LA-UR -82-1279

Conf. 821005--2

LA-UR--82-1279

DE82 015812

TITLE: RADIOLOGICAL PLANNING AND IMPLEMENTATION FOR NUCLLAR-FACILITY DECOMMISSIONING

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FORM NO. 836 R4
ST. NO. 2629 5/81

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Invited Paper for:
1982 International Decommissioning symposium
October 10-14, 1982
Seattle, Washington
Sponsored by the DOE

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The need and scope of radiological planning required to support nuclear facility decommissioning are issues addressed in this paper. The role of radiation protection engineering and monitoring professionals during project implementation and closeout is also addressed. Most of the discussion will focus on worker protection considerations; however, project support, environmental protection and site release certification considerations are also covered. One objective is to identify radiological safety issues that must be addressed. The importance of the issues will vary depending on the type of facility being decommissioned; however, by giving appropriate attention to these issues difficult decommissioning projects can be accomplished in a safer manner with workers and the public receiving minimal radiation exposures.

The discussion will follow the normal sequence of decommissioning project events i.e. preoperational planning, project implementation and project closeout. The political and funding gyrorations associated with decommissioning projects will not be addressed eventhough they may have significant impact on radiological issues.

The extent of radiological planning is dictated by the complexity of the facility and to a lesser extent by the time that has elapsed since the facility was operational. Less planning effort will generally be required if decommissioning is accomplished immediately following shutdown. This is because a cadre of knowledgeable engineers, operators and health physicists will usually exist at these facilities whereas unknowledgeable people must be used at facilities that have been shutdown for long periods. However, for reactor facilities a long shutdown period may be required before decommissioning for exposure control purposes. This is just one example of many radiological related questions that may surface in the planning phase, i.e. Should we proceed with a knowledgeable crew shortly after shutdown or wait until the radiation levels are lower and use an inexperienced crew?

Examples of other radiological questions that may surface long before a decision is made to decommission a nuclear facility follow: Can we let the facility set for another year or ten years without exposing the public or making future decommissioning more difficult? What happens to the radiation levels? What kind of a radiological surveillance program and maintenance program will be required for standby status? Where can we dispose of the rad waste if we do decommission this thing? Is environmental monitoring required if we put it in standby status? How much of the facility will have to be decontaminated? What radiation levels can we leave in the facility? Sound answers to such questions must be provided by knowledgeable radiation protection professionals with a thorough understanding of radiological issues. Errors in predicting radiation levels, waste disposal alternatives, decontamination requirements and surveillance requirements can adversely affect the implementation of decommissioning projects and result in inadequate radiological surveillance programs while a facility awaits decommissioning.

Pre-operational Phase

Radiological planning prior to starting nuclear facility decommissioning work is of utmost importance assuming efficiency is desired during the operation. Preoperational major planning elements typically includes:

1) Facility Characterization;
2) Radiation source Identification and Characterization;
3) Special Radiological Measurement Requirements;
4) Release Criteria for Facility/Site;
5) Waste Release and/or Disposal;
6) Health Physics Staff and Equipment Needs;
7) Documentation Requirements;
8) Bid Specifications for Radiation Protection.

Facility characterization is extremely important since this is the basis used for radiological protection decisions and by engineering and construction personnel for deciding how to accomplish the decommissioning tasks. Some facilities will have detailed as-built drawings and documents describing the critical equipment items and facility construction features and materials. This documentation will be extremely useful particularily if construction and material details are included. If these items are not readily available a search should be initiated. Potential resources can be drawing repositorys, construction engineering firms, safety analysis reports and old timers who may have retained copies for reference. If good documentation is not available it may be necessary to prepare preliminary sketches and drawings from field information and other information sources.

Information concerning facility structural and equipment characteristics will be needed to get meaningful cost estimates and construction bids. It will also be needed to decide the sequence of decommissioning tasks and for determining the volume and nature of waste.

Concurrently with facility characterization, it will be necessary to identify and characterize radiation sources in the facility. Early identification and characterization of as many radiation sources as possible will permit the operation to be conducted as planned with a minimum of surprises. In attempting to identify and characterize radiation sources, one must research the primary and auxillary operations conducted over the entire lift-time of the facility. Special attention should be given to waste treatment and disposal operations that occurred at the facility. This along with a thorough review of auxillary activities may reveal some unexpected sources. During a recent plutonium incinerator facility decommissioning operation at Los Alamos, we discovered that the incinerator facility had also been used for decontamination of plutonium contaminated gloveboxes and equipment items. The decontamination operations resulted in contaminated liquid waste being discarded inadvertently to a sanitary septic tank and drain tile field system. This contaminated the supposedly clean septic tank system and drain system. Had this not been identified a contaminated septic tank may have been overlooked.

