued. At some sites, licensees are financially and technically capable of completing remediation in a reasonable timeframe, whereas at other sites, the licensee or responsible party is unable or unwilling to perform the remediation. In addition, the sites are currently in various stages of decommissioning. At some sites, licensees have ini-

tiated decommissioning, whereas at other sites, decommissioning has not yet been planned or initiated.

In the past, NRC staff has addressed such contaminated sites, and decommissioning issues in general, on an ad-hoc, low-priority basis opting instead to allocate available resources to other matters having a more imminent health and safety concern. However, in a staff requirements memorandum (SRM), dated August 22, 1989, (3) the Commission directed the staff to develop a comprehensive strategy for NRC actions to ensure that issues affecting the decommissioning of contaminated sites are resolved in a timely manner. The original report of the staff's planned strategy for addressing these "non-routine" contaminated sites, entitled the Site Decommissioning Management Plan (SDMP), was submitted to the Commission in March 1990 (4). The staff committed to updating the SDMP on an annual basis. Accordingly, Revision 1 of the SDMP was issued in April 1991 (5) and Revision 2 in May 1992 (6). The objective of the SDMP is the timely decommissioning of the sites listed in the SDMP (and other contaminated problem sites identified in the future) and the subsequent removal of the sites from the list.

The responsibility for the development and management of the SDMP rests with NRC's Division of Low-Level Waste Management and Decommissioning, Office of Nuclear Material Safety and Safeguards. The SDMP describes NRC resource requirements and resource expenditure priorities. It includes a description of planned NRC actions to ensure the timely decommissioning of SDMP sites as well as a detailed description of these sites and the status of decommissioning efforts at the sites. This paper will summarize the major components of the SDMP, including regulatory issues identified as impediments to the timely decommissioning of SDMP

sites. Many of these issues have generic implications for overall NRC policy on decommissioning.

### CRITERIA FOR SDMP LISTING

Sites are listed in the SDMP if they require an increased level of NRC staff attention to resolve non-routine regulatory and technical issues before they can be decommissioned and released for unrestricted use. A site is listed if it meets one or more of the following five criteria:

1. there are problems with viability of the responsible organization (e.g., inability to pay for, or unwillingness to perform decommissioning),
2. there are large amounts of contaminated soil or slag, or unused settling ponds or burial grounds, that may be difficult to dispose of,
3. there is long-term presence of contaminated, unused buildings, holding ponds, or storage areas,
4. the license was previously terminated, and residual contamination is present in excess of unrestricted release limits, and
5. there is contamination or potential contamination of the ground water from onsite wastes.

A site will be removed from the list if it meets one of the following four criteria:

1. the license has been terminated after acceptable cleanup,
2. for operating sites that have an inactive, contaminated portion of the site requiring cleanup (e.g., a contaminated, inactive settling pond or building or a large volume of contaminated soil), decontamination of the area has been completed, and the license has been modified to reflect the cleanup,
3. for unlicensed sites, acceptable cleanup has been completed and the responsible party has been notified, and
4. when regulatory jurisdiction over a site is completely assumed by an Agreement State.

Figure 1 gives a breakdown, by listing criteria, of the 46 contaminated sites listed in Revision 2 of the SDMP. For many of the sites, more than one of the criteria apply. However, only the primary criterion applied to each site is reflected in Fig. 1. Twenty two of the 46 sites were listed in the SDMP since large quantities of soil or slag, contaminated with uranium or thorium, exist at the sites. The presence of contaminated soil or slag is the listing criteria that applies to the greatest number of SDMP sites. The long-term presence of inactive, contaminated facilities resulted in the listing of 11 sites. Groundwater contamination, previously terminated licenses, and the viability of responsible organizations account for the SDMP listing of four, four and five sites, respectively.

### CONTAMINATION AT SDMP SITES

Each of the 46 SDMP sites is described in detail in Appendix A to the SDMP. The descriptions include site identification, site description and previous operations, radioactive wastes present, description of the radiological hazard, financial assurance and responsible organization, status of decommissioning activities, and a schedule of NRC and licensee activities related to the decommissioning of the site. For detailed descriptions of individual sites refer to the SDMP.

