

DOE ORDER 435.1
"RADIOACTIVE WASTE MANAGEMENT"
SRS & DOE COMPLEX IMPLEMENTATION ISSUES AND COSTS

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ABSTRACT

The Department of Energy (DOE) plans to issue Order 435.1 "Radioactive Waste Management" in October 1998. DOE has completely rewritten the requirements for management of radioactive waste including low level waste, mixed, transuranic, and high level waste as a result of Defense Nuclear Facility Safety Board (DNFSB) Recommendation 94-2. The objective of the new Order is to strengthen the department's management of its radioactive waste and to clarify requirements in accordance with its authority under the Atomic Energy Act of 1954. As a result, several new and modified requirements have been included in DOE O 435.1. The Order has been supplemented by a Manual containing specific requirements, Technical Bases for the requirements, and Guidance on how the requirement could or should be implemented.

The intent of this paper will be to describe Savannah River Site's (SRS) role in developing the requirements, estimating the cost of implementation, and identifying issues associated with the new and modified requirements. In addition, the SRS interfaces with the Citizens Advisory Board and other stakeholders to obtain public review will be described.

INTRODUCTION

In early August 1998, the Department of Energy issued a draft of DOE Order 435.1, "Radioactive Waste Management," for public review. This marked one of the first times that a DOE Order was earmarked for public review and was the result of over two years of DOE complex wide preparation. DOE Headquarters (DOE-HQ) received over 200 comments from the public, states, and regulatory agencies. In addition to public comments, DOE must resolve its own internal comments and those of the Defense Nuclear Facility Safety Board (DNFSB) before the Order can be issued for implementation. The task of resolving this many comments is formidable, but that should not take away from the tremendous accomplishment that the DOE and its contractors have made in preparing a more comprehensive, risk-based, set of waste management requirements. The Order is expected to be issued in November 1998 for formal DOE internal concurrence and issued one month later for a three-year implementation period.

DOE plans to issue a "response to comment" table listing each comment, stating how the comment was dispositioned and why, and providing a reference to where in the Order the comments were taken into account (in some cases the comment may not change the Order, in which case an explanation will be given). The comment table will be sent to

each of the commentors as response to their comments. The organizations providing comments included the Natural Resources Defense Council, The Institute for Energy and Environmental Research, The Environmental Evaluation Group of New Mexico, the Oak Ridge Site Specific Citizens Advisory Board, The Savannah River Site Citizens Advisory Board, the Environmental Protection Agency, the states of Idaho, Nevada, and Tennessee.

Implementation of the new or modified requirements of the Order will be difficult and expensive in many cases.

BACKGROUND

DOE and its predecessor agencies have managed the nation's program to produce nuclear weapons, conduct research on nuclear reactors, and perform experiments on nuclear reactor equipment for over 50 years. The Atomic Energy Act of 1954 placed the responsibility for management of most of the waste generated by these programs under the DOE, and DOE is expected to manage these wastes in a manner that protects human health and the environment. The waste types routinely handled by DOE and covered by the Order are: high-level waste (HLW), transuranic waste (TRU), low-level waste (LLW), and mixed low-level waste (MLLW).

DOE began in 1990 to assess the existing Order on Radioactive Waste Management (DOE 5820.2A issued in September 1988) in an attempt to reflect advances in radioactive waste management practices internationally and to improve its requirements to provide a safety, risk, and performance-based set of requirements that were cost effective and yet protective. The basis for each requirement was defined and documented in a technical basis document. During this revision effort, the DNFSB (an independent organization with oversight of DOE) began an examination of DOE's low-level waste practices. In September of 1994, the DNFSB issued Recommendation 94-2, "Conformance with Safety Standards at DOE Low-level Nuclear Waste and Disposal Sites," which identified further improvements needed in DOE's LLW management program.

In late 1995, DOE embarked on a modified method to revise the radioactive waste management requirements. (1) A systems engineering analysis was performed to identify all functions and activities necessary for managing the wastes. (2) The potential hazards that would be posed by managing these wastes were identified and activities or requirements were defined that would mitigate the hazards. (3) Existing requirements from national consensus standards were reviewed and assessed to determine if they would adequately address the identified hazards. The standards used for this evaluation were primarily from the Nuclear Regulatory Commission, the Environmental Protection Agency, or other DOE directives. (4) Proposed revisions to the DOE requirements to address the identified hazards were developed and the technical basis for each requirement was documented.

