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Treatment Deployment Evaluation Tool

M. A. Rynearson
M. M. Plum

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TREATMENT DEPLOYMENT EVALUATION TOOL

(Developed using a Systematic Approach for Spent Nuclear Fuel (SNF) Treatment Deployment Options)

Michael A. Rynearson and Martin M. Plum
Lockheed Martin Idaho Technologies Company
Idaho National Engineering and Environmental Laboratory
Idaho Falls, ID, 83415-3878

Background

The U. S. Department of Energy (DOE) is responsible for the final disposition of legacy spent nuclear fuel (SNF). As a response, DOE's National Spent Nuclear Fuel Program (NSNFP) has been given the responsibility for the disposition of DOE-owned SNF. The NSNFP staff believes that most of DOE owned SNF will be acceptable by the disposition sites in its current storage form. However, some of DOE's SNF may require treatment to meet the acceptance criteria of the currently identified disposition sites. Many treatment technologies have been identified to treat some forms of SNF so that the resulting treated product is acceptable by the disposition site. One of these promising treatment processes is the electrometallurgical treatment (EMT) currently in development; a second is an Acid Wash Decladding process. The NSNFP has been tasked with identifying possible strategies for the deployment of these treatment processes in the event that a treatment path is deemed necessary. To support the siting studies of these strategies, economic evaluations are being performed to identify the least-cost deployment path. This model (tool) will be used to support these economic evaluations.

The model was developed to consider the full scope of costs, technical feasibility, process material disposition, and schedule attributes over the life of each deployment alternative. Using standard personal computer (PC) software, this model was developed as a comprehensive technology economic assessment tool using a Life-Cycle Cost (LCC) analysis methodology[2]. LCC analysis evaluates the costs of future and necessary activities. For this particular evaluation, the activities and their associated costs of full-scale development, technology deployment, facility construction, facility operation, facility maintenance, and eventual disposal of the facility are included. To determine the lowest cost option, all costs are adjusted to reflect the time-value of money according to Office of Management and Budget methods and standards (Executive Office of the President).

Model Methodology

Model development was planned as a systematic, iterative process of identifying and bounding the required activities to dispose SNF. To support the evaluation process, activities are decomposed into lower level, easier to estimate activities. Sensitivity studies can then be performed on these activities, defining cost issues and testing results against the originally stated problem.

Model Requirements

Prior to actual model development, model requirements were derived based on the evaluation needs for deployment. From these needs, several follow-on model requirements are derived:

1) The tool shall be generic
2) The tool shall be reusable
3) The tool shall be developed using standard PC hardware and software
4) The tool shall be compatible with customer hardware and software
5) All options shall be evaluated using an accepted and standard form of economic evaluation. (Given that funding has been provided by the federal government, we adopted the standard method of LCC analysis as defined by the Office of Management and Budget (OMB) Circular A-94, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs," with annual updates to appendix C)
6) All costs shall be discounted to account for timing effects of money

Work Breakdown Structure and Definitions

A functional breakdown structure (WBS) was developed by functionally decomposing top-level work elements into the lower-level work elements. The final WBS product is a tree of product-oriented components that supports the top-level work activity. Development of a WBS provides many advantages. First, costs are typically easier to estimate at lower-level activities, resulting in more accurate higher level WBS activity costs. Second, a WBS provides an exercise in identifying all of the activities necessary to support the agreed upon top-level activity, thus a more complete system is defined resulting in a better LCC estimate. Finally, development of a WBS requires a complete process of identification, definition, and documentation of functional elements that may be used in other aspects of the project.

To support the use of the model, a generic WBS was developed that can be used to evaluate any type of SNF. This generic WBS is then customized for the specific SNF. As a result, costs presented in this evaluation are too generic for actual management of the final project and we suggest further more detailed and refined study by subject matter experts to enhance the WBS. Concurrent to WBS development, a cost breakdown structure (CBS) was developed and became the basis of the economic model. In this paper, the WBS presented in Figure 1 was developed for the disposal of sodium-bonded SNF using the EMT. Please note that the structure of this WBS has been developed solely for the purpose of this evaluation. In addition, for this publication only the top-level elements are presented in the figure due to the size of the working WBS.