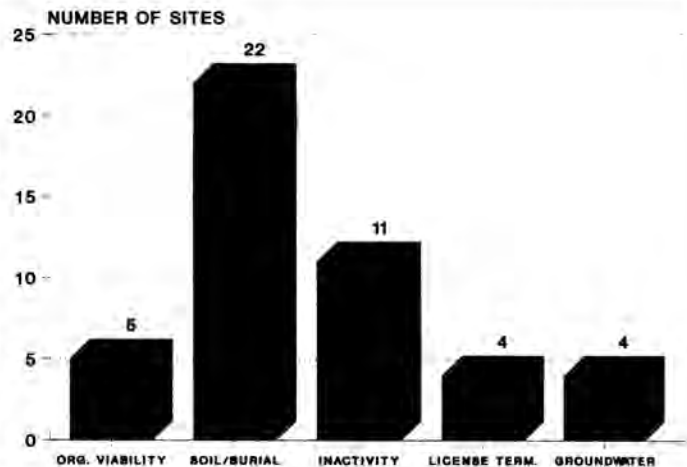
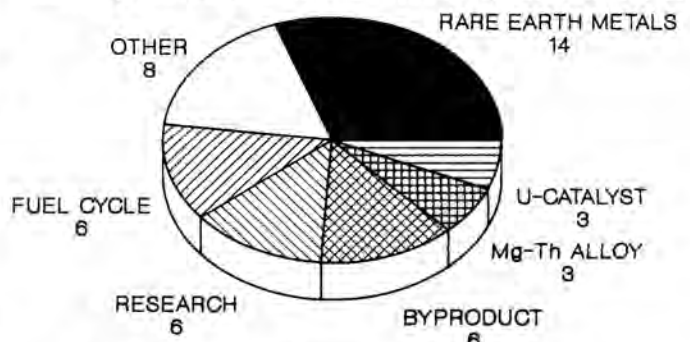


Fig. 1. SDMP sites by listing criteria.

An overview of the source and types of contamination present at the 46 sites is presented below.

The contamination at the SDMP sites resulted from a variety of NRC licensed and unlicensed operations. Figure 2 places each of the 46 sites into one of seven general categories of operations. Fourteen of the 46 SDMP sites were the locations of operations that processed ore, or other feed material, to produce rare earth or other metals. The feed material for these operations contained significant quantities of uranium and thorium, which were entrained in the resulting waste stream, e.g., slag. Facilities which conducted nuclear fuels research, or other research involving radioactive material, were located at six of the SDMP sites. Three of the sites manufactured or used a uranium based catalyst in the production of acrylonitrile, a basic component in the manufacture of plastics. The contamination at the remaining sites resulted from an assortment of operations including the manufacturing or use of sources containing byproduct material, production of Mg-Th alloys, processing of enriched uranium for use in the fuel cycle, production and testing of depleted uranium weapons, extrusion of uranium metal for the Department of Energy, production of optical glass containing thorium, and the disposal of contaminated waste.

The material of primary concern to NRC is soil and slag (soil/slag) contaminated with thorium and uranium. As seen in Fig. 3, a large number of SDMP sites contain contaminated soil/slag and many of the sites contain both thorium and uranium contamination. The thorium and uranium exist in relatively low concentrations. However, the volumes of



### Number of Sites Per Category

Fig. 2. SDMP site facility operations.

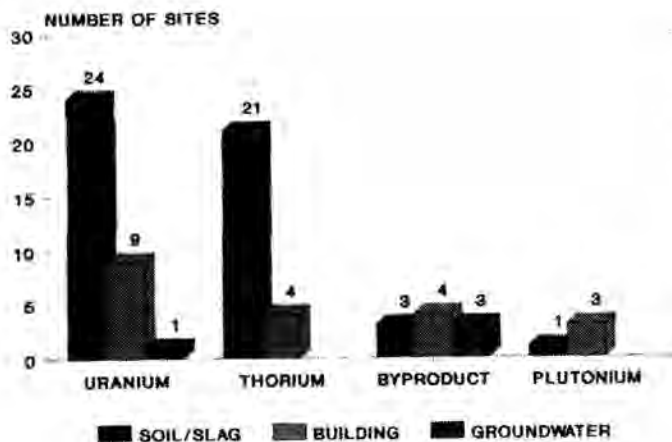


Fig. 3. Contamination at SDMP sites.

