CONF-951127--1

INCLUDING ENVIRONMENTAL CONCERNS IN MANAGEMENT STRATEGIES FOR DEPLETED URANIUM HEXAFLUORIDE

Marsha Goldberg
Argonne National Laboratory
Washington, DC USA

Halil I. Avci
Argonne National Laboratory
Argonne, Illinois USA

Charles E. Bradley
U.S. Department of Energy
Washington, DC USA

ABSTRACT

One of the major programs within the Office of Nuclear Energy, Science, and Technology of the U.S. Department of Energy (DOE) is the depleted uranium hexafluoride (DUF_6) management program. The program is intended to find a long-term management strategy for the DUF_6 that is currently stored in approximately 46,400 cylinders at Paducah, KY; Portsmouth, OH; and Oak Ridge, TN, USA. The program has four major components: technology assessment, engineering analysis, cost analysis, and the environmental impact statement (EIS).

From the beginning of the program, the DOE has incorporated the environmental considerations into the process of strategy selection. Currently, the DOE has no preferred alternative. The results of the environmental impacts assessment from the EIS, as well as the results from the other components of the program, will be factored into the strategy selection process. In addition to the DOE's current management plan, other alternatives that involve conversion of DUF_6 to another chemical form, followed by continued storage, reuse, or disposal of depleted uranium, will be considered in the EIS. The EIS is expected to be completed and issued in its final form in the fall of 1997.

INTRODUCTION

In the United States, there are approximately 46,400 cylinders filled with depleted uranium hexafluoride (DUF_6) that was produced by the U.S. Department of Energy (DOE) prior to July 1, 1993, the date on which the United States Enrichment Corporation (USEC) took over the uranium enrichment operations from the DOE. These cylinders are made of carbon steel and are of varying sizes, but most of them are about 1.2 m in diameter and 3.7 m in height and contain approximately 14 metric tons of DUF_6. The cylinders are stored in yards at three sites where gaseous diffusion plants were built and operated: Paducah, KY; Portsmouth, OH; and Oak Ridge, TN, USA (Table 1). The Oak Ridge plant has been shut down, but the Portsmouth and

TABLE 1. INVENTORY OF DUF_6 IN CURRENT STORAGE[a]

Site	Number of Cylinders	DUF_6 (metric tons)
Paducah, KY	28,351	340,000
Portsmouth, OH	13,388	162,000
Oak Ridge, TN	4,683	54,000
Total	46,422	556,000

[a] Source: DOE Oak Ridge Operations Office (unpublished data).

Paducah plants are still being operated by USEC.

Some of the cylinders have been in storage since the early 1950s. Because of age, less than ideal storage conditions, and other reasons, many of the cylinders have lost their paint and have a rusty appearance. In fact, some cylinders show signs of severe degradation from corrosion. Seven cylinders have been found to have developed holes and to have lost some DUF_6.

Because of (1) the condition of the cylinders, (2) some questions raised by the State of Ohio Environmental Protection Agency, and (3) the changing missions of DOE, the DOE initiated a program intended to evaluate the long-term management strategies for the DUF_6 it owns. This paper provides an overview of the DUF_6 management program (DMP) and discusses in detail one component of the DMP, namely, the environmental impact statement (EIS).

OVERVIEW OF THE DUF_6 MANAGEMENT PROGRAM

The DMP has four major components: (1) technology assessment, (2) engineering analysis, (3) cost analysis, and (4) the EIS. The first three components are described briefly in the following paragraphs. The EIS is discussed in the next section.