The draft DOE Order 435.1 now consists of the Order itself, a Manual that lists the requirements, the Technical Basis for the requirements, and an Implementation Guide.

GENERAL IMPLEMENTATION ISSUES

A major problem for DOE and its contractors will be communication throughout the complex to ensure that each waste generation, treatment, storage, and disposal facility understands and implements the new or modified requirement in a consistent fashion. This will be aided by the use of the Implementation Guide. The Guide provides information to aid in understanding what is necessary to attain compliance and (probably most beneficial of all) examples of acceptable methods of compliance.

The Citizens Advisory Board (CAB) at SRS felt that sufficient time was not allowed for public comment even though they applauded the fact that public comment was sought. The CAB at SRS did provide several significant comments, but had to provide drafts of these comments to meet DOE's aggressive schedule.

One of the immediate problems, of course, is to define what types of waste are included in each category (type), and provide a definition of that waste type. This crafting of a definition of waste type is indeed one of the first issues encountered. It is still not clear exactly what types of waste are included in the definitions of HLW, TRU, and LLW. This is key in most cases to decide final treatment and disposal of a waste form.

The cost to implement the new and modified requirements may be prohibitive at many sites. The DOE budget is lean and the three-year budget cycle may not allow sufficient funding to be obtained within the three-year implementation period to be effective. Specific cost information will be presented later.

SPECIFIC ISSUES

Responsibilities for Establishing the Radioactive Waste Management Basis

The objective of this requirement is to ensure and document that the hazards associated with the radioactive waste management facilities and activities have been identified, the potential impacts analyzed, and appropriate controls documented and implemented for protection of human health and the environment. Most, if not all, of the requirements included in the Waste Management Basis have been met by DOE's programs, but a document containing the individual elements that document compliance with these requirements has not been produced at some sites, and review/approval by the DOE of each document has not occurred in many cases. At the Savannah River Site the documents that make up the Radioactive Waste Management Basis have not been reviewed and approved by DOE-SR. DOE has delegated approval of these items to its contractor. Therefore, collection of this information and review/approval by DOE will be expensive and time consuming. An example of one type of document required to be a part of the RWMB is a facility's Waste Acceptance Criteria.

LLW and TRU Storage Design Requirements

The Order requires that LLW and TRU be stored on covered concrete pads with leak detection and collection systems. The current requirements assume that the LLW container provides adequate confinement of the waste, and most LLW is stored in the open on gravel pads. All TRU is stored on concrete pads with leak detection, but it is not all covered by additional enclosures. At SRS, compliance with this requirement will be very expensive, but other DOE sites such as Oak Ridge may not be able to provide enough funding within the three-year implementation period to build this enhanced storage capability.

LLW in Storage Must be Disposed Within One Year

This requirement will be extremely expensive and difficult to implement within the three-year period. While disposal is certainly preferred over storage, several barriers to compliance exist to the DOE complex. For example, DOE sites without disposal capability cannot ship their wastes to DOE disposal sites until the Waste Management Programmatic Environmental Impact Statement's (WMPEIS) Record of Decision (ROD) on Disposal of LLW is approved and issued. After the WMPEIS ROD's are issued, site specific Environmental Assessments may be required by the National Environmental Policy Act (NEPA) before any shipments will be allowed. Even at sites such as SRS, LLW is routinely stored awaiting treatment for volume reduction or improved stability prior to disposal. SRS has facilities to sort and segregate LLW for compaction or incineration. After compaction, wastes are disposed, and after incineration, the resultant ash and blowdown is solidified in a cement waste before disposal. Each of these treatments takes time and a backlog of wastes currently exist. Also at SRS and other DOE sites, several LLW forms exist that currently cannot meet the Waste Acceptance Criteria (WAC) at the disposal site normally used by that site. At SRS, of course, the LLW disposal facility on site is the site of choice, but items such as reactor deionizers that contain ion exchange media contaminated with Carbon-14 cannot be disposed based on the current WAC. Proposed treatments must be proved experimentally and funding has not been available to conduct such studies. This is only one example where solutions do not exist currently that would allow disposal in less than one year of a particular LLW form.

LLW and MLLW shall be disposed of on the site at which it is generated, if practical, or if onsite disposal capability is not available, at another DOE disposal facility.

