Changes in Cleanup Strategies and Long-Term Monitoring Costs for DOE FUSRAP Sites-17241

Darina Castillo*, Cliff Carpenter**, Rebecca Roberts***, and Carl Young****
*US Department of Energy Office of Legacy Management, Westminster, Colorado
**US Department of Energy Office of Legacy Management, Morgantown, West Virginia
***Navarro Research and Engineering, Inc., Weldon Spring, Missouri
****Navarro Research and Engineering, Inc., Baltimore, Maryland

ABSTRACT

The Department of Energy (DOE) Office of Legacy Management (LM) is responsible for the post-closure management of remediated DOE sites. LM's objective for Formerly Utilized Sites Remedial Action Program (FUSRAP) includes the long-term surveillance and maintenance (LTSM) of sites that have been remediated by the US Army Corps of Engineers (USACE). FUSRAP was initiated in 1974 by the US Atomic Energy Commission, a predecessor agency of DOE. FUSRAP was managed by DOE from 1981 to 1997. Through a congressional act, the scope to remediate FUSRAP sites was transferred to USACE in 1997. By 1997, DOE had completed the cleanup of 25 of the 46 sites that were active within the program, and had begun cleanups at 13 additional sites. USACE assumed responsibility for the cleanup of the 21 remaining FUSRAP sites, and 8 additional sites that have been recommended for cleanup. Presently, LM provides long-term stewardship for 30 completed FUSRAP sites while USACE is actively remediating 23 sites.

FUSRAP sites are typically privately-owned factories or research facilities. However, there are four DOE owned FUSRAP sites. These sites are Maywood and Middlesex in New Jersey, and Colonie and Niagara Falls in New York. In support of LM's Beneficial Reuse strategic mission, the site in Wayne, New Jersey has been transferred to a municipality and the site in New Brunswick, New Jersey has been sold.

Historically, most sites in FUSRAP were remediated to 'unlimited exposure and unrestricted use' cleanup levels consistent with residential use. Some sites were remediated using supplemental limits due to inaccessible areas while remaining sites have been remediated to other-than residential standards based on site-specific long-term land use assumptions. Of the 31 completed FUSRAP sites under LM stewardship, one site requires land-use controls and no site requires groundwater monitoring.

Over the next 10 years USACE plans to transfer 11 sites to LM. Several of these sites will have additional long-term monitoring requirements as per their Records of Decisions (RODs). These transitioning sites include the Colonie, New York site, the Maywood and Deepwater, New Jersey, sites and the St. Louis, Missouri site. The additional stewardship requirements will include groundwater monitoring, enforcement of institutional and engineered controls, and five-year reviews. In addition to these sites, more than 100 vicinity properties will also be transferred to LM for stewardship. Given the increase in long-term stewardship activities for these sites and their associated vicinity properties, initiatives are under way to

incorporate the additional LTSM requirements into the program's out-year planning. LM will be evaluating several methods to customize LTSM cost and liability estimates for all of the completed FUSRAP sites, planning to address the sites not yet transferred and those that are in LM's custody. Where necessary, LM will use remedial process optimization techniques and evaluate monitored natural attenuation protocols to reduced long-term monitoring costs. Methods for identifying costs include the cost estimates provided in RODs, cost estimates refined during remediation, operation and maintenance costs provided by USACE prior to transition, and presumptive remedies using USACE and Environmental Management / LM historic costs at similar sites. On the basis of this evaluation, a strategy for estimating site-specific LTSM costs will be selected.