TECHNOLOGY ASSESSMENT This component of the DMP has already been completed. Technology assessment involved putting a notice in the *Federal Register*[1] asking potential stakeholders for recommendations on potential future uses of DUF_6 and for technologies or processes that can be used to convert it to another chemical form or to store or dispose of depleted uranium in various chemical forms. The recommendations were reviewed by a panel of independent technical reviewers for technical feasibility, and the findings of the reviewers were documented in the technology assessment report issued in June 1995.[2]

ENGINEERING ANALYSIS On the basis of the recommendations of the independent technical reviewers in the technology assessment report, the engineering analysis project grouped the recommendations into functional modules that will be arranged into strategies for consideration in the EIS and cost analysis projects. The modules and the options included under each module are shown in Figure 1. Some of the options shown in Figure 1 have suboptions; for

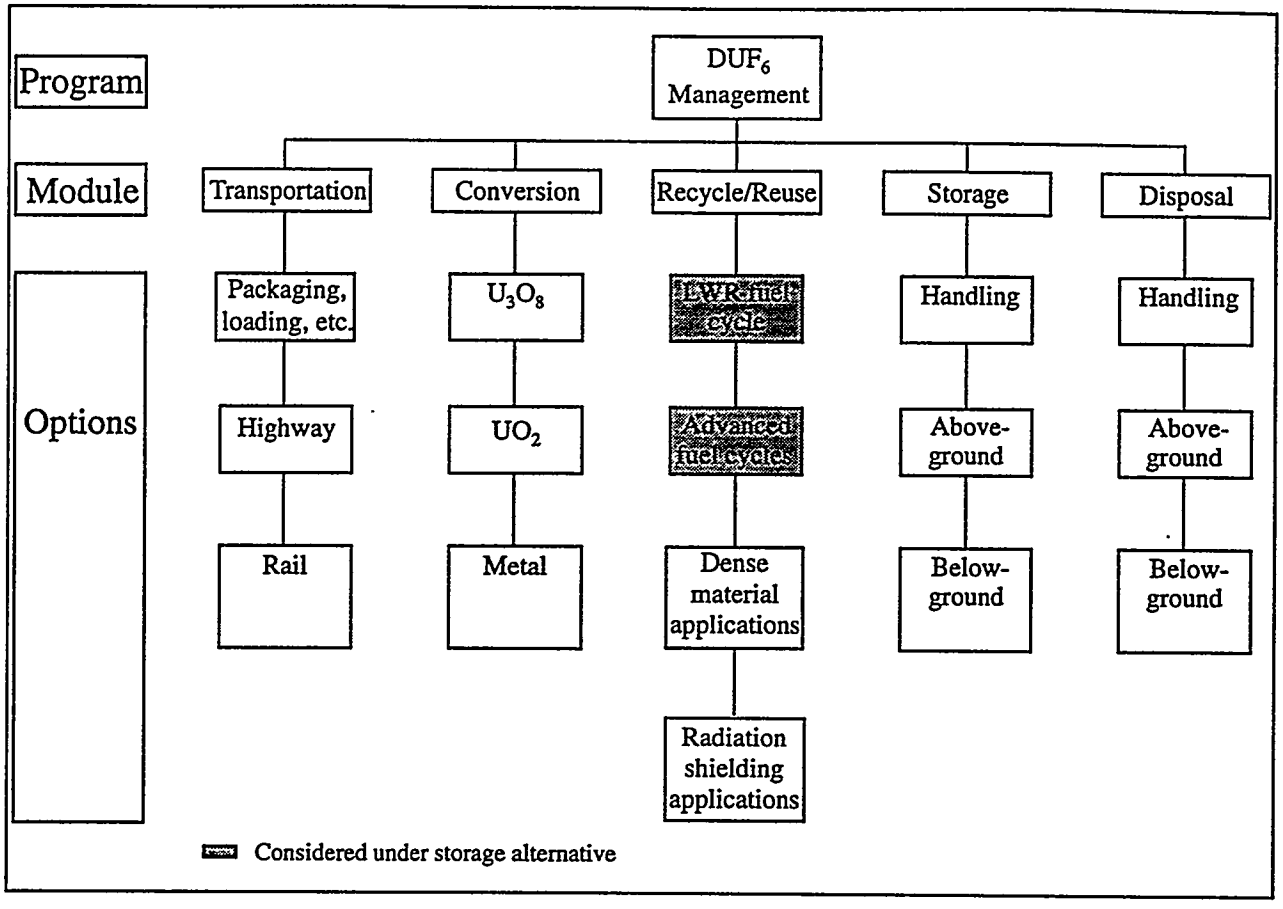

FIGURE 1. FRAMEWORK FOR CONSTRUCTING THE DUF_6 EIS ALTERNATIVES (LWR = LIGHT-WATER REACTOR)

example, two different methods are considered for conversion of uranium hexafluoride (UF_6) to uranium dioxide (UO_2): one method uses the gelation process and produces UO_2 microspheres, and the other method employs the dry process and produces UO_2 pellets. In the dry process, two cases are considered: in the first case, anhydrous hydrogen fluoride (HF) is generated as a by-product and sold for use; and in the second case, the HF is converted to calcium fluoride (CaF_2) and either disposed of or used.