DOE announced in the March 1998 "Federal Register" its intent to analyze its existing policy for use of commercial disposal facilities. Even though the current policy allows exemptions from the Order's requirements to be granted, on a case-by-case basis, this requirement was placed in a "reserved" status until the policy was examined. The Order is not expected to be issued until this policy examination is completed, and a decision is made to maintain the existing policy or modify it.

Definitions of Waste Types

Various problems existed during the crafting of these definitions of each waste type. For example, the definitions of high-level waste, TRU waste, and low-level waste did not make clear whether or not the waste produced when treating HLW samples by vitrification in the laboratory (resulting in HLW encapsulated in glass) was to be disposed as high-level waste or low-level waste. This is a major implementation problem for SRS. Glass encapsulated HLW samples do exist at SRS. If this waste is handled as LLW, it would be disposed on site. If handled as TRU waste, it would be stored awaiting shipment to WIPP. If the glass samples were determined to be HLW, they would be prepared for storage as HLW awaiting shipment to a National HLW Permanent Repository. This last option requires development of a method to place the glass samples in a Defense Waste Processing Facility (DWPF) canister prior to filling the canister with vitrified HLW from the DWPF melter. At one point in the preparation of the draft Order the definition of LLW included the statement, "Wastes excluded above, such as test specimens irradiated for research and development, and test specimens created from high-level waste disposal research and development..." This statement was subsequently removed from the draft Order, but only through vigorous arguments that to handle the LLW glass test specimens as LLW or TRU was inappropriate and would not be consistent with the handling of other HLW.

Similar discussions have taken place concerning the inclusion of accelerator produced wastes as LLW. Since accelerator produced wastes are clearly not as a result of reprocessing of spent nuclear fuel, then these wastes are LLW. Exactly which definition is used will make large differences in the way the wastes will be handled for treatment and disposal.

Requirements Dealing with Wastes Incidental to Reprocessing (Incidental Waste)

The process for determining "waste incidental to reprocessing" is not HLW will greatly reduce the cost of treatment and disposal of that waste. Examples of this type waste would be job control clothing, tools, or pumps/valves used in working with HLW facilities that may have come in contact with the actual HLW, but may be only contaminated to some small degree. This draft Order requirement determines the method to use to allow incidental waste to exit the definition of HLW, and thus be appropriately handled as LLW or TRU (usually requiring much less expensive treatment and disposal).

SRS developed a performance evaluation that identifies requirements, evaluates alternatives, develops performance objectives, and evaluates fate and contaminant transport of radionuclide contamination as a result of closure of HLW storage tanks. SRS has successfully closed a HLW tank using the performance evaluation while involving the public and the Nuclear Regulatory Commission in its considerations. The draft Order 435.1 points to the LLW chapters for instructions on closure requirements for incidental wastes. These LLW closure requirements would require a LLW Performance Assessment be performed that follows a different administrative process and uses different performance objectives that are specific to LLW (not HLW) and thus are not

appropriate. Modification of the performance evaluation process used for closure of the HLW tanks at SRS would provide little, if any, environmental benefit, but would be very expensive.

Retrieval of Earth-Covered TRU Waste

The DOE draft Order states that plans for the retrieval of waste from earthen-covered TRU storage facilities should be established and maintained. CERCLA closure of buried TRU waste sites is not specifically addressed. At SRS, TRU waste was stored on above ground concrete pads under earthen berms following Atomic Energy Commission direction concerning retrievable storage of TRU waste in the early 1970s. TRU waste buried prior to this time is being managed under the provisions of CERCLA. It would be inconsistent not to handle the no longer active waste sites as CERCLA sites, and it would not be cost effective to retrieve all disposed/buried TRU wastes that were not retrievably stored. The CERCLA program provides assurance that appropriate risk assessments are performed and the proper remediation of a waste site is selected to protect the public and the environment. This provision in the Order needs clarification as to its application.

LLW Performance Assessment, Composite Analysis, and Disposal Authorization Statement

Under the draft Order 435.1, a Composite Analysis that accompanies the original required Performance Assessment is required to form the basis of DOE's Disposal Authorization Statement. The Disposal Authorization Statement provides a LLW disposal site such as SRS the "license" to continue to dispose of LLW and sets the conditions for disposal. While the Performance Assessment provides reasonable assurance that disposal of LLW at a site will meet DOE's performance objectives, the Composite Analysis provides an assessment of the impact to a hypothetical future member of the public of all radioactive sources that may interact with the ongoing LLW disposal activities. All DOE LLW disposal sites are preparing PAs and CAs due to interim instructions from DOE to do so. These analyses are expected to improve DOE's technical basis for LLW disposal, but of course, are expensive to maintain. The definition of CA scope and level of technical detail in the review process is not specified in the Manual or Guidance. This is a major problem, for CA's could grow to be very expensive if a detailed analysis of all sources at a site were included versus only those sources that interact with disposal sites.

