conf-790209--3

MASTER

# WASTE MANAGEMENT PRACTICES IN DECOMMISSIONING NUCLEAR FACILITIES

H. W. Dickson

# WASTE MANAGEMENT PRACTICES IN DECOMMISSIONING NUCLEAR FACILITIES*

H. W. Dickson
Health and Safety Research Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37830

## ABSTRACT

Several thousand sites exist in the United States where nuclear activities have been conducted over the past 30 to 40 years. Questions regarding potential public health hazards due to residual radioactivity and radiation fields at abandoned and inactive sites have prompted careful ongoing review of these sites by federal agencies including the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC). In some instances, these reviews are serving to point out poor low-level waste management practices of the past. Many of the sites in question lack adequate documentation on the radiological conditions at the time of release for unrestricted use or were released without appropriate restrictions. Recent investigations have identified residual contamination and radiation levels on some sites which exceed present-day standards and guidelines. The NRC, DOE, and Environmental Protection Agency are all involved in developing decontamination and decommissioning (D&D) procedures and guidelines which will assure that nuclear facilities are decommissioned in a manner that will be acceptable to the nuclear industry, various regulatory agencies, other stakeholders, and the general public.

## INTRODUCTION

Decontamination and decommissioning (D&D) of nuclear facilities is playing an increasingly greater role in demonstrating the credibility of

*Research sponsored by the Division of Operational and Environmental Compliance, U.S. Department of Energy under contract W-7405-eng-26 with Union Carbide Corporation.

the nuclear industry. Several thousand sites exist in the United States where nuclear activities have been conducted over the past 30 to 40 years. Many hundreds of these sites either have been abandoned or have become inactive. A few have been totally decommissioned and released for unrestricted use. Recently, questions regarding potential public health hazards due to residual radioactivity and radiation fields at the abandoned and inactive sites have prompted careful review of these sites by federal agencies including the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC).

The DOE is responsible for the radioactivity in facilities it owns or controls. Also, DOE has assumed the responsibility for abandoned or inactive sites which were under the control of its predecessors, the Manhattan Engineer District (MED), the Atomic Energy Commission (AEC), and the Energy Research and Development Administration (ERDA). Of immediate concern to DOE are 22 inactive uranium mill sites in the western part of the United States. In addition, DOE has the responsibility for reviewing more than one hundred excess MED and AEC sites that played a role in the early development of the atomic energy program.

Decommissioning criteria applied to NRC licensees prior to 1965 were not as stringent as present guidelines (Di78). Documentation of the final radiological status of the properties involved may be inadequate. As a consequence, NRC has initiated a systematic program to review all of its docket files of licenses terminated prior to 1965. In addition, formal radiological surveys are being conducted at a few selected sites with a known potential for residual contamination.

While individual states have not as yet undertaken extensive review programs, it is well-known that a few problem areas exist. For example, a former nuclear facility in Tennessee and another in New York (DOE78), both with significant levels of residual contamination, have become inactive and essentially abandoned. The site in Tennessee was partially decontaminated at federal expense by the Oak Ridge National Laboratory (ORNL), and at least a portion of the New York site may become a ward of the state for cleanup.

## OBSERVATIONS

Some nuclear sites have been decontaminated successfully and decommissioned. Former AEC reactors, including the Piqua, Elk River, and BONUS reactors, have been decommissioned. In one of the most ambitious decommissioning actions ever undertaken, the Elk River Reactor in Minnesota was completely dismantled and removed from the site. The NRC also has decommissioned a large number of formerly licensed sites with documentation verifying that the sites met the established decommissioning criteria (Di78). However, it has been pointed out that a number of sites have either been abandoned or allowed to become inactive without adequate documentation of radiological conditions at the time of release or without imposing appropriate restrictions. As a consequence, recent investigations (Ha77, Di77, Le78b, Pe78) have identified residual contamination and radiation levels on these sites which exceed applicable standards and guidelines (ANSI78, Di78).

Of the 22 inactive uranium mill sites, 16 are accessible to the general public, seven have had no significant stabilization against erosion, and 16 show evidence of off-site contamination (Go76). While some of

these locations are remote, at least four of the sites are within a 16-km radius of a population exceeding 10,000 persons (Go76). Many of these sites have existed without active surveillance for 10 to 15 years. From these observations, it is apparent that some early waste management practices were less than adequate by today's standards even though waste management was judged to be adequate at many of these sites under the then existing standards.