The engineering analysis project is performing preconceptual designs of the selected technologies in all modules except the transportation module. The environmental impacts and costs associated with all modules will be evaluated by the EIS and cost analysis projects, respectively.

COST ANALYSIS This component of the DMP will be used to estimate the costs of long-term management strategy alternatives to be analyzed in the EIS. The strategies to be considered in the EIS are discussed subsequently.

Figure 2 illustrates the integrated process used in the DMP. The components of the DMP and their relationships to each other are shown in the figure.

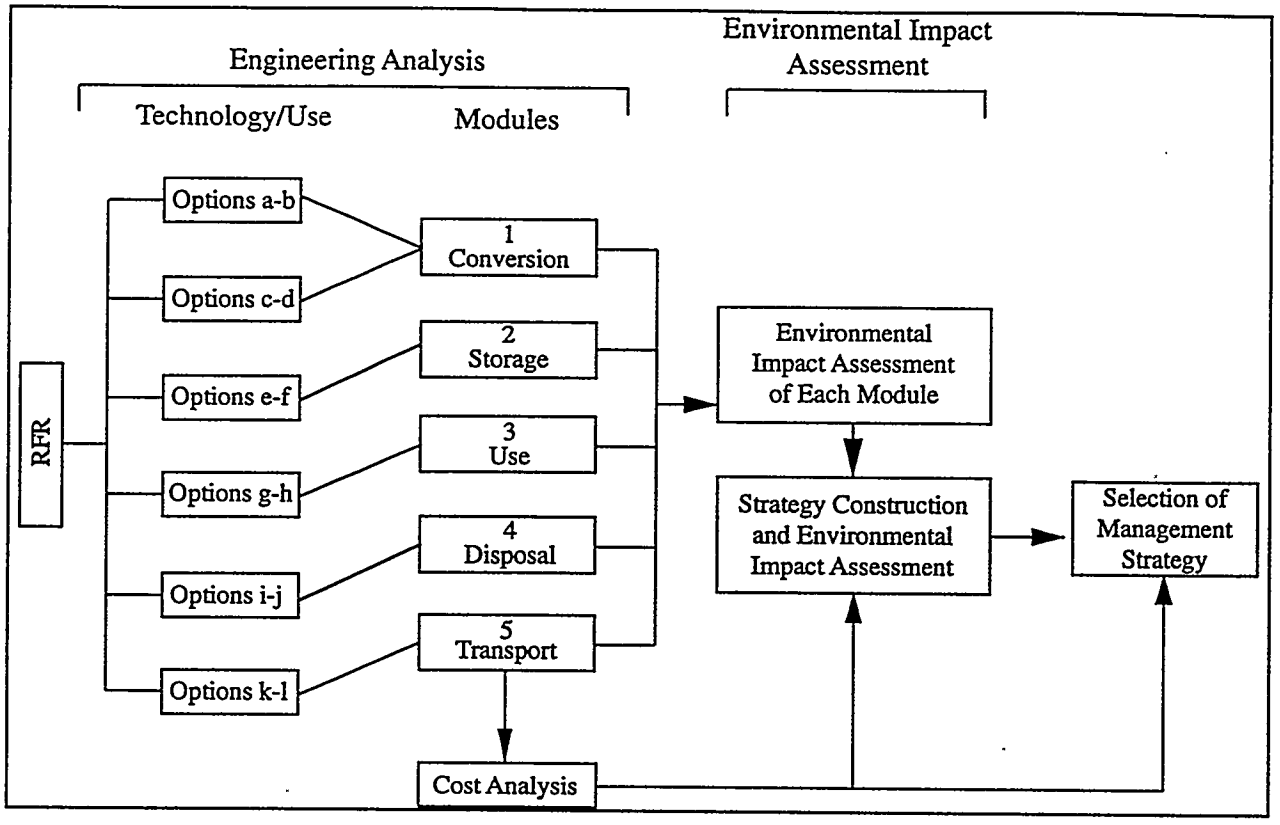

FIGURE 2. BUILDING BLOCKS OF DUF_6 MANAGEMENT STRATEGY SELECTION PROCESS (RFR = REQUEST FOR RECOMMENDATIONS)

DEVELOPMENT OF THE ENVIRONMENTAL IMPACT STATEMENT

The EIS that is currently being prepared as part of the DMP is a strategic EIS. It will address the strategies available for long-term management of the DUF_6 and will not identify specific technologies or sites where the selected management actions would be implemented. This EIS is the first level of a tiered EIS. Tiering refers to the process of first addressing general (programmatic) matters in a broad EIS, followed by more narrowly focused (project-level) environmental statements or analyses that incorporate by reference the more general discussions. At this first level, the EIS addresses the potential impacts of broad strategy alternatives. This level includes analyses of the general impacts of the current management program for DUF_6 at the DOE's three storage sites (Paducah, KY; Portsmouth, OH; and Oak Ridge, TN, USA); of technologies for converting the DUF_6 to other chemical forms; of storage for use or disposal; of the transportation of product or waste; and of disposal facilities. The impacts from the specific siting of any facilities or activities resulting from strategy selection will be assessed in subsequent National Environmental Policy Act documents as appropriate. These later documents would address traditional siting issues, decisions about construction and about operation, and

the impacts of transportation between identified origins and destinations.

The focus of this first-tier DUF_6 EIS is the evaluation of broad alternative strategies for the long-term management of DUF_6 as an aid in the selection of one strategy for implementation. The alternatives will be analyzed for their impacts on the human environment, including risks to public health and safety and occupational health and safety, and for effects on the natural environment.