The WBS dictionary is a necessary product in the development of the WBS. This dictionary defines, documents, and communicates the boundaries of each WBS activity. A generic template was also created for the development of this dictionary and this is provided in Table 1. This template was used for each WBS element. We cannot overstress the value of the defining the WBS dictionary. It has been our experience that the activity provides a forum for communicating and testing the required activities, definitions, and their boundaries. Definitions typically include but are not limited to work statements, inputs & interface requirements, deliverable & interface requirements, major cost contributors, schedule requirements, and assumptions.

Model Boundaries

Through an iterative approach to problem definition and dictionary development, the model's boundary was defined. Initially, model boundaries assumed that activities begin with the design phase of a treatment facility, and include all proceeding activities associated with construction, operation, waste transportation, and end with demolition and required monitoring of the treatment facility site.

Transportation costs include all costs associated with transporting SNF from the current storage locations to the proposed treatment location and finally to the final disposition site. Our evaluation also included all on-site transportation costs as these were often very expensive.

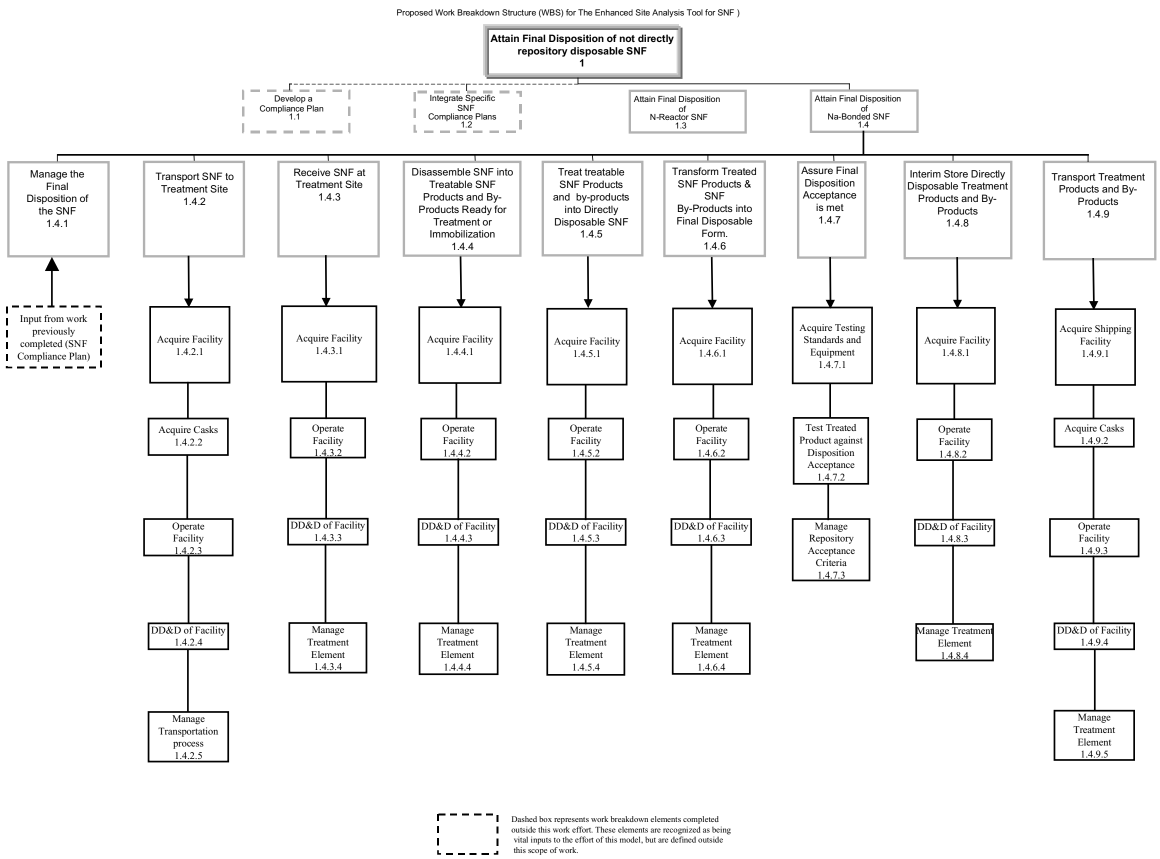

Figure 1 Work Breakdown Structure

Model Development and Resources

Model development incorporated the WBS and cost elements of the dictionary. As specified by OMB circular A-94, future costs are discounted with respect to time for the cost elements of design, construction, installation, operations, and demolition of the project. To incorporate a generic approach to evaluations, model inputs are inclusive to capture all identified cost elements as defined in the WBS dictionary. Thus, if a cost does not apply, a zero value is entered. For this reason, a zero entry implies important cost information; whereas, a blank entry requires further cost investigation and entry.

Closing

Given the current development stage of EMT and the array of deployment options, this tool is anticipated to be helpful in understanding the cost implications the many one deployment options. From these evaluations, cost drivers will be understood better, deployment strategies will be improved through sensitivity studies, and opportunities for improvement identified. The end result will be a better-informed decision based on the systematic evaluation of all the possible deployment options.