contaminated material are large. The soil/slag volumes at the sites range from less than 1000 ft<sup>3</sup> to greater than 10,000,000 ft<sup>3</sup>. The highest waste volumes are at the sites where ore processing operations were conducted. The volume of slag at these sites averages over 1,000,000 ft<sup>3</sup> per site. The very large waste volumes, and the fact that the major contaminant in the slag is thorium limits the remediation alternatives for these sites. Large volumes obviously lead to limitations due to large remediation and disposal costs. Thorium contamination affects remediation alternatives, as compared to uranium, since the direct radiation from thorium, i.e., Th-232 in equilibrium with its daughters, results in relatively high direct gamma exposure rates per pCi/g of material. When performing a dose assessment to evaluate a given remediation alternative, the high direct exposure rate drives the acceptable concentration of thorium down to relatively low levels in comparison to uranium.

Three sites contain soil contaminated with byproduct material and one site contains plutonium contaminated soil. The volumes of soils contaminated with plutonium and byproduct material are small. These contaminated soils do not pose a major regulatory problem and are not the primary reason for the sites being listed in the SDMP. Groundwater contamination has been identified at four sites. Byproduct material has been identified in groundwater at three sites and uranium at one. The general absence of uranium, thorium, and plutonium groundwater contamination at the SDMP sites is not unexpected since these isotopes are believed to be present in predominantly insoluble forms. The extent of the groundwater contamination which has been identified does not indicate a major health and safety problem. However, the presence of contaminated groundwater complicates the remediation process since more detailed hydrological analyses are required and remediation is more complicated. Also, at several of the sites where radiological groundwater contamination has been identified, non-radiological hazardous material is also present, necessitating a host of additional regulatory considerations.

Again referring to Fig. 3, several SDMP sites also hold buildings that are contaminated with uranium and thorium. In addition, a small number of sites contain buildings contaminated with byproduct material and plutonium. The regulatory, technical, and long term health and safety concerns for contaminated buildings are not as great as for the contaminated

soil/slag discussed above. The remediation technology for buildings is relatively simple and inexpensive. Also, considering the NRC position on decommissioning finality stated in the SDMP, licensees should be more confident that building decommissioning actions will be final and not require additional investigation in the future in response to ongoing EPA and NRC rulemakings on radiological criteria for decommissioning. The NRC rulemaking on radiological criteria for decommissioning and the NRC position on finality of decommissioning actions will be discussed in more detail below, along with other issues affecting the timely decommissioning of SDMP sites.

#### MAJOR POLICY ISSUES AFFECTING TIMELY SDMP SITE CLEANUP

As NRC focused on the remediation of the SDMP sites, several issues emerged as impediments to the timely cleanup of these sites. A primary objective of the SDMP is to identify these issues and ensure that the appropriate level of NRC staff resources are devoted to their resolution in order for the decommissioning of the SDMP sites to proceed in a timely manner. Several of these policy issues have generic implications for NRC's overall decommissioning program, or involve other matters, that must ultimately be decided by the Commission. Resolution of the policy issues discussed below will provide a regulatory framework for more efficient and consistent licensing actions for site remediation and decommissioning in the future.

#### Radiological Criteria for Decommissioning

NRC criteria specifically pertaining to decommissioning and termination of licenses are contained in 10 CFR Parts 30, 40, 50, 70, and 72 and in NRC guidance documents and staff guidelines. However, these documents do not contain generally applicable and definitive radiological criteria for decommissioning. Licensed facilities are currently remediated in accordance with staff guidance written in the 1970's and 1980's. The numerical guidance has not been updated and does not cover all situations. Without residual contamination criteria addressing all situations, and in the absence of a rule establishing criteria, the staff has had to review the remediation alternatives proposed for some SDMP sites on a case-by-case basis using existing guidance and the as low as reasonably achievable (ALARA) principle.

The process of a licensee developing proposed remediation alternatives based on existing guidance on acceptable residual contamination criteria, that in many cases does not directly apply to the circumstances of the particular site, and the staff's review of the proposed remediation alternatives has proven to be time consuming and inefficient. Therefore, in a paper submitted to the Commission on February 7, 1992, (7) the staff proposed to initiate a rulemaking on radiological criteria for decommissioning which includes "enhanced participation" by affected parties. The Commission approved the staff's plan on April 15, 1992.