The level of the decision requires a systems approach to the analysis. For this reason, a strategy is defined as a set of actions for handling DUF_6 from its current storage at the three sites to its ultimate disposition. The range of actions include storage, conversion, recycling or reuse, packaging and handling, transportation, and disposal activities. Strategies also take into consideration the configuration of the facilities associated with these actions. Consequently, the EIS will assess the transportation and cumulative impacts of placing proposed storage, conversion, and disposal facilities at more than one location (decentralization), as well as at a single site (centralization).

PRELIMINARY ALTERNATIVES FOR THE EIS

The alternative management strategies to be analyzed in the EIS will be constructed from combinations of modules shown in Figure 1. Because the public scoping process for this EIS has not yet been conducted, the final set of alternatives is not known; however, on the basis of the responses to the *Federal Register* notice (Request for Recommendations)[1] and the internal planning within DOE, the alternatives appear to fall into four general categories:

1. *No action (Continue current management plan).* This alternative would be based on the current management plan to store and maintain DUF_6 cylinders at the Paducah, Portsmouth, and Oak Ridge locations for 20-30 years. Starting at about 2020, the DUF_6 would be converted to U_3O_8 and, depending on the need identified at that time, would either be disposed of or used.

2. *Storage.* Under this alternative, the DUF_6 would be stored beyond 2020. This alternative would defer the decision on final disposition of the DUF_6, as well as preserving the options for its use in areas that are not currently developed enough to make reasonable choices (e.g., use as reactor fuel in either fast breeder reactors or advanced light-water reactors). Two subalternatives would be considered: continued storage as DUF_6; and conversion to an oxide, followed by continued storage.

3. *Use.* Under this alternative, DUF_6 would be converted either to uranium metal or to UO_2 and used as an input to a manufacturing process. Two potential uses would be considered in the EIS. In the first application, uranium

metal would be used for shielding material in the manufacture of spent nuclear fuel (SNF) packages that can be used to store, transport, and dispose SNF. In the second application, UO_2 would be mixed with concrete (to make what is called Ducrete) for use in the manufacture of SNF containers used for storage only.