WBS (Work Breakdown Structure) DICTIONARY
ELEMENT DEFINITION
TEMPLATE

1. Project Title:	**2. Date:**
3. WBS Element: x.x.x.xx.00.	**4. WBS Element Title:** Generic –
5. Revision No. & Authorization:	**6. Cause for Revision:**
7. Revision Description:	
8. Element Description: **Work Statement -** **Inputs & Input Interface Requirements –** **Output & Output Interface Requirements -** **Final Product / Service –** **Cost Content –** Direct & support labor. Direct facilities and equipment and government furnished equipment . Direct consumables, supplies, & maintenance; start-up materials. Travel, office, & supply expenses. General Overhead and Administration / Overhead. Fee. **Schedule –** Consider all stakeholder agreements. **Assumptions –** All requirements necessary for and prior to this activity have been completed successfully.	
9. Prepared By:	

Table 1 WBS Dictionary Template

References

1) Office of Management and Budgets (OMB) Circular A-94, "Guidelines and Discount Rates for Benefit Cost Analysis of Federal Programs," October 29, 1992.

2) NIST Handbook 135, 1995 Edition "Life-Cycle Costing Manual for the Federal Energy Management Program", U.S. Department of Commerce.

3) *Ten/yr Oxide Spent Fuel Electrometallurgical Conditioning Facility Concept,* ANL-NT-54, November 1997.

4) *Deployment Evaluation Methodology for the Electrometallurgical Treatment of DOE-EM Spent Nuclear Fuel,* DOE/SNF/REP-014, July 1998.

Biography

Michael Ardel Rynearson is a systems engineer with Lockheed Martin Idaho Technologies Company at the Idaho National Engineering and Environmental Laboratory. His current duties with the systems engineering directorate include performing life-cycle cost, schedule and risk analysis as well as integration of large and small projects for the Department of Energy. He has supported projects in all phases of development: concept, full scale, and production. Michael has a Masters of Engineering degree in Engineering Systems; Energy Systems Specialty, and a Bachelors of Engineering, Mechanical Specialty, both from the Colorado School of Mines.

Martin Michael Plum has been a systems engineer / economist with Lockheed Martin Idaho Technologies Company at the Idaho National Engineering and Environmental Laboratory for 16 years. His duties has included many aspects of engineering economic analysis such as production and profitability studies, market studies, risk to market evaluations, and evaluating the economic effects of technology substitution and improvement. He has supported many DOE / DOD projects in all phases of development. Martin has two Bachelors degrees, one in Architecture and a second in Economics, both from the University of Idaho.