The "Devil is in the Detail"

The DOE draft Order and Manual 435.1 will be accompanied by a Guidance document. The Guidance will provide explanation and examples of how to comply with the requirements of the Manual. A detailed review of the Guidance is required to accurately assess the implementation design and costs. This has yet to be done by most DOE sites, therefore, estimates of impact could change substantially.

COSTS OF IMPLEMENTATION

DOE conducted and SRS participated in a cost of implementation study to present an order of magnitude estimate for the incremental life-cycle costs of implementing DOE Order and Manual 435.1 throughout the DOE . The intent of the study was to identify only costs driven by the implementation of new or modified requirements of DOE Order 435.1, not costs that have other drivers and would be incurred if DOE Order and Manual 435.1 were not issued. (The exception to this is that costs driven by DNFSB 94-2 and institutionalized in the Order were included in the cost estimate.)

The costs were derived on a requirement by requirement basis to determine (1) the initial cost to implement the requirement at each site and (2) the life-cycle cost over 30 years at each site. Only the new or modified requirements were estimated. The Cost Estimate Team consisted of DOE-Headquarters personnel, including representatives from Environmental Management (EM-30 and EM-40) and Defense Programs (DP); field representatives from all major DOE Operations Offices; and the Center for Acquisition and Business Excellence personnel. The team included field representatives who have a broad knowledge of the radioactive waste management activities at their sites. Other experts included site financial personnel and cost estimators, the authors of the Order, and DOE-HQ radioactive waste type managers.

The total life-cycle cost for the DOE is projected to be approximately \$168 million. Of that, about \$61 million is the initial cost to achieve compliance over the first three years.

Oak Ridge estimates the highest life-cycle costs at \$54 million and the highest initial costs at \$27 million. This appears to be driven by the LLW facility design requirements to maintain waste confinement and monitor for leaks. The Oak Ridge cost is over \$33 million to meet these requirements due to the fact that Oak Ridge currently has the largest inventory of LLW in the complex, and much of it is in storage that would not meet the DOE Order 435.1 requirements. It was assumed that LLW currently stored outdoors will need to be transferred to an indoor storage facility such as fabric covered structures on concrete pads with leak detection capability and costs would be incurred to move the wastes to these facilities.

The new or modified LLW requirements represent the highest costs by a fairly large margin. About \$125 million of the \$168 million total life-cycle costs, or about 75% of the costs, are due to LLW requirements. Only 10% of the costs are due to new or modified HLW and TRU requirements combines.

As one might expect, the three of the largest and most complex sites are estimated to incur the highest costs. Oak Ridge, Richland, and SRS combine to be about 72% of the total life-cycle costs. The individual sites' estimated life-cycle costs are as follows: Oak Ridge \$54 million; Richland \$34 million; SRS \$32 million; Oakland \$12 million; Chicago \$11 million; Albuquerque \$11 million; Nevada \$10 million; Idaho \$2 million; Rocky Flats \$1 million; DOE-HQ \$1 million; West Valley \$1 million.

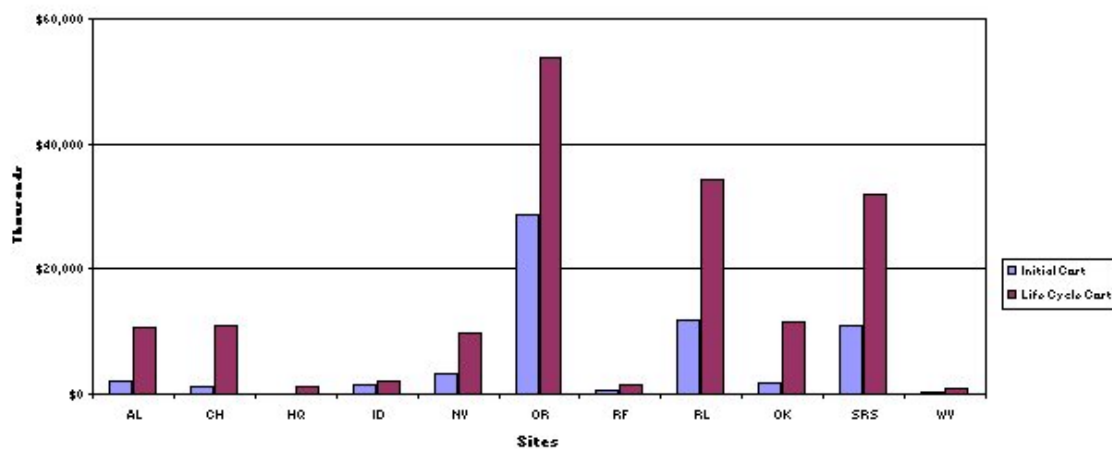
Idaho's relatively low costs of implementation is due primarily to the fact that LLW requirements drive about 75% of the costs (as discussed earlier) for the complex and Idaho's LLW program already meets most of the DOE Order 435.1 requirements. SRS's costs to implement the new or modified requirements are presented below grouped by major requirement category.