4. *Disposal.* In this alternative, DUF_6 would be converted to an oxide (U_3O_8 or UO_2) for disposal as low-level waste. Figure 3 shows the modules and options that would be considered as part of the disposal alternative. The steps in the analyses would include (1) movement to a conversion facility, (2) conversion to an oxide, (3) transport of the material to a disposal facility, and (4) disposal. The facility designs analyzed in the alternative would include (1) drums placed in shallow trenches, (2) below-grade concrete vaults, and (3) mines. The disposal facility configurations would be assessed in wet and dry locations to provide the full range of potential impacts associated with disposal. The range of transportation

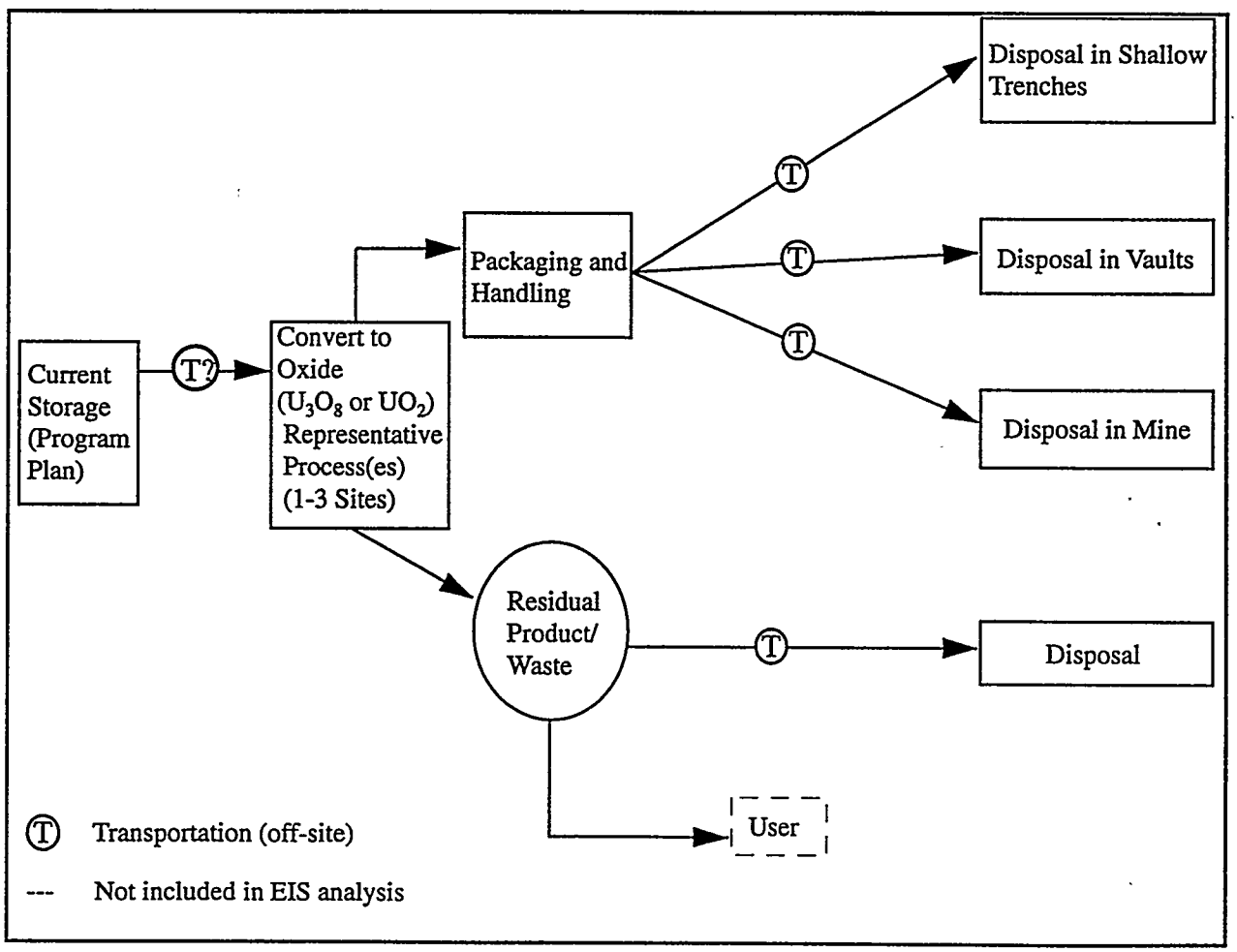

FIGURE 3. GENERALIZED DISPOSAL-OF-OXIDE ALTERNATIVE (Question mark indicates that off-site transportation may not be necessary.)

impacts associated with moving the waste material would be assessed by assuming that the disposal facility is located at a central location in the eastern and in the western United States.

As with the other alternatives that include a conversion step, by-products are produced that can potentially have commercial use or can be considered waste. The transport of these additional materials to their place of final disposition would be included in the assessment.

APPROACH TO DUF_6 MANAGEMENT STRATEGY SELECTION

The development of the EIS and the consideration of environmental issues that will be addressed in the EIS have been a part of the DMP from its inception. The DOE is incorporating the environmental concerns into the decision-making process early in the program. Currently, DOE does not have a preferred alternative. The alternatives described previously, as modified by the public scoping process, will be equally evaluated and compared with one another. The environmental impacts of the alternative strategies, as well as the predicted costs, will be considered in the decision-making process. The process and the selected strategy will be documented in the Record of Decision to be prepared following the issuance of the final EIS. Trade-offs will be performed between the environmental impacts and the costs associated with the steps in each strategy.

The environmental impacts of the alternative strategies will be estimated in the following way: The environmental impacts associated with each option and suboption will be estimated. The results will be aggregated at the module level, giving the ranges of impacts that can be expected for each module. The environmental impacts for a complete strategy alternative (from storage as DUF_6 at the current locations to final disposition) will be estimated by aggregating the impacts of individual modules.