In the case of the excess MED/AEC sites, properties with significant levels of residual contamination and/or radiation levels have been identified in or near major metropolitan areas (Di77, Le78a, Le78b). While the total quantities of residual radioactive materials may be less than those quantities at inactive uranium mills, there are more people who potentially could be exposed. Most of these sites were contaminated in the 1940's and 1950's and have been inactive for 10, 20, or even 30 years.

The NRC also has discovered previously licensed sites that have been decommissioned without adequate verification of the radiological status (Pe78). It is difficult to assess the possible extent of this problem. The NRC estimates that as many as 8,000 source material and special nuclear material licenses have been terminated over the years prior to 1965. Again, because waste management practices in the past were not as thorough as present practices, many of these sites could not be decommissioned using present-day decommissioning criteria without substantial decontamination.

## FACTORS CONTRIBUTING TO RESIDUAL CONTAMINATION PROBLEMS

It should be pointed out that many of the current radiological problem sites had their beginning long before the days of the AEC and other regulatory authorities. For example, Lindsay and Company began operation

in West Chicago in 1931 (Fr78). Another example is the former Vitro Rare Metals Plant in Canonsburg, Pennsylvania, which was used as early as 1911 for the commercial extraction of radium from carnotite ore (Le78a). Consequently, at least a portion of the present problems can be blamed on a total lack of regulation. Although advisory groups had been formed as early as 1929, no regulatory authority existed until the Atomic Energy Act of 1946 when Congress established the AEC. The AEC and its successors had no regulatory authority over naturally occurring, non-source material (e.g., $^{226}Ra$) until Congress passed the Uranium Mill Tailings Radiation Control Act of 1978 (PL 95-604) which defines tailings as "byproduct material," thus, giving NRC authority over such materials.

Users or handlers of large quantities of radioactive materials (e.g., uranium mills) have tended to use large scale industrial processing techniques which have a few percent loss and/or spillage. As a consequence, the facility involved became generally contaminated with low-level radioactive waste. ~~Because~~ much of the feed material contained "natural" radioactivity which was considered rather innocuous~~, at the time, control measures tended to be rather lax.~~ Efforts to prevent the spread of materials which had been extracted recently from the earth received little attention. Even to this day, several uranium mill tailings piles have had no deliberate surface stabilization (Go76) to prevent erosion or security measures to prevent casual access by the public.

In some cases, the large user would contract for waste disposal via conventional industrial means. As a result, radioactive waste has been placed in muncipal or industrial landfills or other such accessible

locations. The examples of this are numerous and include Middlesex, New Jersey, and Burrell Township, Pennsylvania. These specific examples are covered in greater detail by Goldsmith (Go79).

In other cases, the large users possessed a property which was unused, and perhaps unusable, for other purposes which became the collecting place for nuclear waste. Although the site was not strictly considered a waste burial site, radioactive material accumulated there over the years awaiting ultimate disposal. Specific cases are represented by the Kerr McGee site (Fr78) (old Lindsay Light and Chemical Company) in West Chicago, Illinois, Canonsburg, Pennsylvania, (Le78a), and the Haist property (Le78b) in Tonawanda, New York, which was used by Union Carbide under a lease arrangement with property owners and MED.

Many licensees who used small quantities of radioactivity took advantage of the on-site burial provisions of 10 CFR 20. While this provides expedient removal of radioactive waste from sight, the problem of ultimate disposal was simply deferred to license termination. It is uncertain as to whether many sites can be decommissioned and released for unrestricted use when substantial quantities of radioactive materials are known to be buried on the site, even if the material is below licensable concentrations (e.g., ores containing by weight 0.05% or more of uranium).

The pressures of commercial competition and governmental regulation caused the termination of many nuclear activities. In the case of uranium mills, antiquated equipment and a low profit margin caused by a depression in the price of uranium were responsible for the premature closing of several mills. Some firms with marginal operations tended to short-cut on waste management procedures to maintain a favorable economic picture. Such

was the case with the American Nuclear Corporation in Oak Ridge, Tennessee. Government (AEC or state) inspections were too infrequent to detect items of noncompliance on a timely basis. As a result, a facility could experience significant degradation in general housekeeping in the period between inspections, which in some cases might be as long as several years.

In a few cases, sites have been virtually abandoned. One can speculate that the reasons for this abandonment range from ignorance of decommissioning requirements to the more likely case of financial insolvency. Since it has not been regulatory practice (NRC78) to require decommissioning funding arrangements (e.g., posting of bond) in advance of decommissioning for small users, the licensee frequently does not have the financial resources to cope with the cleanup and decontamination required to be able to obtain consent for unrestricted release.