INTRODUCTION

The Formerly Utilized Sites Remedial Action Program (FUSRAP) was initiated in 1974 by the former Atomic Energy Commission (AEC) to identify the sites that were involved in United States' atomic energy program and determine their radiological status. AEC searched their files for government-owned and leased facilities, and for private parties that performed research or production work with radionuclides. At many of the sites, surveys and cleanup were completed using then-current criteria at the end of the contract periods. The AEC site survey program also identified additional sites for which no survey information was available. [1] In 1975, AEC was abolished and its programs were assigned to either the Energy Research or Development Administration (ERDA) or the Nuclear Regulatory Commission (NRC). ERDA continued the FUSRAP mission and contacted site owners, conducted site visits and performed radiological surveys. In 1977, the DOE was created, which combined several administrations and commissions, including ERDA. DOE continued investigating sites under FUSRAP and reviewed records and/or conducted radiological surveys on over 600 sites. DOE began performing remedial actions at certain FUSRAP sites in 1979, using limited authority granted under the Atomic Energy Act of 1954. [1] In 1997, management of FUSRAP was transferred to USACE by congressional act. By that time, DOE had completed the cleanup of 25 of the 46 sites that were active within the program, and had begun cleanups at 13 additional sites. [2] USACE assumed responsibility for the cleanup of the 21 remaining FUSRAP sites, and subsequently received 8 additional sites that have been determined to be eligible for the program. DOE created the Office of Legacy Management (LM) in 2003 to undertake the long-term stewardship duties and today performs LTSM of over 91 sites, including the FUSRAP sites. Long-term stewardship may include environmental monitoring, maintenance, treatment, inspections, soil management, land-use controls, and periodic reviews. As of 2016, USACE has completed the cleanup and transferred five sites into LM's stewardship. Presently, LM provides long-term stewardship for 30 completed FUSRAP sites and USACE is remediating 23 sites. The remaining USACE FUSRAP sites are scheduled to be remediated and transitioned to LM by 2030. [3] Figure 1 shows how the number of sites transferred to LM will rapidly increase during the next decade.

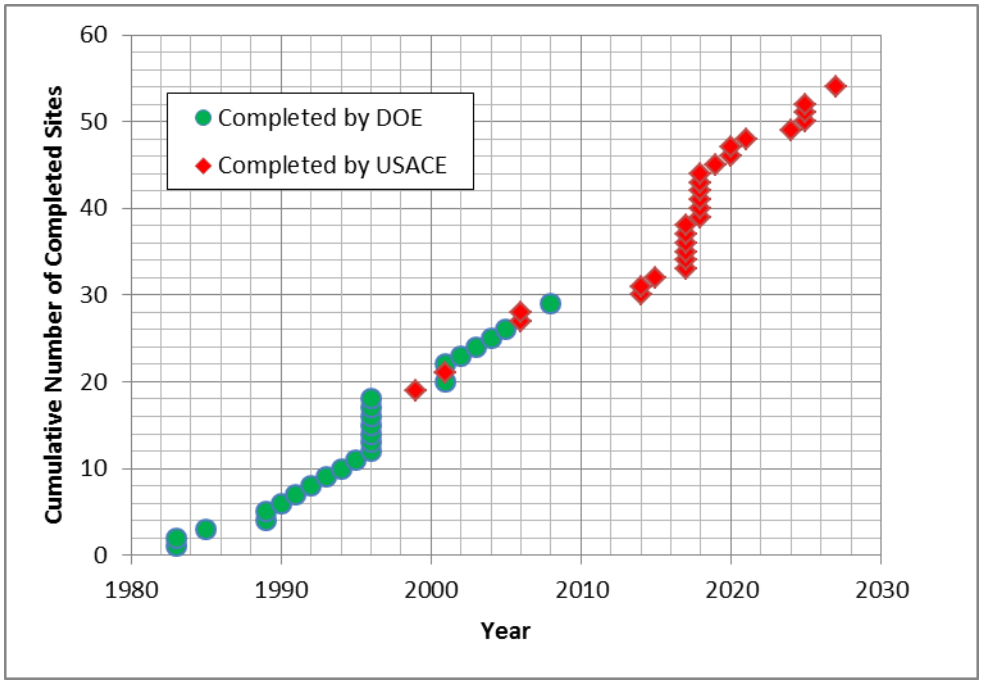

Figure 1: Completion of FUSRAP Sites by Year

PREVIOUS WORK BY DOE

DOE interpreted the Atomic Energy Act of 1954 to authorize the agency to perform remediation at sites where the government had ownership or control of radioactive material. Other sites could not be remediated under DOE authority. At some sites, there was no documentation that the government owned or controlled the radioactive material. Some of the sites had radiological licenses and were therefore under the authority of the NRC. At other sites, contract language absolved the government of liability for contamination.