The enhanced participatory rulemaking process entails a series of workshops, to be conducted by NRC staff, to solicit the advice and recommendations of affected interests on the fundamental approaches and issues that must be addressed to establish radiological criteria for decommissioning. The spectrum of affected interests invited to participate in the workshops include State, local, and tribal government; Federal agencies; citizen groups; various segments of the nuclear

industry; and professional societies. The workshops are scheduled to be held at the times and locations listed below:

- January 27 and 28, 1993, Chicago, Illinois
- February 23 and 24, 1993, San Francisco, California
- March 12 and 13, 1993, Boston, Massachusetts
- March 23 and 24, 1993, Dallas, Texas
- April 13 and 14, 1993, Philadelphia, Pennsylvania
- April 29 and 30, 1993, Atlanta, Georgia
- May 6 and 7, 1993, Washington, D.C.

The proposed rule on radiological criteria for decommissioning is scheduled to be issued for public comment in May, 1994, and issued in final form in May 1995.

Pending the issuance of the final rule on radiological criteria for decommissioning, the Commission directed the NRC staff, in an April 6, 1992 SRM (8) (SDMP Action Plan), to "continue to consider existing guidance, criteria, and practices such as those listed below in determining whether sites have been sufficiently decontaminated so that they may be released for unrestricted use, pursuant to, or consistent with, the decommissioning rules in 10 CFR 30.36, 40.42, 50.82, 70.38, and 72.54. These cleanup criteria will be applied on a site-specific basis with emphasis on residual contamination levels that are ALARA.

1. Options 1 and 2 of the Branch Technical Position "Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations" (46 FR 52061, October 23, 1981).
2. "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Termination of Licenses for Byproduct, Source, or Special Nuclear Material," Policy and Guidance Directive FC 83-23, Division of Industrial and Medical Nuclear Safety, August 1987.
3. "Termination of Operating Licenses for Nuclear Reactors," Regulatory Guide 1.86, June 1974, Table 1, for surface contamination of reactor facility structures. Also, Cobalt-60, Cesium-137, and Europium-152 that may exist in concrete, components, and structures should be removed such that the indoor exposure rate is less than 5 microrentgen per hour above natural background at 1 meter, with an overall dose objective of 10 millirem per year (cf. Letter to Stanford University from James R. Miller, Chief, Standardization and Special Projects Branch, Division of Licensing, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, April 21, 1982, Docket No. 50-141).
4. The Environmental Protection Agency's (EPA's) "National Primary Drinking Water Standards," 40 CFR Part 141. In accordance with FC 83-23, the maximum contaminant levels or radionuclides in public drinking water as established by the EPA should be used as reference guidelines for protection of groundwater and surface water resources.
5. The EPA's "Radiation Dose Guidelines for Protection Against Transuranium Elements Present in the Environment as a Result of Unplanned Contamination" (42 FR 60656; November 30, 1977). This document provides guidelines for acceptable levels of transuranium elements in soil.

The criteria of this section will be considered in establishing site-specific ALARA levels for each of the SDMP sites in license amendments and orders."

#### Finality

The finality of decommissioning has emerged as an important issue affecting the timely decommissioning of SDMP sites. SDMP site Licensees, or responsible parties, are uncertain as to whether or not in years after a site is remediated in accordance with current applicable criteria and the license is terminated, NRC or another regulatory agency (e.g., Environmental Protection Agency (EPA)) could require further remediation as a result of more stringent future cleanup standards. The potential lack of finality associated with cleanup actions today, in the absence of EPA and NRC radiological criteria for decommissioning, is seen by some licensees or responsible parties as a disincentive to undertake remediation activities.

In the SDMP Action Plan, the Commission laid out the following policy towards finality:

"NRC decisions to terminate a license will relieve the licensee from any further obligation to NRC to conduct additional cleanup, as long as the licensee decommissioned the site in full accordance with an approved decommissioning plan. The licensee will demonstrate compliance with the cleanup levels described in the decommissioning plan by a radiologic survey of the site prior to license termination. The NRC usually conducts an independent survey to confirm the accuracy of the licensee's termination survey. Therefore, if a licensee or responsible party cleaned up a site, or was in the process of cleaning up a site, under an NRC-approved decommissioning plan, the NRC will not require the licensee to conduct additional cleanup in response to NRC criteria or standards established after NRC approval of the plan. An exception to this case would be in the event that additional contamination, or noncompliance with the plan, is found indicating a significant threat to public health and safety. Noncompliance would occur when a licensee or responsible party does not comply with an approved decommissioning plan, or provides false information. NRC will inform EPA about specific decommissioning actions at sites. NRC will also inform State and local agencies that have jurisdiction over aspects concerning decommissioning actions."