There have been numerous cases where radioactive waste materials have been misused. The removal of tailings and their subsequent use as fill around homes, schools, and other buildings in Grand Junction, Colorado is one noteworthy case. In fact, many of the inactive uranium mill tailings sites are accessible to the general public (Go76). Consequently, the tailings materials easily could be misused at these sites. The misapplication of radioactive materials extends to other source material as confirmed by a review of NRC records (Cr78). Another example concerns the unauthorized removal of contaminated tools and equipment from the commercial burial site of the Nuclear Engineering Company at Beatty, Nevada.

Along similar lines, radioactive material has been transferred to clean sites without specific application, probably in ignorance of the radiological hazards involved. Examples of this include the spread of contamination from the Kerr McGee site in West Chicago to at least 75 other locations in in the Chicago area (Fr78) and the relocation of a major portion of the radioactive residues from the Haist property (Le78b) to the nearby Seaway Industrial Park in Tonawanda, New York (Le78c). Numerous small areas of radioactive contamination can also be found in residental areas of Canonsburg, Pennsylvania, presumably spread there from the early operations at the Vitro site (Le78a).

Another problem has been the lack of a comprehensive, internally consistent set of decommissioning criteria and numerical guidelines. Many contamination limit proposals have been adopted for use at specific sites, apparently with marginal scientific justification. The Grand Junction Remedial Action Criteria (CFR76) were written specifically to resolve the dilemma at Grand Junction but may have applicability to other sites contaminated with radium. The Environmental Protection Agency (EPA) is the federal agency responsible for providing federal guidance on radiation exposure related to the release of contaminated property. As an example, EPA is considering interim recommendations for radiation levels at new structures located on Florida phosphate lands (FR76). While these fragmentary guidelines are of value for specific applications, a master set of decommissioning criteria with general applicability does not exist. Surely it is not practical for the nuclear industry to develop a new and different set of criteria for each D&D action.

## CORRECTIVE ACTION

While waste management practices involved in the decommissioning of nuclear facilities in the past have resulted in unacceptably high levels of residual contamination at many sites, a number of steps have been taken recently to correct this situation. Several federal agencies are actively pursuing programs to correct past D&D deficiencies and to provide improved D&D processes in the future.

For many of the sites formerly utilized by MED and AEC, available records before the recent resurveys were not adequate to identify the radiological condition at the time government controls were relinquished (Cr78). Records for some formerly licensed sites are similarly lacking in pertinent radiological information (Cr78). Both DOE and NRC have programs to determine the adequacy of documentation and to make new surveys if warranted. The DOE program is known as the Formerly Utilized Sites–Remedial Action Program.

In addition to the review of terminated licenses which is being conducted by the NRC, the whole decommissioning policy of that agency is being reevaluated (NRC78). The NRC has sponsored considerable research to determine the technology, safety, and costs associated with decommissioning reactors (Sm78) and fuel reprocessing plants (Sc77). The DOE was instrumental in the passage of Public Law 95-604, Uranium Mill Tailings Radiation Control Act of 1978. This law provides the legal basis for remedial action at the inactive mill tailings sites and at the former Vitro Rare Metals Plant in Canonsburg, Pennsylvania. The EPA continues to work on the development of appropriate criteria and guidelines (FR77, FR78); however, a comprehensive set of decommissioning criteria is in an embryonic state.

Interest has been shown by a number of technical societies such as the American Nuclear Society and the Health Physics Society, especially with respect to their standards committees. Other interest groups such as the Atomic Industrial Forum (Ro78) and the American National Standards Institute (ANSI78) continue to make contributions in the D&D field.

While all of the problems related to waste management in D&D activities have not been solved, it is encouraging to see so much interest and effort. One concern is that all of this effort is not well coordinated. An inter-agency task force much like the one organized in Canada (AECB77) to provide D&D criteria might be the answer to a more efficient production of the much needed guidance in this country. For example, DOE could take a leading role in this activity since it is encumbent upon DOE to implement D&D at a large number of facilities including the excess MED/AEC sites, inactive uranium mill sites, and 300 to 400 excess contractor facilities. In all likelihood, Congress would have to act to set up the machinery for such a broad scope effort. Other participants in this undertaking should include, but not be limited to, NRC, EPA, and state regulatory agencies.