Table I. SRS Major Cost Drivers

	Initial Costs	Life-cycle
Radioactive Waste Management Basis, and Program Plans	\$0.8 million	\$4.8 million
Waste Incidental to Reprocessing	\$0.4 million	\$2.2 million
LLW & TRU Design Requirements	\$7 million	\$8.5 million
Characterization (including Data Quality Objectives)	\$0.85 million	\$3.8 million
LLW Composite Analysis, and Disposal Authorization Statement (PA costs were not included in HQ study, because the PA was a previous requirement.)	\$1.4 million	\$1.9 million
LLW Disposal Monitoring	\$0.4 million	\$8.0 million

At SRS the major cost of implementation is in meeting the LLW and TRU storage design requirements for confinement and monitoring. Then the additional administrative burden of obtaining DOE approval of the documents that make up the Waste Management Basis, development of waste stream program plans, and documenting data quality objective considerations in the characterization of wastes represents another significant cost center. The LLW Composite Analysis is a requirement from DNFSB 94-2, and is largely already spent (sunk costs). The costs to develop and implement monitoring plans for LLW disposal are captured here due to the increased emphasis and improved clarity of the DOE Order 435.1 requirement. However, monitoring of LLW disposal sites has always been a DOE requirement, and an argument could be made not to include this as a "new" cost.

Complex Wide Estimated Initial* and Life Cycle Costs to
Implement DOE Order and Manual 435.1**



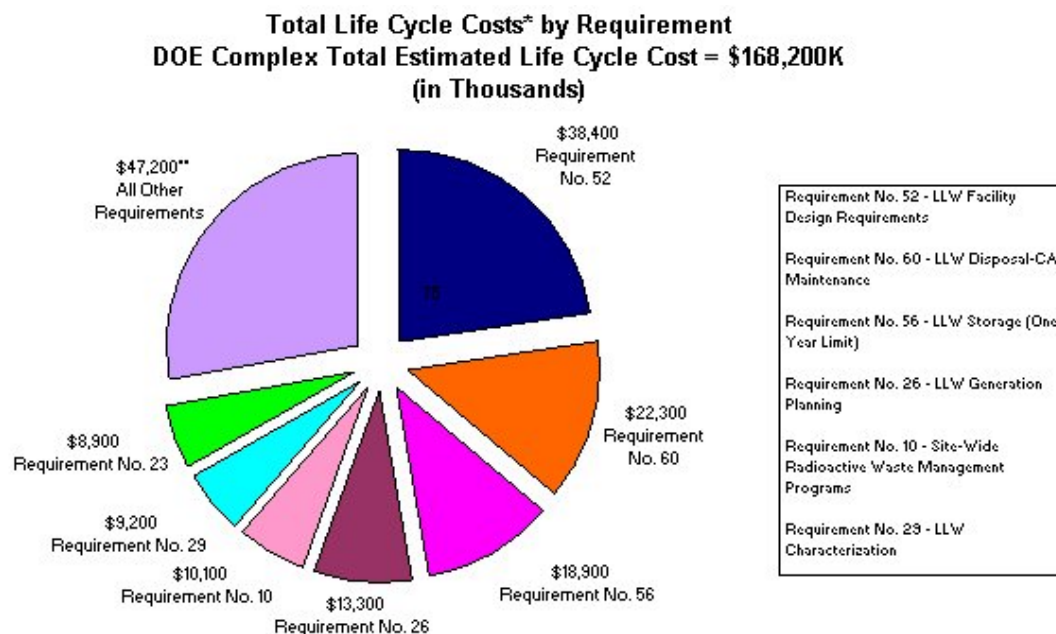
*Initial Costs are one-time estimated costs to achieve compliance with the requirement. They do not necessarily occur during the first year of implementation.