DOE is the owner of four FUSRAP sites currently under remediation; the Maywood and Middlesex (Sampling Plant) sites in New Jersey, and the Colonie and Niagara Falls sites in New York. In support of LM's Beneficial Reuse strategic mission, the Wayne, New Jersey site was transferred to a municipality and the site in New Brunswick, New Jersey was sold to a private owner who intends to develop the property.

The FUSRAP sites that were remediated by DOE were typically privately owned metal casting, machining or research facilities. These sites were typically remediated to promulgated standards that allowed for unlimited use and unrestricted exposure (UUUE). [4] UUUE is the level of cleanup at which there is an acceptable level of risk through all exposure pathways and under all land-use scenarios. [5] The promulgated standards used for cleanup of thorium and radium contamination were from the Uranium Mill Tailings Radiation Control Act (UMTRCA). Uranium cleanup goals were developed using site-specific criteria based on future residential use and ranged from 1.85 to 7.4 becquerels per gram (50 to 200 picocuries per gram) of uranium-238. Surface contamination thresholds were from

DOE orders (DOE Order 5400.5), which were the same as found in NRC guidance (NRC Regulatory Guide 1.86). Due to the use of promulgated standards and guidelines preferring UUUE final status, the cleanups performed by DOE typically did not require either land use controls or post-closure monitoring. LTSM for these sites has typically been limited to records management and responding to stakeholder inquiries.

CLEANUP WORK BY USACE

In 1997, USACE was mandated by Congress to undertake the remediation of FUSRAP sites, while DOE retained responsibility for determining whether a site was eligible for the program. DOE was responsible for long-term stewardship of the sites after they were remediated by USACE. The 21 sites originally transferred to USACE were typically large metal refinement and production facilities. USACE was directed to use the processes of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to remediate the sites. CERCLA cleanup standards are based on site-specific analysis of risks posed to human health and the environment. [6] At some sites, USACE followed NRC guidance to analyze risks into the 'reasonably foreseeable future' (interpreted for up to 100 years by NRC) [7] which allowed for some sites to be remediated to industrial-use standards. [2] USACE also plans to employ long-term groundwater monitoring and land-use controls in the remedies of some of the sites. These and other methods allow for higher contaminant concentrations as remediation goals, which should result in reductions in total cleanup costs. USACE is currently planning long-term monitoring programs for groundwater at the FUSRAP sites in Colonie, New York, the St. Louis and Berkley sites in Missouri, and the Deepwater and Maywood sites in New Jersey. [8, 9, 10, 11, 12]

LONG-TERM COST ESTIMATES

One of LM's responsibilities is to estimate sound and defensible life cycle baseline costs for use in federal budget estimates and meeting the federal financial reporting requirements. The reporting requirements include: Chief Financial Officer Act of 1990, Government Management Reform Act of 1994, the Accountability of Tax Dollars Act of 2002 and Federal Financial Management Improvement Act of 1996. The federal budget process is important and internal to the government, so discussion will focus on the life cycle baseline approach for developing and documenting environmental liability requirements, which covers a minimum of 75 years unless a longer period is stipulated in agreements with states.

Annually, LM evaluates these long-term cost estimates to support the federal budget process and to estimate its environmental liabilities. FUSRAP sites that have not yet been transferred to LM are classified as 'Active' while the sites already in LM custody are described as 'Completed' sites. [13] For active FUSRAP sites, LM is only responsible for reporting on these sites two years following the completion of cleanup by the USACE.

There are many factors that impact environmental liability estimates for active FUSRAP sites, such as the timing and complexity of the site transition and transfer to DOE, changes in end state, regulatory approach, changes in anticipated costs efficiencies, etc. In order the meet these programmatic requirements, LM develops life cycle baselines to report long term stewardship estimates for all completed FUSRAP sites and for all active FUSRAP sites after completion of FUSRAP activities.

LM life cycle baselines are developed using detailed projections of the technical scope, schedule, costs and risks. DOE guidance directs that a minimum contingency be applied to all LTSM sites because of the uncertainties associated with long-term management. This contingency includes a probability of a major event at the site and the uncertainty associated with the assumptions and costs of maintaining the site over the extended timeframe. Risk screening is performed to determine if a site or associated activity has the potential for other specific costs or schedule variances. Expert judgement is exercised in determining whether a particular screening item results in a potential risk. Once a risk item and statement is identified, it is evaluated by the probability of occurrence and the severity of consequence. A risk assessment matrix is used to determine the site's risk level which is based on the previous described outcomes and applied as a percentage of direct total cost. [14]

Beginning in 2013, LM started to develop life cycle baselines for Active and Completed sites based on historical averages for similar LM-managed sites. The sites were grouped according to their level of complexity, and average LTSM costs were determined.