Health physics logs and survey records provide potentially useful information as well as operational logs. If knowledgeable operators or health physics personnel are available they should be interviewed and questioned about operations and facility uses. They may also be able to recall contamination incidents that affected normally clean areas or facilities. One effective interview process is to let the knowledgeable individual look at facility and site drawings. This helps the individual think about all parts of the facility and site. In addition to researching records and conducting interviews, it will normally be advantageous to conduct base line reference radiation surveys in accessible areas to determine radiation and contamination levels. By conducting direct surveys and swipe tests, the approximate mobility of remaining radioactive material can be determined along with identification of waste disposal requirements.

Special measurement techniques and instruments may be required to determine radiation levels during and upon completion of decommissioning projects. These techniques and instruments need to be identified since a failure to do so may result in costly delays during operational phases. This is particularily important for projects involving contaminated land areas and transuranic radioactive materials. Normally available health physics instruments and analysis laboratory capabilities can prove to be totally inadequate.

Pre-decommissioning planning should als address health physics staff and equipment needs; confinement and monitoring requirements for environmental and personnel protection; special shielding devices, and, personnel monitoring needs. By considering these aspects of a decommissioning projects, appropriate funds and resources can be allocated for radiological needs.

The disposal of non-radioactive and radioactive and contaminated materials and equipment items will constitute a major radiological issue because health physics personnel will likely be expected to determine what is radioactive and what is okay for release to the public or disposal at nearby sanitary landfill sites. Criteria and procedures for making these decisions must be covered in preoperational planning phases.

Documentation is an important aspect of any decommissioning projects. Documentation will especially be required regarding worker exposure, waste radioactivity content, environmental surveillance results and final site radiological conditions. By planning documentation programs, relevant information can be gathered and reported in a manner that will allow compilation of meaningful and complete accurate final reports. Frequently documentation requirements are not adequately addressed prior to and during decommissioning projects. This treatment can result in incomplete final documentation. A good example of this is the failure to sample, analyze and document subsurface contamination levels. Once backfilling occurs subsurface sampling becomes a whole lot more difficult and expensive. By determining such requirements early such pitfalls can be avoided.

Many decommissioning projects will require that a decision be made as to who will do the actual decommissioning construction work i.e., will an outside construction firm be used or will work be performed by an in-house crew? Radiological conditions and legal ramifications concerning the involvement of non-radiation workers and uncontrolled equipment may be a major point of discussion. The health physicist will normally be called upon to provide opinions and information regarding such issues.

Since the objective of most decommissioning projects is to cleanup a site or facility so it can be released for uncontrolled or public use. Release criteria must be established along with the final documentation requirements. The issue of release criteria must be addressed early because the authority for such criteria can vary in addition to fact that criteria seem to be ever changing. Satisfying release criteria and monitoring requirements ~~needed~~ to demonstrate that the criteria has been met can determine to a great degree the extent of cleanup operations. Hence, preoperational planning must address the release criteria issue. A word of caution concerning the acceptance of purely numerical criteria is offered. Consideration should be given to whether or not the project will involve deep or inaccessible radioactive levels that exceed established numerical release criteria values for near surface contamination. If so, the release criteria should include provisions for meeting ALARA criteria for subsurface contamination and inaccessible contamination as well as fixed numerical levels established for near surface soil contamination or other accessible areas where radiation prevails. If such provisions are not established, costly work stoppage situations may occur as the project progresses.

Implementation Phase

Decommissioning operations normally involve a collection of craftsmen and laborers typical of construction industry. These workers are accustomed to working hard, getting paid for working hard and taking risks. They will be accustomed to taking short cuts if it speeds up the job. These characteristics are desirable insofar as getting the job completed is concerned, but undesirable when it comes to radiation protection. Additionally these workers will typically not be trained or experienced radiation workers. The operational radiation protection program must take these facts into account and be modified to assure adequate protection.

Experience has shown that more extensive worker training and procedural controls are required for decommissioning programs than are required for ongoing operations. These controls are also needed because conditions change drastically and frequently during decommissioning projects so the operation is by no means static or routine. More rugged instruments and dosimeters may also be required because of the abuse and adverse conditions that frequently exist.