In addition, NRC staff intends to cooperate with EPA in current and anticipated future rulemaking to establish generally acceptable environmental standards for residual contamination, and to encourage EPA to find NRC's decommissioning program to be acceptable. The March 1992 General Memorandum of Understanding between NRC and EPA should provide the framework for the agencies to communicate regarding these issues.

#### Decommissioning Timeliness Criteria

Existing regulations require that sites be remediated to a level that permits returning the site to unrestricted use. However, there is no time limit in the regulations for accomplishing this. If decommissioning is delayed for long periods following cessation of operations, there is a risk that safety

practices at the inactive facility may become lax as key personnel relocate and management interest wanes. In addition, bankruptcy, corporate takeover, or other unforeseen changes in the company's financial status may complicate and perhaps further delay decommissioning.

The existence of several SDMP sites that ceased operations with radioactive material over 20 years ago and still remain to be decommissioned can be attributed to the absence of a definitive decommissioning timeliness criteria. The absence of a definitive timeliness criteria has also fostered delays in the decommissioning of these sites after their identification and inclusion in the SDMP. To correct this deficiency NRC developed and published a proposed timeliness rule on January 13, 1993 (9). The comment period on the proposed rule expires March 29, 1993.

The proposed decommissioning timeliness rule would establish specific requirements for: 1) timely decommissioning of the entire site at the end of licensed activity at the site, thereby allowing license termination and release of the site for unrestricted use; and 2) timely decommissioning of separate buildings and outdoor areas where licensed activities have ceased while licensed activities continue to be conducted at other site locations. The time requirements for completing decommissioning consist of time periods both for initiating the decommissioning process and for subsequently completing decommissioning activities.

The proposed rule requires that the Commission be notified within 60 days of a license expiring or a licensee deciding to cease principle activities at the entire site or in any separate building or outdoor area that contains residual radioactivity such that the building or outdoor area is unsuitable for unrestricted use. Also, notification is required within 60 days if no principle activities have been conducted under the license for 24 months at the entire site or in any separate building or outdoor area on the site. If a decommissioning plan is not required by NRC regulations, the decommissioning must be completed within 18 months of notifying the Commission. If a decommissioning plan is required, the plan must be submitted to the Commission within 12 months of notification and the decommissioning must be completed within 18 months of NRC approval of the plan. The proposed rule allows for delays in the decommissioning deadlines if the delay is not detrimental to the public health and safety and is otherwise in the public interest.

Pending publication of a final rule on decommissioning timeliness, NRC staff was directed by the Commission in the SDMP Action Plan to address the timing of site remediations on a case-by-case basis, with the expectation that cleanup will generally be completed within about four years after operations that caused the contamination cease, or 3 years after issuance of an initial cleanup order. NRC will establish specific and enforceable milestones for each phase of decommissioning, e.g., site characterization plan, site characterization report, decommissioning plan, and termination survey report, through license amendments and orders.

#### **Site Characterization**

Inadequate site characterizations have been the cause of delays in remediation at several SDMP sites. This delay is most often manifested in iterative reviews by NRC staff of licensee site characterization plans and reports, and decommissioning plans. To help ensure that site characterization plans and reports contain the information needed to

properly plan and implement site decommissioning activities, NRC is developing new guidance, to be issued as a Branch Technical Position (BTP) on the content of acceptable site characterization programs. A draft BTP, "Guidance on Site Characterization for Decommissioning Sites," is currently being circulated within NRC for comment. The BTP is scheduled to be issued for public comment in March 1993. However, the draft guidance is available to the public now upon request.