Since long-term stewardship costs need to be updated based on the most current available information and changes in guidance. The next round of active sites transferring to LM will be more complex than the current 30 completed sites, over the next 10 years, LM continues to refine and customize its LCB approach. It includes a comparison of current LM-FUSRAP cost estimates with cost estimates from other large LM sites plus LTSM cost estimates developed by USACE during their stewardship of the sites. Following a CERCLA process, USACE develops cost estimates for LTSM for sites as part of a Feasibility Study (FS) process. An FS typically identifies a number of remedial options and associated costs, then selects a preferred remedy in the Proposed Plan (PP). After stakeholder comments are received, a CERCLA decision document is published in the form of a Record of Decision (ROD). Notably, the actual cost of remedial action may vary significantly from the estimated cost in the ROD, so likewise actual LTSM costs that USACE provides to LM may vary from earlier estimates that were made during FS, PP and ROD. Also, the FS process may not capture potential long-term environmental liabilities that extend into the timeframe needed by LM.

For some sites, such as the DuPont Deepwater, New Jersey site, detailed cost estimates are available from the FS, PP and ROD. For other sites, less detail is available, depending where the project is in the CERCLA process. The USACE estimated costs include both implementation costs and costs for maintaining the selected remedy. Costs that would be borne by USACE as part of a site's transition

to LM need be removed from LM's cost estimate. As mentioned before, USACE bears the costs for LTSM for a two-year period after completing a cleanup. [13] For example, the costs of developing land use controls would be a capital cost borne by USACE. USACE costs attributable to the LTSM period will be reviewed and broken down in order to make them comparable to LM experience. The cost-estimate process is diagrammed in Figure 2.

The first step in the process has been to develop a catalog of USACE cost estimates from available CERCLA decision documents. From the approximately 25 Active FUSRAP sites, there is a wide range in the availability of costing data from USACE for estimated LM transition and LTSM costs. This catalog determined the type of LCB estimate that will be utilized for those sites either a fully customized comprising of the USACE estimate that are cross referenced with LM historic values, blended a mix of historic LM values and customized value where available or historic LM values only. Nine sites have CERCLA documents available to fully customize the LCB estimates, six sites have only a portion of documents available for evaluating LTSM costs and would need a blended approach to estimate LCB costs and nine sites would have to be estimated based on historic LM costs. Next, USACE assumptions and estimates for future LTSM of costs will be evaluated and contrasted with LM assumptions about DOE's long-term responsibilities. Another step will be to review actual LTSM costs from LM analog sites. Finally, when sites transfer to LM, USACE is tasked with stating the actual LTSM costs to LM for the prior two-year period. [15] While the USACE costing has the advantage of being site-specific, the LM analogs have the advantage of being specific to the LM LTSM processes. The costs of specific LTSM tasks will be reviewed, both as performed by LM and as planned by USACE. For example, five year reviews will be required at a number of transferring Active sites, so costs for performing these reviews at current LM sites will be compared to the site-specific cost estimates that are developed by USACE. LM also has monitoring and sampling programs for well fields at LM sites. These costs will be compared to the cost estimates developed by USACE.

There are several differences between USACE and LM's estimate of LTSM costs that influence the total value of the life cycle baseline. USACE often uses CERCLA guidance that suggests 30 years will be needed for attenuation of heavy-metal concentrations in groundwater. In contrast, LM has tended to assume that the model for long-term monitoring costs is constant into the foreseeable future. LM has used a default period of 100 years as the estimated length of monitored natural attenuation programs to manage groundwater contamination. Additionally, LM continues to improve by using the most current available information to optimize long-term stewardship estimates. Both models will be reviewed using any site-specific information that is available. Figure 3 shows a conceptual diagram of the two cost models, showing that the model following CERCLA guidance results in marked cost-tapering after 30 years while the LM model shows consistent costs through 100 years. The LM model may be considered as a worst-case scenario.