In addition to needing more rugged instruments and dosimeters, the entire personnel monitoring program must be geared to exisiting work conditions and worker characteristics. Getting in-vivo counts and bioassay samples from a crew of construction workers can be a real challenge for the health physicist. Compliance with such requirements is greatly improved if they are established as requirements in the bid specifications and the contract. Having too many jobs in progress concurrently is a common and a real radiological problem because construction projects are typically performed with maximum crew levels. Establishing crew limits and health physics support requirements is essential for efficient, safe decommissioning operations. This is particularily true if the contractor has a fixed fee contract.

Procedures and contract provisions must be established for the monitoring and release of privately owned equipment items. These provision should provide for decontamination and/or confiscation if needed. During soil removal operations this may be of particular concern along with the need to determine remaining contamination levels in a timely manner. All to frequently procedures call for chemical analyses that require days if not weeks to complete. With pressures to minimize waste volumes, to keep the digging crew working, and to get the residue levels at or below the release criteria, the health physicist must have field measurement capabilities that can be used to direct field operations.

Special procedures may be required to perform satisfactory release surveys and waste assays due to higher than normal and changing background radiation levels. An example of this occurred during a recent plutonium facility decommissioning project at Los Alamos. It was impossible to use a "phoswich" x-ray detection system to locate "hot" spots inside the facility until internally contaminated gloveboxes and process equipment items were removed. The residual plutonium and americium contained in the gloveboxes and equipment items caused background radiation levels that interferred with the desired low level surveys.

Waste assay requirements can also become a big issue since waste management organizations want to know exactly what they are receiving; whereas, it is frequently impossible to accurately assay the waste generated during decommissioning projects. This is particularily true for facilities contaminated with radionuclides that do not generate penetrating gamma radiation. Early assessment of waste assay needs and capabilities will alleviate most later misunderstandings and delays. Experience has also shown the importance of filling solid waste containers inside or in shelters that provide protection against intrusion of water from rain or snow. Waste managers dispise water in a container of solid waste.

Another waste management issue that has serious radiological implications is the matter of size reduction to met waste container size limitations. From a waste management viewpoint it is highly desirable to have containers all of a standard size; whereas, it is desirable from a health physics viewpoint to do minimal size reduction particularily if it increases the potential for worker exposure. Satisfactory resolution requires involvement and input from informed health physics personnel and waste managers who have a good understanding of the risks associated with size reduction.

Environmental protection is a primary concern during decommissioning operations. At best, major facility decommissioning activities involve the handling of some highly contaminated materials or equipment item outside the confinement capabilities of a normal nuclear facility. The need for doing this should be minimized by intelligent planning that maximizes the use of existing containment buildings and filtered exhaust air systems. Other confinement and containment techniques may suffice for the protection normally afforded by a building.

Closeout Phase

The closeout planning must start early in the project to assure good final survey results and documentation. Using release criteria closeout surveys must be conducted as decommissioning is completed in individual land areas and facility segments. By sampling as the project progresses one has greater assurance that final survey results will meet the previously established criteria. This will also permit further cleanup work as needed. Final surveys must be integrated with field surveys conducted during the cleanup and by using similiar if not identical survey techniques and instruments the possibility of last minute surprises can be reduced.

The extent of final documentation will depend on the nature of the project, planned future use, and requirements imposed by the responsible agency or company. In general, the documentation needs to be complete and informative to those who may be looking at the situation many years in the future. It is very desirable for closeout documentation includes: 1) photographs and drawings that identify and locate facilities and areas that were decommissioned; 2) a description of the decommissioning project; 3) drawings and photographs that show the final site or facility conditions; 4) schematic drawings that show final sample/survey locations and results; and, 5) a description of the techniques and instruments used in the final survey. This should be followed by graphic and narrative descriptions of structures left at the site. If there was suspect or known contamination left at the site, the location and nature of this should also be included.

Final documentation often suffers because of poor planning and implementation during early phases and because it is difficult to keep skilled individuals working on documentation after the field operations are completed. This must be avoided to get final documentation that is accurate and complete.

This paper has attempted to summarize the major radiological considerations that should be taken into account when planning and implementing nuclear facility decommissioning projects. It did not provide detailed information as to how these considerations are to be accomplished but it did identify some common pitfalls and provide general guidence.