**Life Cycle Costs represent the total estimated costs over 30 years, although the number of years used to compute the Life Cycle Cost for a particular requirement and site may be less than 30.

Note: There were no incremental costs for the Fernald Environmental Management Project.

Figure 1

Complex Wide Estimated Initial and Life Cycle Costs
To Implement DOE Order and Manual 435.1



*Life Cycle Costs represent the total estimated costs over 30 years, although the number of years used to compute the Life Cycle Cost for a particular requirement and site may be less than 30.

**Includes costs for all requirements at Chicago sites ANL-W, FERMI, and Ames (\$5,200K).

Figure 2

Total Life Cycle Costs by Requirement
 DOE Complex Total Estimated Life Cycle Cost = \$168,200K

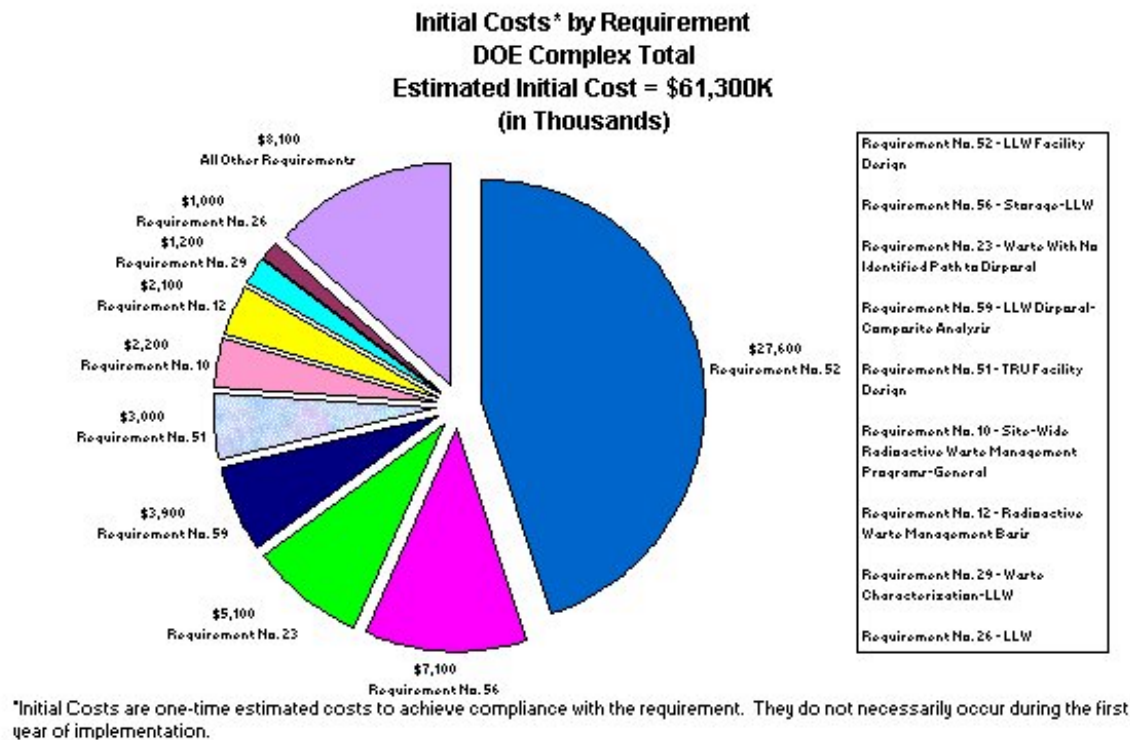


Figure 3

Initial Costs* by Requirement
DOE Complex Total
Estimated Initial Cost = \$61,300K
(in Thousands)

REFERENCES

1. "Cost of Implementation Study for the Departmental Concurrence Draft of Department of Energy Order and Manual 435.1 Radioactive Waste Management," USDOE Office of Environmental Management, July 1998
2. Draft DOE Order 435.1, "Radioactive Waste Management," July 31, 1998
3. Draft DOE Manual 435.1, "Radioactive Waste Management," July 31, 1998
4. Fact Sheet, "Draft DOE Order and Manual on Radioactive Waste Management," USDOE, August 1998