#### **SDMP SITE DECOMMISSIONING STATUS**

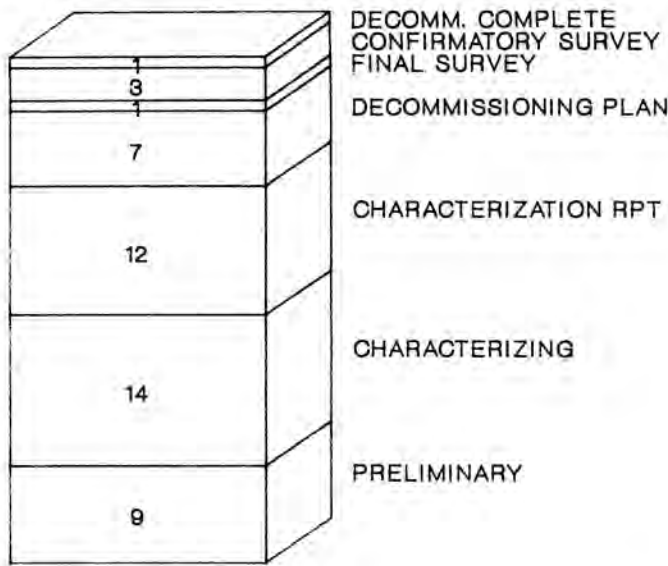
After the original version of the SDMP was issued, proposals for the characterization and decommissioning of several of the SDMP sites were submitted to NRC. Nearly every characterization plan and report, and decommissioning plan presented a unique issue requiring significant effort by the licensee or responsible party to address and by the NRC staff to review, causing progress towards decommissioning to be slow. During these reviews, the major policy issues discussed above, as well as several other issues that are discussed in the SDMP, were identified. In the three year period since the original SDMP publication, significant progress has been made towards resolving these issues and developing NRC positions and guidance for licensees or responsible parties to use when preparing their submittals, and for NRC to use during the review of the submittals. Consequently, progress towards decommissioning of the SDMP sites has improved and NRC expects continued improvement in the future.

The process of decommissioning a site under NRC jurisdiction generally consists of six milestones: 1) site characterization, 2) site characterization report approved by NRC, 3) decommissioning plan approved by NRC, 4) site remediation, 5) licensee's final termination survey, and 6) NRC confirmatory survey. The current decommissioning status of the SDMP sites is summarized in Fig. 4 according to the number of sites that have completed a given milestone. The "preliminary" milestone indicates that very little characterization has been performed. The "characterizing" milestone represents ongoing site characterization. For the remaining milestones shown on Fig. 4, the number of sites listed reflects the number that have completed the particular milestone and are currently working towards completion of the next milestone. For example, seven sites have submitted, and have received NRC approval of, their decommissioning plans and are currently remediating the site in accordance with the plan.

To date, one site has completed decommissioning. Four sites have completed final or confirmatory surveys, and should be removed from the SDMP in the next year. The majority of the SDMP sites are currently performing site characterizations or developing site decommissioning plans.

#### **REFERENCES**

1. NRC staff paper to the Commission, "Contaminated Material Licensee Facilities," October 31, 1988, (SECY-88-308)
2. NRC staff paper to the Commission, "Strategy For Decommissioning of Material Licensee Sites," December 8, 1989, (SECY-89-369)
3. Memorandum from Samuel J. Chilk, Secretary, U.S. Nuclear Regulatory Commission, to James M. Taylor and William C. Parler, "SECY-89-224 - Determining Need for Discussions with EPA on Use of Superfund," August 29, 1989



Completed Milestones (# of sites)

Fig. 4. SDMP site decommissioning status.

4. NRC staff paper to the Commission, "Site Decontamination Management Program," March 29, 1990, (SECY-90-121)
5. NRC staff paper to the Commission, "Updated Report on the Site Decommissioning Management Plan," April 12, 1991, (SECY-91-096)
6. NRC staff paper to the Commission, "Updated Report on the Site Decommissioning Management Plan," (SECY-92-200)
7. NRC staff paper to the Commission, "Enhanced Participatory Rulemaking Process," February 7, 1991, (SECY-92-045)
8. Memorandum from Samuel J. Chilk, Secretary, U.S. Nuclear Regulatory Commission, to James M. Taylor, "SECY-92-106 - Action Plan To Ensure Timely Remediation of Sites Listed in the Site Decommissioning Management Plan," April 6, 1992
9. U.S. Nuclear Regulatory Commission, Proposed Rule on Timeliness in Decommissioning of Materials Facilities, Federal Register, v. 58, 4099-4110, January 13, 1993