## SUMMARY

A number of factors have contributed to the marginal waste management practices observed in decommissioning of nuclear facilities. Some of the more pertinent factors include:

1. lack of regulation--particularly with respect to naturally occurring radioactivity;
2. poor control measures on large scale industrial processes;

3. radioactive waste disposal by conventional methods such as dumps, landfills, and on-site burial;
4. misapplication of waste products containing radioactive material;
5. short-cutting of waste management procedures to increase the profit margin;
6. abandonment of sites;
7. lack of continuing surveillance over inactive sites; and
8. lack of a comprehensive set of D&D criteria.

As a consequence, recent investigations have revealed residual contamination and radiation levels on some sites which exceed present-day standards and guidelines. Efforts by major federal agencies including DOE, NRC, and EPA are serving to correct these deficiencies. An interagency task force could be the most expedient approach to arrive at the D&D guidance which is urgently needed by the nuclear industry.

## REFERENCES

AEC877 Atomic Energy Control Board, 1977. "Criteria For Radioactive Clean-up in Canada," Information Bulletin 77-2.

ANSI78 American National Standards Institute, 1978, Control of Radioactive Surface Contamination on Materials, Equipment and Facilities to be Released for Uncontrolled Use, ANSI-N13.12.

Cr78 Crow W. T., 1978, "Problems at Inactive or Abandoned Fuel Cycle Facility Sites," Ninth Annual National Conference on Radiation Control, HEW Publication (FDA) 78-8054, p. 271.

CFR76 Code of Federal Regulations, 1976, Title 10, Part 712, Grand Junction Remedial Action Criteria.

Di77 Dickson H. W., Leggett R. W., Haywood F. F., Goldsmith W. A., Cottrell W. D., and Fox W. F., 1977, Radiological Survey of the Middlesex Sampling Plant, Middlesex, New Jersey, DOE/EV-0005/1.

Di78 Dickson H. W., 1978, Standards and Guidelines Pertinent to the Development of Decommissioning Criteria for Sites Contaminated with Radioactive Material, ORNL/OEPA-4.

DOE78 U.S. Department of Energy, 1978, Western New York Nuclear Service Center Study Final Report for Public Comment, TID 28905-1.

FR76 Federal Register, 1976, "Interim Recommendations for Radiation Levels at New Structures on Florida Phosphate Lands," Vol. 41, p. 26066.

FR77 Federal Register 1977, "Transuranic Elements," November 3, 1977.

FR78 Federal Register 1978, "Criteria for Radioactive Waste," Vol. 43, pp. 53262-8.

Fr78 Frigerio N. A., Larson T. J., and Stowe R. S., 1978, Thorium Residuals in West Chicago, Illinois, NUREG/CR-0413, ANL/ES-67.

Go76 Goldsmith W. A., 1976, "Radiological Aspects of Inactive Uranium Mill Sites: An Overview," Nucl. Saf. 17(6), 722.

Go79 Goldsmith W. A., Crawford D. J., Haywood F. F., and Leggett R. W., "Previous Management Practices for Naturally Occurring Radionuclides Wastes: Current Radiological Status," Proceedings of Low-Level Radioactive Waste Management Symposium of the Health Physics Society Williamsburg, VA, February 11-15, 1979.

Ha77 Haywood F. F., Goldsmith W. A., Perdue P. T., Fox W. F., and Shinpaugh W. H., 1977, Assessment of Radiological Impact of the Inactive Uranium Mill Tailings Pile at Salt Lake City, Utah, ORNL/TM-5251.

Le78a Leggett R. W., Haywood F. F., Barton C. J., Cottrell W. D., Perdue P. T., Ryan M. T., Burden J. E., Stone D. R., Hamilton R. E., Anderson D. L., Doane R. W., Ellis B. S., Fox W. F., Johnson W. M., and Shinpaugh W. H., 1978, Radiological Survey of the Former VITRO Rare Metals Plant, Canonsburg, Pennsylvania, DOE/EV-0005/3.

Le78b Leggett R. W., Cottrell W. D., Dickson H. W., Golden C. A., Fox W. F., and Anderson D. L., 1978, Radiological Survey of the Former Haist Property, DOE/EV-0005/4.

Le78c Leggett R. W., Cottrell W. D., and Dickson H. W., 1978, Radiological Survey of the Seaway Industrial Park, Tonawanda, New York, DOE/EV-0005/6.

NRC78 U.S. Nuclear Regulatory Commission, 1978, Plan for Reevaluation of NRC Policy on Decommissioning of Nuclear Facilities, NUREG-0436.