The ability to vary the combination of blocks within a strategy allows the decision maker to vary environmental impacts and costs, increasing the ability to select an optimum strategy. The decision maker also is able to make trade-offs between cost and environmental risk at the early stages of a program. This approach provides the decision maker with all of the components necessary to make an informed decision.

Because the approach uses a modular system with a large number of configurations, this approach is well suited to the development of a computerized model for management strategy selection. Such a computer model is currently being developed for DUF_6 management.[3] The model allows variations to be made in each strategy and allows those variations to be analyzed quickly.

STATUS OF THE EIS DEVELOPMENT

The EIS is currently in the internal planning phase. An advanced notice of intent to prepare the EIS was published in the *Federal Register* on November 10, 1994.[4] The notice

of intent will be published in mid-January 1996. Public scoping meetings will be held in February 1996. The draft EIS will be issued for public review in January 1997. The final EIS and the Record of Decision are scheduled for October 1997 and November 1997, respectively.

REFERENCES

1. U.S. Department of Energy, "Management of Depleted Uranium Hexafluoride (UF_6): Request for Recommendations," *Federal Register* 59(217)56324, Nov. 10, 1994.

2. Lawrence Livermore National Laboratory, *Depleted Uranium Hexafluoride Management Program: Technology Assessment Report for the Long-Term Management of Depleted Uranium Hexafluoride*, Livermore, CA, June 1995.

3. Gasper, J., et al., "Depleted Uranium Hexafluoride (DUF_6) Management System: A Decision Tool," presented at the Third International Uranium Hexafluoride Conference: Processing, Handling, Packaging, Transporting, sponsored by the Institute of Nuclear Materials Management, Northbrook, IL, held at Paducah, KY, Nov. 28-Dec. 1, 1995.

4. U.S. Department of Energy, "Alternative Strategies for the Long-Term Management of Depleted Uranium Hexafluoride Resources at Several Geographic Locations: Advance Notice of Intent," *Federal Register* 59(217)56325, Nov. 10, 1994.

Work supported by the U.S. Department of Energy, Office of Nuclear Energy, Science, and Technology, under contract W-31-109-Eng-38.