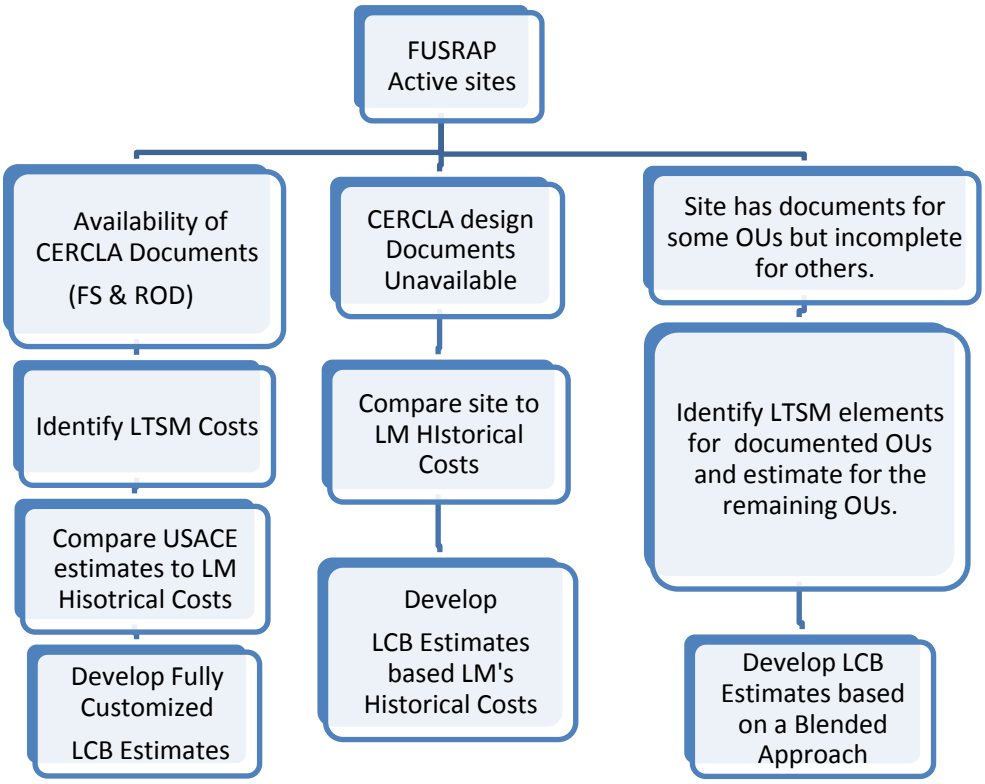

Figure 2: Cost Estimating Process

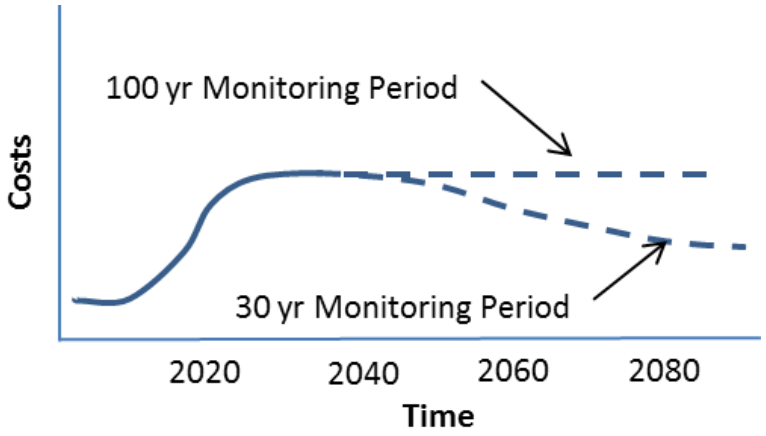

Figure 3: Two Models for Long-term Monitoring Costs

CONCLUSIONS

LM is preparing for the transfer of 11 new FUSRAP sites within the next 10 years from USACE, many of which will have substantially greater LTSM requirements than the current Completed sites. LM is analyzing the estimates for the level of effort

required to monitor the new sites in order to make more customized and accurate predictions of future life cycle costs and environmental liabilities of these sites.

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